Addis Ababa University School of Commerce

Assessment of Factors Affecting Road Construction Heavy-Machinery Spare Part Supply Chain Performance: A Case of My Wish Enterprise P.L.C. Addis Ababa, Ethiopia.

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University School of Commerce in Partial Fulfillment of the requirements of Masters of Arts degree in Logistics and SCM

Advisor Dr. Busha T.

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BY

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DECLARATION

I, the undersigned, declare that the thesis work **"*Assessment of Factors Affecting Road Construction Heavy-Machinery SPSC Performance: A Case of My Wish Enterprise P.L.C. Addis Ababa, Ethiopia*"** is my original work under the supervision of my research advisor, **Dr. Busha Temesgen**. The work has not been presented elsewhere at any other university or college to award a degree, diploma, or certificate. All sources of materials used in the thesis have been duly acknowledged.

Declared By:

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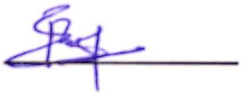
CERTIFICATION

This is to certify that the research work entitled **"Assessment of Factors Affecting Road Construction Heavy-Machinery SPSC Performance: A Case of My Wish Enterprise P.L.C. Addis Ababa, Ethiopia" is prepared and submitted by Tesfai Habteab.** This work was submitted in partial fulfillment of the requirements for the degree of Masters of Arts in Logistics and Supply Chain Management and complied with the university's regulations, and meets the accepted standards for originality and quality.

Busha Temesgen (PHD)

Signature: 

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Acronyms

MWE P.L.C.. : My Wish Enterprise P.L.C..

SCM : supply chain management

SP: Spare part

SPSC: Spare part supply chain

EOQ: Economic order quantity

VMI: Vendor managed inventory

JIT: Just in time

IS : Information sharing

ANOVA : Analysis of variance

Sig. : Significance

R : Pearson correlation coefficient

ABSTRACT

Road construction, which requires heavy equipment, is one of the developing countries' leading priorities, including Ethiopia. In Ethiopia's case, this sector consumes the most prominent national budget, though challenged due to a shortage of spare parts that allow the deployed machines to work efficiently. Therefore, this study aims to assess, Factors Affecting Road Construction Heavy-Machinery Spare Part Supply Chain Performance: A Case of My Wish Enterprise P.L.C. Addis Ababa, Ethiopia. Based on the literature reviewed, the study has identified four factors that affect performance (responsiveness and efficiency): inventory level, information sharing, demand forecasting accuracy, and product pricing. A descriptive and explanatory research design was used in the study. Both quantitative and qualitative data were used in this research. For quantitative data, structured questionnaires were used. Besides, focused group discussions were conducted to collect more qualitative information. Out of 100 employees of the study organization, a sample size of 63 was taken using a stratified sampling technique. The response rate was 100%. The Data were analyzed using mean, standard deviation, percentages, correlation, and regression analysis with the help of SPSS version 26 software. The study results indicated that the inventory level, information sharing, demand forecasting accuracy, and product pricing collectively impact the SPSC performance significantly. These factors collectively explain 43.6% of the SPSC performance, while the rest, 56.4%, is explained by other factors which are not subject to this study, such as transportation-related and other variables mentioned in the qualitative findings. Further, the study revealed that, among the predictors (independent variables), information sharing-related characteristics have more remarkable predictive ability for SPSC performance (responsiveness and efficiency). In contrast, the other variables relating to inventory level, demand forecasting accuracy, and product price has no impact on predicting SPSC performance (responsiveness and efficiency), as far as the other variable information sharing-related factors exist. Moreover, the study recommends enhancing the quality of information sharing across SC members by employing the latest IT facilities that can enhance information sharing benefits the SPSC actors in Ethiopia.

Keywords: Spare part, Supply Chain, Performance, *Road Construction, Heavy- Machinery.*

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

As a developing country, Ethiopia has a strong focus on the construction industry in general and the road sector in particular. As a result, an outstanding national budget is allocated to construction projects going in the country. In 2019-2020, Ethiopia allocated about 1 billion USD to the road sector alone, which covers about a quarter of the nation's budget, as indicated by (Cepheus Research & Analytics, 2019).

Road construction is one of the heavy equipment-intensive sectors that principally rely on the high utilization of machinery (Day & Benjamin, 1991). Excavators, graders, bulldozers, scrapers, loaders, tippers, dump trucks, smooth wheel rollers, pneumatic rollers, and vibratory rollers are some heavy construction machines deployed in road construction activities (Prajeesh & Sakthivel, 2016).

Perhaps, the heavy machines deployed in road construction are subjected to failure, looking for proper maintenance and spare parts. Spare parts (SP) are essential inputs required to conduct maintenance activities (Al-Najjar & Alsyouf, 2004). Furthermore, SP's are machine components that need to be replaced due to wear and tear over the equipment's operational life (Gopalakrishnan and Banerji, 2013). In addition, spare parts are needed after the main products have been sold to customers or end-users (Wagner et al., 2012).

Further, SP customers demand long-time availability of spare parts through the whole product lifecycle of the primary product (Wagner et al., 2012). Besides, SP must be available across the supply chain (SC) to enable after-sales services and guarantee service to end-users (Botter and

Fortuin, 2000). Therefore, a robust SC is required to make spare parts available and to accommodate customer requirements.

The spare part supply chain (SPSC) is like any supply chain except that it solely exists to make maintenance operations run smoothly such that equipment is down for maintenance no longer than necessary (Arts, 2013). The road construction heavy machinery SP supply chain is not far from this idea; it can be defined as a network of firms supporting and strengthening heavy equipment maintenance operations to maximize equipment output.

Moreover, in the SC approach, original equipment, and SP manufacturers delegate dealers to different areas of the world where their machines are expected to be sold, and the dealers play a mediation role between the end-users and the manufacturers.

My Wish Enterprise PLC (MWE PLC) is one of the non-governmental-owned SP dealers in Ethiopia. MWE PLC is an exclusive dealer of heavy machinery manufacturers such as Doosan Infracore (manufacturer of excavators, articulated dump trucks), Liugong Machinery Co., Ltd (manufacturer of Backhoe Loaders, Rollers, Forklifts, Truck Mounted Cranes, Concrete Pumps), Soosan Heavy Industries Co., Ltd (manufacturer of Hydraulic Breakers and Wagon Drill), Bobcat (manufacturer Mini Excavators), and many others.

MWE PLC can represent similar companies (dealers) in the construction equipment and SP business with its diversified supply chain network. With this in mind, this study was conducted on MWE PLC, as it represents similar companies (dealers) in the construction equipment and spare parts business.

Furthermore, it is critical to identify the factors influencing the SPSC performance of construction equipment, as it will contribute to the efficiency of national road projects and ensure the revenue

of the supply chain actors in general and MWE PLC in particular. Besides, it is vital to meet the machine owner's (end users) needs ultimately.

Due to the deficiency of prior research, the study is dedicated to identifying the factors affecting the Road Construction Heavy-Machinery SPSC performance of MWE PLC.

1.2. Problem statement

Ethiopia does not manufacture branded construction machines (Woldegiorgis and Pedagopu, 2018). Inline, data collected from the national bank indicates that Ethiopia has imported different road motor vehicles at an annual average cost of about 690 thousand USD in the last five years (from 2014 up to 2019 GC); this indicates that all the machines and other motor vehicles deployed in different national road construction projects are imported with a significant amount of foreign exchange.

Perhaps, Ethiopian scholars, including Emran Hassen A. (2017), Dagne Abebaw W. (2014), and Abdisa D. (2003), have shown that managing these national resources has been difficult due to the shortage and unavailability of SP in the supply chain.

According to Barkawi and Partners companies with limited liability (GmbH) (2002), availability is a key performance indicator in the spare parts supply chain; this indicates that the Ethiopian SPSC has poor performance that provokes further examination of the sector.

Besides, during the preliminary assessment and discussion with the company's senior staff, the SPSC setting of MWE was observed to have some problems. The problems include, but are not limited to, unavailability of parts, incomplete order fill rate, longer lead time, frequent backorders, lost sales, unreasonably high spare part costs due to governmental regulation, dead stock inventories as a result of the long forecast horizon, and others.

Generally, supply chain performance is affected by many factors, such as inventory level, information sharing, demand forecasting, and product pricing. The higher the inventory level, the greater the supply chain responsiveness, whereas little inventory improves efficiency (Chopra and Meindl, 2013). Information sharing influences service levels, responsiveness, cost, and complexity (Flynn, Huo & Zhao, 2010). The forecast accuracy highly influences the supply chain performance measures such as inventory cost, backorder cost, lost sales cost, and customer goodwill (George and Madhusudanan Pillai, 2019). Finally, pricing affects the supply chain regarding the level of responsiveness required and the demand profile that the supply chain attempts to serve (Chopra and Meindl, 2013).

The rationale behind conducting this study was that no prior empirical studies showed how the factors mentioned impacted the road construction heavy machinery SPSC performance in the Ethiopian context.

With this in mind, this researcher set out to do a case study on assessing factors affecting the SPSC performance of the construction equipment dealer, MWE, as representative of other similar companies in the construction equipment and spare parts business.

To this end, this study was devoted to filling the gap by empirically finding the factors affecting the SPSC performance of road construction machinery and opens the door to future researchers for further investigation.

1.3. Research questions

1. How does inventory level affect the Road Construction-Heavy Machinery SPSC performance of MWE?
2. To what extent does information sharing affect the Road Construction-Heavy Machinery SPSC performance of MWE?

3. How does demand forecasting accuracy affect the Road Construction-Heavy Machinery SPSC performance of MWE?
4. How does product pricing affect the Road Construction-Heavy Machinery SPSC performance of MWE?

1.4. The objective of the study

1.4.1. General objective

The study's general objective is to Assess Factors Affecting Road Construction Heavy Machinery SPSC Performance in the case of MWE P.L.C. Addis Ababa, Ethiopia.

1.4.2. Specific objectives

The specific objective is to look at the following factors and empirically identify how they affect SPSC performance.

1. To assess the effect Inventory level in the Road Construction-Heavy Machinery SPSC performance of MWE.
2. To assess the effect of information sharing in the Road Construction-Heavy Machinery SPSC performance of MWE.
3. To assess how demand forecasting accuracy affects the Road Construction-Heavy Machinery SPSC performance of MWE.
4. To assess how product pricing affects the Road Construction-Heavy Machinery SPSC performance of MWE?

1.5. Significance of the study

Spare parts shortages and unavailability are becoming problems in the Ethiopian construction industry, resulting in the downtime of productive machines. Moreover, the downtime has resulted in delays and cost overruns of national projects. This study will contribute to the sector by

reviewing the primary causes of the problems, believing that a well-identified problem is half solved or will not be challenging to solve.

Further, the research was one of the few empirical studies in the Construction Machinery Spare Part Supply Chain. Therefore, it will help the industry under investigation, researchers, academia, policymakers, and other related fields. Besides, it may be aground for other researchers to further study and correct this paper's limitations. Furthermore, the findings of this study will contribute to making some general inferences about the construction equipment SPSC practice in Ethiopia.

1.6. Scope of the study

The study will be conducted in Addis Ababa, the capital city of Ethiopia. The conceptual scope of the assessment undertaken is expressly framed to focus on the effect of the level of inventory in the Ethiopian spare part supply chain, the effect of information sharing on the Ethiopian spare part supply chain, the role of demand forecasting accuracy in the Ethiopian spare part supply chain, and the impact of pricing on the Ethiopian spare part supply chain. Methodologically, the study used judgmental sampling, in which samples were selected based on the researchers' judgment. Further, the supply chain concepts of production are excluded from the study because the company does not manufacture spare parts.

Moreover, the study was conducted from October 2020 to June 2021 in Addis Ababa, Ethiopia, where the principal office of MWE is located. MWE was chosen due to the proximity of the researcher to MWE in Addis Ababa.

1.7. Limitation of the study

The study recognizes that the research has limitations, which can be subjected to future empirical studies. Among the ample heavy machinery spare parts dealers in the country, only MWE was selected to be part of the study, limiting the generalization of the study.

Besides, other governmental and non-governmental stakeholders are excluded, which might affect the generalization of the findings. Hence, future researchers can work to improve the generalization of the study by improving the sample size, and involving different stake holders. .

1.8. Definition of terms

Supply chain: Supply chain is defined as a group of inter-connected participating companies that add value to a stream of transformed inputs from their source of origin to the end product or service that are demanded by the designated end – customer. (Dawei, 2011, p. 9).

Supply Chain Management: SC management is the coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served (Hugos, 2011, p.4)

Spare parts: Spare parts: spare parts are defined as similar machine components that require replacement because of wear and tear during equipment operation (Gopalakrishnan & Banerji, 2013)

Maintenance: Blanchard (2004) defined maintenance as all necessary and vital procedures that maintain a system or product functioning and/or repair it so that it can fulfill its original purpose.

Inventory: Inventories are idle assets (in different forms) are retained for future use (selling or distribution) (Hokey Min, 2015).

Information sharing (IS): I.S. refers to exchanging crucial and exclusive information with distribution partners (Li *et al*., 2005).

Forecasting: is described as the practice of creating predictions from historical and current data, most often via trend analysis (Sunil Chopra and Meindl, 2007).

Pricing: The process of determining how much to charge clients for a company's products and services (Chopra and Meindl, 2013).

Efficiency: Efficiency is a measure of how resources are used economically (Beamon,1999).

Responsiveness: The capacity of responding to changes in customers demand, and how well the supply chain is able to do so (Holweg, 2005).

1.9. Organization of the Study

This study is organized into five chapters; chapter one explains the introduction and background of the research and describes what the research is intended to achieve. Chapter two includes a literature review on different aspects of the SPSC and related reviews. Chapter three discusses methods used for research, and it highlights the research approach and type of research, study area, data collection tools, population and sample of the study, and the methods of data analysis used in the study. Chapter four summarizes the results/findings of the study and interprets and discusses the findings. Chapter five summarizes the results/findings of the study and interprets and discusses the findings. Finally, chapter five will be followed and includes four sections, a summary of findings, conclusions, recommendations, and suggestions for future study.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter presents existing academic literature on the subject under the study. It provides a definition and explanation of the main theories related to the topic. Here, we will first see the theoretical review of related studies followed by the study's conceptual framework and, finally, the literature gap.

2.1 Theoretical literature review

The necessary concepts that are relevant for this study will be seen here.

2.1.1 Supply Chain and Supply Chain Management

A supply chain is a physical network that extends from the supplier's supplier to the ultimate consumer. A supply chain is a network of businesses that collaborate to bring goods or services to market (Lambert et al., 1998).

A supply chain comprises several actors; it comprises suppliers, production facilities, warehouses, distribution centers, retail outlets, raw materials, work-in-process inventory, and completed goods that move between the various locations (Simchi-Levi et al., 2008). Businesses join this chain to increase operational efficiency, provide value at all levels, and finally serve the client fairly.

Multiple flows are accommodated between the various supply chain phases, a continuous movement of material, information, and finance occurs (Chopra and Meindl, 2013).

Following the supply chain comes the idea of supply chain management; SCM coordinates production, inventory, location, and transportation among supply chain participants to satisfy market needs (Hugos, 2011).

SCM is the process of coordinating production, inventory, location, and transportation among the supply chain's members to achieve the optimal combination of responsiveness and efficiency for the market being served. (Hugos, 2011).

Moreover, the goal of SCM is to optimize total value created, reduce costs, and ensure the efficient and timely delivery of items required by customers (Chopra and Meindl, 2013).

2.1.2 Spare parts

Gopalakrishnan and Banerji (2013) describe spare parts as equivalent to the component of a machine that requires replacement due to wear and tear throughout the equipment's operational life. According to Patton and Feldmann (1997), spare parts are interchangeable with matching objects installed or in use and may replace objects during maintenance. According to Luksch (2014), a spare component might be an original item manufactured by the original equipment manufacturer or a component manufactured by a third party with manufacturing capabilities.

Spare parts are designed to ensure the continued operation of the primary product. In other words, spare parts are not required until the buyer has purchased the principal product (Wagner et al., 2012). SP is required when a section of the primary product breaks. The primary product may be a vehicle, machine, or appliance for the home (DHL, 2008).

Typically, spare parts are developed and produced concurrently with the original product (Inderfurth & Mukherjee, 2008). Moreover, the primary products serve as a template for spare parts production (Wagner et al., 2012).

Spare component demand is often erratic since it is highly dependent on the equipment's use pattern and degree of maintenance (WJ Kennedy, 2002). On the other hand, spare part consumers need long-term availability of spare parts throughout the main product's lifespan.

Spare parts are obtained from the original manufacturer or their authorized agents due to their specialized use. Therefore, original equipment manufacturers and their respective dealers must maintain an optimal level of spare parts to meet customer demand and ensure the continued functioning of the equipment and machinery they sell (Hopp et al., 1997).

As a result, manufacturers and their respective dealers must maintain spare parts inventories and be prepared to provide necessary spares when there is a demand (Flowers and O'Neill II, 1978).

2.1.3 Road Construction-Heavy Machinery Spare Part Supply Chain

These days, the necessity for SPSC is becoming more apparent in the construction business in general and road construction in particular.

Generally, a supply chain is defined as a complex network of interconnected and interdependent organizations that collaborate to create and distribute items or services to the market (Tsadikovich et al., 2016).

The SPSC is not far from this idea, but its role is distinct. First, the SPSC exists to ensure that maintenance activities operate smoothly and that equipment is idle for no longer than required (Joachim A., 2013). Similarly, the road construction heavy machinery SPSC is a network of firms that supports and strengthens the road construction equipment's maintenance operations to maximize equipment output.

Because there is no visible difference between the road construction-heavy equipment SPSC and the general idea of SP chain, these concepts and their performance assessment and other features will be used interchangeably in this research.

2.1.4 Factor affecting supply chain performance

Studies have indicated that supply chain performance is vulnerable to many factors; this section will discuss few factors: inventory level, information sharing, demand forecasting accuracy, and product pricing.

2.1.4.1 Inventory level related factors

An Inventory is a kind of idle asset stored in various forms for current and future usage (selling or distribution) (Hokey Min, 2015). Inventory might include supplies, spare parts, fuels, lubricants, oils, tires, and other products that help run smoothly and meet demand. Spare part inventories are required to smoothly run production activities, plant and machinery maintenance, and other operational requirements.

Inventories are huge expenses throughout the supply chain, but it also impacts responsiveness. Due to the high binding cost associated with inventory (Guajardo et al., 2012), supply chain managers' primary priority is to reduce inventory without raising expenses or losing responsiveness.

According to Chopra and Meindl (2013), responsiveness and efficiency are fundamental trade-offs when managers make inventory level decisions. Increased inventory typically improves the supply chain's responsiveness to the consumer but at the expense of efficiency.

Supply chain actors must maintain adequate inventory levels at each chain step to maintain responsiveness and efficiency, which necessitates good inventory management.

According to Kotler P. (2002), inventory management encompasses all operations involved in establishing and controlling inventory levels of raw materials, semi-finished materials (work-in-progress), and completed items to ensure appropriate supply and a low degree of over-or under-stocking.

The primary goal of inventory management is to reduce overall costs to assure profitable operations (efficiency) and optimize customer service, which is defined as responsiveness to the customer (Oluwaseyi J. et al., 2017). Additionally, supply chain players must use different approaches that lower operating costs while improving supply chain performance (Oluwasey et al., 2017).

Businesses use various inventory management models and strategies to determine inventory levels that balance responsiveness and efficiency. Some of the techniques include; Economic Order Quantity (EOQ), Vendor-Managed Inventory (VMI), and Just-In-Time (JIT).

I. Economic Order Quantity

An economic order quantity (EOQ) is the best order quantity that minimizes total yearly inventory costs and guides how much and when to refill inventory (Hokey Min, 2015).

The Economic Order Quantity (EOQ) inventory control model determines the optimal delivery size and the cheapest carrier, ensuring that overall inventory costs are minimized.

The Economic Order Quantity (EOQ) model examines the trade-off between ordering and storage costs when determining the amount to replace item stocks. A more significant order amount decreases ordering frequency, which lowers ordering costs, but demands storing a massive average inventory, raising holding costs. On the other hand, a lower-order amount decreases average inventory but necessitates more frequent ordering and more significant ordering expenses.

EOQ improves performance by ensuring that supplies are delivered to the organization within the specified time frame; this decreases the lead time or waiting time (Nerea, 2014), as stated by (Nerea 2014) as stated by (Eveline et al.,2019). In addition, the ordering cost, cheapest deliverer advantage, and others are benefits of EOQ that impact the efficiency.

II. Vendor-Managed Inventory (VMI)

In VMI, the supplier owns the inventory and is responsible for its management, including the financial burden of keeping inventory (Hokey Min, 2015). In return for the added expense of inventory management, the vendor is often compensated with expanded or more reliable business prospects.

The customer that utilizes VMI receives a variety of advantages. These advantages include more significant inventory turnover, more excellent sales, greater order fill rates, enhanced customer service, shorter lead times, more significant cash flows, reduced liabilities, and a better inventory level based on actual customer sales (Hokey Min, 2015). Besides, according to Datalliance's (2007) research, firms deploying VMI found an average gain in sales of 47%, overall growth in inventory turnover of 38%, and an average decrease in stock-outs of 45%.

Enhanced sales volume obtained from VMI leads to better efficiency, whereas VMI characteristics such as higher-order fill rates, enhanced customer service, and shorter lead times result in increased customer response.

III. Just-In-Time (JIT)

Heizer, Render, and Munson (2017) defined Just-in-time as delivering an exact quantity of inventory products at the precise time required. Therefore, it is essential to ensure the minimum required inventory required to keep the system operational. Furthermore, this methodology or approach improves the efficiency of the business and reduces waste, which results in a drop in inventory costs since goods will come just as required (Heizer, Render, and Munson (2017) Implementing a JIT inventory system necessitates a favorable relationship with suppliers, since suppliers are critical in providing goods when needed.

JIT is often regarded as the most crucial component of reducing inventory levels and cutting the cost of inventory holding (Phung, 2011). Thus, the advantages of JIT include minimizing inventory costs (efficiency) and ensuring that items are accessible when needed (responsiveness).

2.1.4.2 Information sharing related factors

Information Sharing (IS) refers to exchanging crucial and exclusive information with distribution partners (Li et al., 2005).

Numerous scholars have shown the relationship between IS and supply chain performance. For example, Zhao (2002) demonstrates the beneficial effect of IS on inventory and cost reduction. Furthermore, according to Ajay & Maharaj (2010), IS significantly reduces the total cost of operating a successful supply chain and enhances the holistic management of supply chain operations.

IS enhances supply chain performance in various ways; it improves service levels, customer response, cost savings, and complexity reduction (Flynn, Huo & Zhao, 2010). IS eliminates the need for inventory. As a result, the supply chain would perform better in terms of financial returns, service quality, and time spent doing tasks (Sheikhi et al.,2018)

Further, the following are some of the fundamental roles of IS;

- Continuously sharing updated information with essential stakeholders in a timely and meaningful way enables managers to make more informed decisions, resulting in increased performance (Hatala and Lutta, 2009),
- IS system enables a business to procure a variety of customized items swiftly and to understand the changing tastes and preferences of its customers (George and Madhusudanan Pillai, 2019)

- IS lowers the bullwhip effect, improves coordination among various activities, enhances decision-making, and lowers supply chain uncertainties (Moyaux, Chaib-Draa, and Amours, 200). (Zhao, Xie, and Wei, 2002),
- IS, increase productivity and effectiveness and shorten the time required to respond to market changes (George and Madhusudanan Pillai, 2019)
- Adequate information flow between businesses in the supply chain results in product enhancement, reduced customer response times, and cost savings or efficiency (Alvarez, 1994; Paulraj and Chen, 2007).

In general, IS may be considered the primary driver of performance in the SC (Chopra and Meindl, 2013). However, the influence of information sharing on the supply chain is dependent on many aspects, including the quality of shared information, the extent or level of information shared, and the company's capacity to utilize and transform the information into supply chain strategies and actions (Moberg et al., 2002). Furthermore, according to Vives (2013), IT technology enables the exchange of actionable information across diverse businesses.

I. Quality of information sharing

The quality of information sharing encompasses the correctness, timeliness, sufficiency, and reliability of the data provided (Moberg et al., 2002).

With these predispositions in mind, guaranteeing the quality of shared information becomes crucial to good supply chain operation (Feldmann et al., 2003). Therefore, organizations must consider information as a strategic asset and ensure it flows with the slightest delay and distortion possible. While information quality is critical for decision-making, firms may delay or falsify information to their suppliers and consumers (Mcadam and Mccormack, 2001) due to an innate sense of fear (Mason-Jones and Towill, 1997; Mason-Jones and Towill, 1999).

Researchers have examined the effect of information quality on firm performance and discovered a strong correlation between enhanced information quality and increased organizational performance (Vivek et al., 2009). Furthermore, better organizational performance would mean better supply chain performance.

II. Level of information sharing

The level of information sharing refers to how critical and proprietary information is communicated to one's supply chain.

The information may be strategic or tactical and may pertain to logistical operations, customers and markets, product availability, inventory levels, expeditions, and the status of manufacturing demand fulfillment (Paulraj, 2006).

The extent to which agencies share information is determined by a variety of factors, including organizational and individual cultures, information governance, policies and guidance in place, existing collaboration and partnerships, information sensitivity, information communication and dissemination strategies, information systems in use, and data standards and formats (Vive, 2013). Due to the diversity of information and the availability of several sharing alternatives, determine the type or extent of information sharing across organizations is challenging (Feldmann and Müller, 2003); as a result, Seidmann and Sundararajan (1998) argue that enterprises should disclose information only to the extent that it benefits them. For instance, communicating order status may help enhance customer service and save manpower expenses.

Sharing retail sales data may help lessen the bullwhip effect, leading to the belief that a high degree of information results in a responsive and efficient supply chain.

III. Information technology

Information technology enables the exchange of information between multiple entities (Vives, 2013). Information technology has a critical component in information exchange and coordination (Bharosa, Lee, and Janssen, 2009). Organizations may use information technology to communicate real-time data and coordinate various operations (Patterson et al., 2003).

Adoption of information technology may be one strategy for enhancing the supply chain's performance. Investing in IT will surely increase supply chain performance, naturally boosting company performance (Daugherty et al., 1995). In addition, SC performance is boosted by information technology, which provides real-time data on inventory levels, production requirements, product availability, and shipping status (Salcedo and Grackin, 2000).

In general, (IT) enables a reduction in cycle time, a decrease in inventory, a reduction in the bullwhip effect, an increase in the effectiveness of distribution channels, and ultimately aids in the development of responsiveness, resilience, reliability, and realignment necessary for developing a customer-focused supply chain strategy (Madhani, P. M., 2017).

As a result, information technology plays a critical role in the responsiveness and efficiency of a supply chain.

2.1.4.3 Demand forecasting accuracy-related factors

Forecasting: is described as creating predictions from historical and current data, most often via trend analysis (Sunil Chopra and Meindl, 2007).

Demand forecasting provides businesses with the facts they need to manage their internal operations and fulfill market demand. SCM judgments are made based on predictions that describe which items will be required, in what amounts, and when they are needed (Hugos, 2003).

A strong forecast is a first and most crucial step in successfully managing a supply chain (Singh, 2014). Lee et al. (1997) identified demand forecasting as one of the primary sources of the bullwhip effect in the supply chain. Members of a supply chain must foresee future demand, which is hard to do with accuracy. This uncertainty results in a skewed order quantity and, via order variance amplification (X. Zhao et al., 2002).

Given that all businesses operate in an uncertain future, some discrepancy between anticipated and actual demand must be assumed. Thus, a practical forecasting approach reduces the variance between actual and predicted demand (Joel D. et al., 2012).

Forecasting strategy may mitigate bullwhip impacts by up to 55% (Wright and Yuan, 2008). As a result, forecasting is a vital aspect in determining the overall success of the supply chain (Zhao & Xie, and Trapero et al., 2011). Moreover, accurately forecasting leads to fewer inventories, fewer stock-outs, better production schedules, cost savings, and more excellent customer service (Joel D. et al., 2012); this demonstrates that forecasting plays a critical role in increasing supply chain efficiency (lowering supply chain costs) and enabling responsiveness (improved customer service).

The prediction should be as precise as feasible. "forecast accuracy" refers to the discrepancy between projections and actual demand or sales (Donald J. et al., 2002). Forecast precision has a significant impact on supply chain performance, such as inventory cost, backorder cost, lost sales cost, and customer goodwill (George and Madhusudanan Pillai, 2019)

Forecasting errors are connected with high supply chain costs, such as missed sales, unneeded safety stock, dissatisfied customers, and loss of goodwill (Donald J. et al., 2002). Besides, an erroneous estimate leads to a company's resources being underutilized (Shang, Li and Tadikamalla, 2004).

Forecast accuracy is dependent on several elements, including the forecast's time horizon, the data used to create the forecast, the forecaster's competence, and forecasting tools and systems. The following section will discuss these aspects in further detail.

I. Time horizon

The forecast horizon is the number of periods beyond the recognized data for making projections (Lewis, 2000). Forecast horizons can be long or short; long-term projections run three to ten years while short-term projections reach one to three months (Korpela J. et al., 1996).

The majority of scholars believe that the longer the prediction horizon, the less accurate (Schnaars, 1984).

II. Data availability

More precise projections are achievable when more data is provided (Michael 1979). Besides, the more data accessible, the more accurate forecasts will be, and fewer inventory costs characterize the better supply chain performance, lower backorder costs, reduced missed sales costs, and more customer goodwill (Schnaars , 1984).

III. Human factors

The forecaster is the process's leader (Singh, 2014); to make the necessary adjustments and judgments, they must possess a robust set of skills and competencies.

A good forecaster should have a thorough understanding of the business, including its products, customers, markets, and competitive environment; this should be followed by a comprehensive understanding of the data that is fed into and processed by forecasting systems, including its meanings, validity, and alignment (Singh, 2014). Further, the forecaster must effectively employ tools, methods, and information, recognizing when and how to modify and make intelligent adjustments.

These forecaster skills and capabilities substantially influence forecast accuracy; this implies that the more competent the forecaster is, the more accurate the forecast and the more efficient the supply chain.

IV. Tools and Systems

These days various tools and systems are being applied to assist with analysis and decision-making processes. Forecasting is one of the significant areas that tools and systems are involved. Tools and systems make it possible to store and exchange a large amount of information, enable fast and complex analysis, and produce forecasts more efficiently. Tools and systems can process a large volume of data more efficiently and accurately than a human being. However, if not well-utilized tools and systems can become obstacles to forecast accuracy, they may produce a useless or misleading result (Morlidge, 2014); this revealed that the more appropriately deployed forecasting tools and systems, the more forecast accuracy would be resulting in better supply chain performance.

2.1.4.4 Product pricing related factors

Pricing is how a business determines the price at which it will sell its products and services to customers (Chopra and Meindl, 2013).

Historically, supply chain participants utilized pricing to affect demand over time. Besides, Hugos (2011) asserts that pricing affects a firm's sales and gross profit. Then again, Chopra and Meindl (2013) stress that pricing affects the customer segments that purchase the product and their expectations; this directly impacts the supply chain in terms of the level of responsiveness required and the demand profile that the supply chain attempts to serve.

Pricing is another lever that may balance supply and demand, mainly when the supply chain is inflexible. In brief, price is a critical component in determining the amount and kind of demand that the supply chain will experience (Chopra and Meindl, 2013).

Certain businesses alter their prices according to the customer's desired response time. For instance, as stated by Chopra and Meindl (2013), transportation companies set the price of their services according to the customer's preference for response time. Thus, such businesses respond to two distinct consumer segments: those who need timeliness (excellent service at a high price) and those who need efficiency (low price). In such instances, it becomes critical for these enterprises to create a supply chain that meets the two divergent demands.

Chopra and Meindl (2013) demonstrated that all pricing choices should increase company profitability; this involves an awareness of the cost structure of conducting a supply chain activity and the value added by the action. This concept concludes that pricing has a role in the responsiveness and efficiency of the supply chain.

According to Chopra and Meindl (2013), the following components of price choices that impact supply chain performance are crucial.

I. Pricing and Economies of Scale

The majority of supply chain operations benefit from economies of scale Chopra and Meindl (2013). Many businesses choose to purchase every quarter to accrue big enough orders for bulk buying or freight consolidation and take advantage of economies of scale (Hokey Min, 2015). According to Chopra and Meindl (2013), changeovers make shorter manufacturing runs are more costly per unit than big production runs, while loading and unloading expenses make delivering a truckload to one place less costly than delivering it to four.

Supply chain players must choose how to price a product or service in order to capture scale economies; sometimes, discounts are established by supply chain participants to reflect the economics of scale (Chopra and Meindl, 2013)

Increased sales due to quantity discounts generate profit for the business, while reduced manufacturing and transportation costs due to economies of scale result in increased customer satisfaction (responsiveness).

II. Everyday Low Pricing Versus High-Low Pricing

According to Chopra and Meindl (2013), certain firms employ everyday low pricing, strategy to maintain stable prices over time. Such businesses will go to great lengths to avoid offering discounts to maintain their daily low pricing strategy.

In comparison, most supermarkets and other seasonal product retailers employ a high-low pricing strategy and periodically offer steep discounts on a subset of their products.

Daily low prices result in relatively stable demand Chopra and Meindl, 2013). On the other hand, the high-low pricing strategy results in a peak in demand during the discount period, frequently followed by a sharp decline in demand during the subsequent discount exemption period. Thus, both pricing models result in significantly different demand profiles that the supply chain must meet (Chopra and Meindl, 2013).

The concepts outlined above lead us to believe that both approaches enable the firm to meet a variety of customer requirements (meaning be responsive) while also ensuring the firm's profitability by securing sufficient sales to meet customer needs.

III. Fixed Price Versus Menu Pricing

A business must determine whether to charge a flat rate (fixed price) for supply chain operations or provide a menu of rates that change according to other attributes, such as response time or delivery location (Chopra and Meindl, 2013).

If consumer value varies greatly across specific qualities, a price menu is often viable; and these tactics are customer-centric, which means they are responsive (Chopra and Meindl, 2013).

2.1.5 SPSC Performance Measurement (Responsiveness and efficiency)

Performance measurement is often described as the process of assessing efficiency and effectiveness (Neely et al., 1995). Mentzer (1991) stated that effectiveness is how many objectives are realized. According to (Beamon 1999), efficiency measures how economically a firm's resources are optimized.

Few studies have examined spare-part supply chain performance assessment, and the majority has concentrated on revealing specific critical performance indicators. According to Barkawi and Partners GmbH (2002), stock availability, On-Time Delivery performance, order fill rate, number of backorders, failure rate, the average cost per event, cycle time, and delivery accuracy are fundamental SPSC performance metrics. De Leeuw and Beekman (2008) set vital performance metrics, including availability rate, stock-out, lead time, delivery frequency, completeness, accuracy, regularity, and punctuality. Gaiardelli, Saccani and Songini (2007) identified three critical performance metrics; error rate, picking time, and delivery time.

Most prior studies have shown consumers' expectations about service quality and spare part availability to measure performance. Indeed, Zineb Achetoui et al. (2019) described the importance of alternative ways to assess spare parts supply chain performance.

Following earlier research suggestions to consider additional dimensions for SPSC performance, this research will utilize what Hugos (2011) has provided to quantify supply chain performance using two characteristics: responsiveness and efficiency.

A responsive supply chain focuses on the speed at which a supply chain offers items to customers (Bolstorff and Rosenbaum, 2012). A responsive supply chain quickly reacts to market demand but costs more, requiring larger batch sizes (Skinner, 1974). Product latency, delivery, customer

response time, lead time, shipment errors, and customer complaints are few metrics used to assess responsiveness.

Efficiency is concerned with determining the extent to which resources are utilized (Lai et al., 2002). An efficient supply chain focuses on lowering unit costs but frequently at the expense of market responsiveness (Skinner 1974). In this study context, the primary metrics for efficiency include production costs/distribution costs, transaction costs, profit, return on investments

Table 2.1 Metrics of the study

I. Responsiveness related metrics
• **Fill rate:** Percentage of units ordered that are shipped on a given order. Fill rate measures the actual fill rate as compared with the target fill rate.
• **Product lateness:** Product lateness is the amount of time between the promised product delivery date and the actual product delivery date; it measures delivery date minus due date.
• **Customer response time:** The amount of time between an order being made and its corresponding delivery; this measures the difference between the time an order is made and its corresponding delivery.
• **Lead time:** Total amount of time required to produce a particular item or service. Moreover, lad time measures the total amount of time required to complete one unit of product or service.
• **Customer complaints:** Registered complaints from customers about products or services. Customer complaints measure the total number of complaints registered.
• **Shipping errors:** shipping error measures wrong product shipments; this measures the percentage of wrong shipments.
II. Efficiency related metrics
• **Production costs/distribution costs:** Production cost refers to the combined costs of raw materials and labor in producing goods. Moreover, distribution costs include transportation and handling cost. Thus, the production and distribution costs measure the total costs of inputs used to produce output/services.
• **Transaction costs:** The indirect costs of a product or service other than the such as searching cost, negotiation costs, and enforcement costs). For example, transaction cost includes such costs as the sum of searching costs (the costs of locating information about opportunities for

exchange), negotiation costs (costs of negotiating the terms of the exchange), and enforcement costs (costs of enforcing the contract).
• **Profit:** The positive gain from an investment or business operation after subtracting all expenses. Moreover, these measures total revenue after deducting expenses.
• **Return on investments:** A measure of a firm's profitability and how effectively it uses its capital to generate profit; it measures the ratio of net profit to total assets.

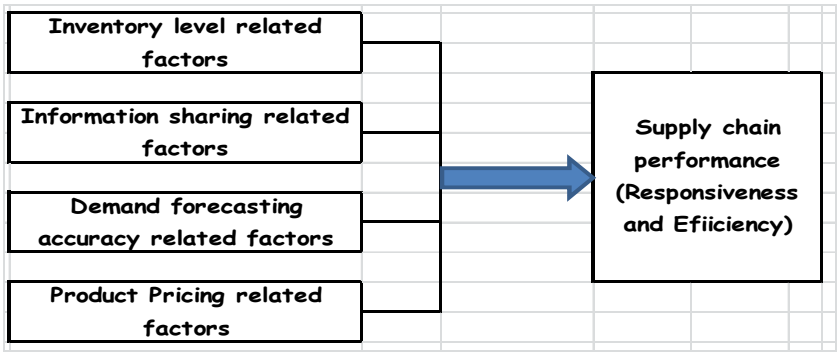
Source: (Beamon (1998, 1999a), Bowersox and Closs (1996), Hobbs (1996), Persson and Olhager (2002), Lai et al. (2002), Womack and Jones (2002), Gunasekaran et al. (2001), Supply Chain Council (2004), Berry (2006), Luning et al. (2002), Van der Spiegel (2004), Valeeva (2005), and Beamon (1999b) as cited in (Aramyan *et al.,* 2007)

2.1.6 Empirical review

To the researcher's knowledge, no previous study has been undertaken on Assessing Factors Affecting the Performance of the Road Construction-Heavy Machinery Spare Part Supply Chain. Additionally, the fundamental motivation for this research is a paucity of study data on the issue.

2.1.7 Conceptual framework

The graphic below depicts the study's conceptual structure; it shows the presumption of a link between the components (independent variables) and performance (dependent variable) based on the study question and literature.



Source: Own survey referring to different works of literature

Figure 2.1 Conceptual frameworks

2.1.8 Literature gap (Identified Literature gap)

Spare parts are critical maintenance inputs (Al-Najjar and Alsyouf, 2004). Besides, spare components are necessary to ensure the main product's operability. Further, spare components are required once the primary product is sold to the customer (Wagner et al., 2012). Furthermore, the spare component supply chain exists exclusively to ensure that maintenance activities operate efficiently and that equipment is not down for longer than required (Joachim A., 2013). Spare part buyers expect long-term availability of spare parts during the main product's lifespan. (Wagner et al., 201)

Ethiopian scholars, including Emran Hassen A. (2017), Dagne, Abebaw W. (2014) , and Abdisa D. (2003), have shown a shortage and unavailability of spare parts in the Ethiopian Roads Construction-Heavy Machinery SPSC scheme.

According to Barkawi and Partners GmbH (2002), availability is a critical performance factor for suppliers of spare parts supply chains; this shows that Ethiopia's spare part supply network performs poorly.

Though numerous previous studies in the Ethiopian road construction sector have shown a poor performance of the road construction equipment spare part supply chain, characterized by parts shortages and unavailability, they all do not go deep down to examine the elements impacting the chain's success. Thus, the inception of the research gap starts here.

To this end, this research will examine the factors influencing the Road Construction-Heavy Machinery SPSC performance in a case firm MWE P.L.C. and attempt to bridge the gap.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter discusses the methodology used in the research. The study's approach is explained and demonstrated. The target demographic is described in-depth, as are the data collection techniques. Additionally, the chapter covers the data collection methods, the instruments utilized, the data analysis methodologies, and the ethical issues that arose throughout the research.

3.1 Description of the study area

The study was done at MWE PLC, one of the heavy-duty equipment suppliers in Addis Abeba, Ethiopia's capital city. MWE PLC is a privately owned machinery and spare dealer. MWE P.L.C. is the sole distributor of several heavy-duty heavy- equipment manufacturers. For over 15 years, MWE PLC has provided dependable and quality products.

MWE PLC provides the construction sector with the most comprehensive range of integrated solutions for the supply, sales, buy, and leasing of new machines, equipment, and engines, as well as authentic spare parts. The figure below briefly shows the SC network of MWE PLC.

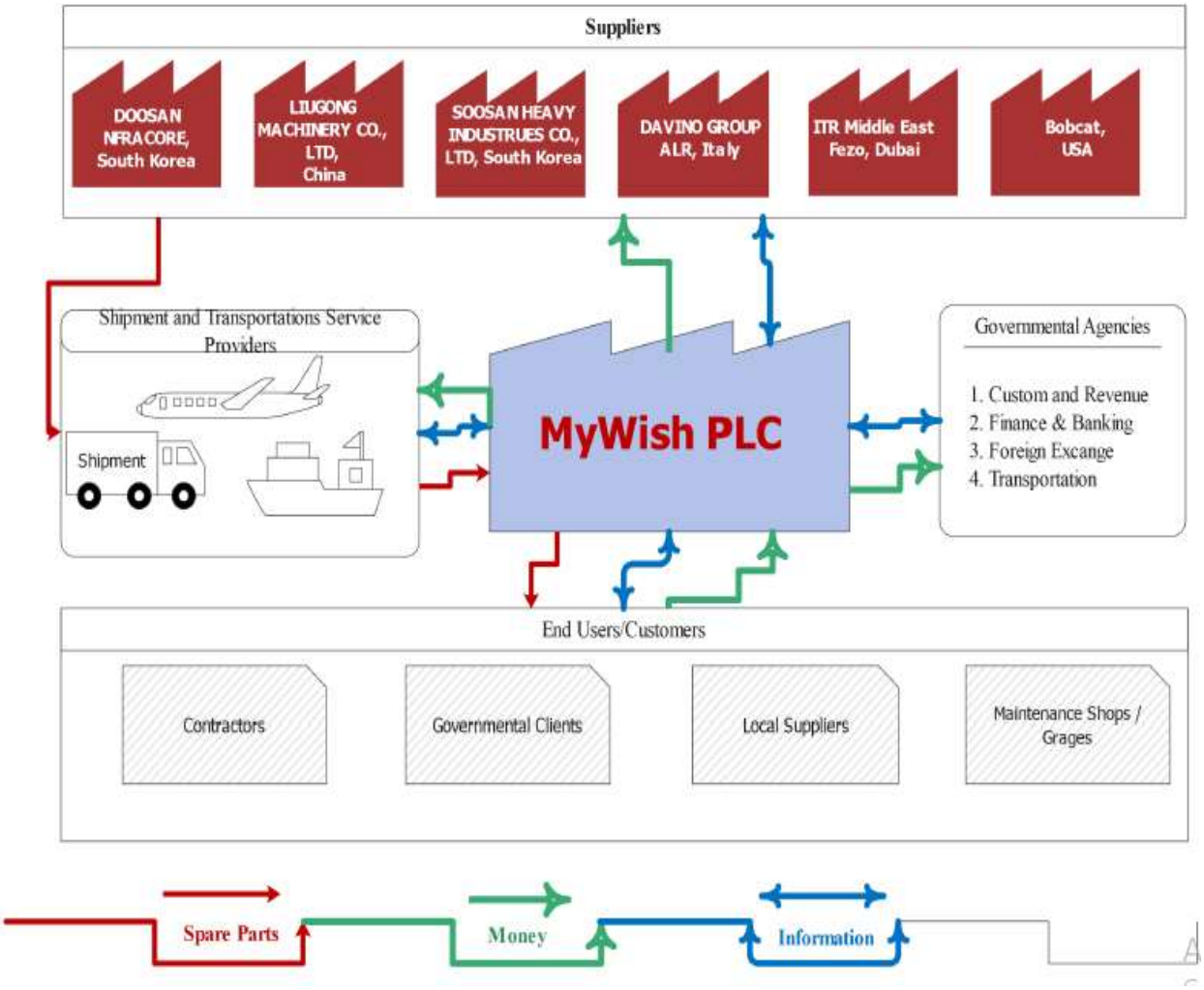


Figure 3.1 Supply chain network of MWE P.L.C.

Source: own source based on briefing by MWE P.L.C.

3.2 Research approach

Quantitative and qualitative approaches are the main categories in research. A mixed approach may be used in some specific studies to triangulate the findings of a study (Fellows and Liu, 2003). Triangulation combines the two methods in a research study to cross-check results (Saunders et al., 2007)

This study took a mixed approach to understand better the variables influencing the road-heavy construction equipment supply chain and offer extensive datasets.

3.3 Research design

The study design makes it possible for the researcher to respond to the central research question. According to Saunders, Lewis, and Thornhill (2009), the choice of research design is determined by the study's goal, the availability of time, data, and the cost of collecting the data. Both descriptive and explanatory designs will be used in the research.

Descriptive research, according to Kothari (2004), comprises several types of surveys and fact-finding inquiries. The main goal of descriptive research is to characterize the situation as it now exists. The descriptive method was chosen because it comprehends and reports items related to the study variables. Furthermore, descriptive research enables the researcher to gather data on the present state of the phenomenon and characterize "what exists" in terms of factors such as inventory level, information sharing, demand forecasting accuracy, and price.

The explanatory research method was chosen because it stresses why questions (Cooper and Schindler, 2000), and the investigation would establish causal explanations between the dependent and independent variables by addressing the why questions.

3.4 Variables of the study

The study has both dependent and independent variables.

Independent variables: inventory level related factors, information sharing related factors, demand forecasting accuracy-related factors, and product pricing relate factors are the independent variables

Dependent variable: SPSC performance (responsiveness and efficiency) is the dependent variable.

3.5 Population and sampling Design

3.5.1 Population

According to Mugenda & Mugenda (2003), the target population refers to all members of an entire set of people, events, or objects to which the study generalizes the research's hypothetical results. All personnel directly related to the spare supply chain, such as those at operations department staff (sales, store, marketing), import and export department staff, and product support department staff (Service department and Parts department). With this regard, our target population is 105, as tabulated below.

Table 3-1 Population of the study

Department or position of respondents	Number of Employees (x)	Remark
General Manager	1	
Deputy General Manager	1	
Operation Manager	1	
Sales & Marketing department	30	
Store department	1	
Import & Export department	6	
Service department	53	
Parts department	4	
Training department	0	Recently vacant
Planning department	0	Recently vacant
Customer Relation department	3	
Total Sample size	**100**	

Source: MWE P.L.C. and own calculation

3.5.2 Sampling technique

A non-probabilistic sampling technique termed judgment sampling (sometimes referred to as authoritative sampling) was utilized in this thesis. Judgment sampling allows the researcher to choose units to be sampled based on previous knowledge or professional judgment.

According to Saunders et al. (2007), purposive sampling is a helpful sampling technique that enables a researcher to obtain information from a population sample that one believes best about the topic matter. Therefore, the study has used this method since it is convenient, and also, the targeted respondents are the ones who know the subject under investigation.

All the responses are chosen after having adequate knowledge regarding MWE PLC's organizational structure. Moreover, the research thinks that respondents have adequate information on what might affect the SPSC performance.

Besides, judgmental sampling is employed when an authority's expertise may choose a more representative sample, giving more accurate findings than other probability sampling methods. Further, the rationale for selecting non-probability over probability sampling is the cost and time considerations (John Adams et al., 2007).

3.5.3 Sample size

Calculating a sample size is a complicated process since it is dependent on many variables such as error margins, degree of confidence, and statistical methodology (Corbetta, 2003).

A general rule is that the sample size should be optimal, and it should neither be too high nor minimal (Kothari, 2004).

The research anticipated collecting questionnaires at a rate of 90% since few respondents (particularly service department employees) make frequent field trips and may be out of the office

when questionnaires are collected; therefore, the remaining 10% may be faulty or non-response. Therefore, this study has a 95 percent confidence level.

A formula by Kothari (2004) was used to determine the sample size.

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 (N-1) + z^2 \cdot p \cdot q}$$

Accordingly, the sample size was calculated to be 59.

Where:

- ☞N = Size of Population = 100
- ☞Z = Z score level of confidence (95% confidence level = 1.96;
- ☞P = Sample successfully collected (0.9)
- ☞q = Failure of sample (0.1),
- ☞e = marginal error (5%)

$$n = \frac{(1.96)^2 * 0.9 * 0.1 * 100)}{(0.05)^2 (100-1) + (1.96)2 * 0.9 * 0.1)}$$

n = 58.2

= 59 respondents

Table 3- 2 Analysis of sample size (participants from each department)

Department or position of respondents	Number of Employees (x)	Sample Size (X/P)* R P=Population=100 R=Respondents 59	Approximated sample	Remark
General Manager	1	0.59	1	
Deputy General Manager	1	0.59	1	
Operation Manager	1	0.59	1	
Sales & Marketing department	29	17.11	18	
Store department	1	0.59	1	
Import & Export department	6	3.54	4	
Service department	53	31.27	32	
Parts department	4	2.36	3	
Training department	0	0	0	Recently vacant
Planning department	0	0	0	Recently vacant
Customer Relation department	3	1.77	2	
Total Sample size			**63**	

3.6 Source of Data and Collection Methods

The researcher gathered both primary and secondary data in order to acquire reliable data.

The primary data for this research was gathered from workers, supervisors, and managers at the targeted business.

Additionally, secondary data were gathered from textual sources such as academic publications, organizational reports, and manuals available in books and the internet.

3.7 Data collection tool

Closed-ended questionnaires and focus group discussions were utilized to gather data in this research. For survey research, structured questionnaires are the most suitable data collecting tool (Askia, 1999).

Closed-ended surveys were designed to make responding easier for respondents since writing on open-ended questions with blank spaces may be tedious, affecting the study outcome. As a result, a structured questionnaire with closed-ended questions and a five-point Likert scale was employed. Additionally, a five-point scale is more trustworthy and valid than shorter or greater length (Krosnick and Fabrigar, 1997). Thus, a five-point rating system was utilized to assess employee answers in this research, with respondents marking options 1 for "Strongly Disagree," 2 for "Disagree," 3 for "Neutral," 4 for "Agree," and 5 for "Strongly Agree."

Furthermore, focused group discussion was utilized to gather employee data, and the results were then recounted.

3.8 Data collection procedure

To elicit personal information, the researcher distributed questionnaires to each stratum on an individual basis. Moreover, to avoid misunderstandings and to simplify administration, the questionnaire completion process was closely monitored.

3.9 Data analysis

Following the data collection, both descriptive and inferential statistical methods were used to examine the collected data. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0.

Descriptive statistics were utilized to convert a large amount of raw data gathered into tables, charts, and percentages, which are critical components in making sense of the data.

Additionally, inferential statistical analysis was conducted using the SPSS software. Inferential statistics use correlation and multiple regression analysis techniques. Correlation analysis was performed to determine the degree and direction of the connection between the independent and

dependent variables. Multiple regression analysis was used to determine the independent variable's impact on the dependent variable SPSC performance (responsiveness and efficiency).

3.10 Scale reliability and Validity

3.10.1 Reliability

According to Golafshani (2015), reliability refers to how a study's findings are consistent across time and that the population under research is accurately represented. The Chronbach alpha coefficient is the most often used method in the literature for assessing the scale's reliability and stability. Cronbach's Alpha coefficients should be higher than 0.7, according to Andy (2006). Therefore, the Alpha value of each variable in the research, individually and collectively, is higher than 0.7, which is considered acceptable.

Table 3.3 Reliability Test result (Analysis)

Reliability Statistics		
Variable	**Cronbach's Alpha**	**No. of Items**
Inventoty level related factors	**0.786**	7
Information sharing relate factors	**0.818**	6
Forecast accuracy related factors	**0.720**	7
Price related factors	**0.727**	6
Responsiveness related statements	**0.797**	5
Efficiency related statement	**0.756**	4
Over all	**0.855**	**35**

Source: SPSS output of survey, 2021

3.10.2 Validity

According to Kothari (2004), Validity shows the degree to which instruments measure what they are supposed to measure. Additionally, the scientific Validity of a study result is decided by the instruments used. Thus, the researcher tried to address content validity since this would aid in determining the instrument material's suitability for a conclusion. Every effort was made to ensure that the data

collecting tools were readily understood by respondents to gather the desired information, thus improving the reliability of the final results. The researcher used a variety of sources to determine the instruments' content validity.

3.11 Ethical consideration

Permission was obtained for the research through a written letter to all businesses from whom data was gathered. Additionally, respondents were given essential information to help them comprehend the study's aim. All data obtained from respondents, including their personal information, is kept strictly private and is used only for academic research purposes.

To ensure respondent comfort and candor, they were advised not to submit their personal information in the questionnaire; such efforts will minimize the skewness of the responses gathered from respondents. Additionally, many research papers, journals, and textbooks referenced in the study will be thoroughly cited.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, AND INTERPRETATION

Introduction

The main objective of this study was to assess factors that affect the SPSC performance of MWE PLC; therefore, this chapter presents the results and findings of the study as per the data collected from the sample population.

4.1. Demography

In this part, the researchers examined and discussed demographic information about the respondents pertinent to the study. The table below illustrates the respondent's background profile using frequency and percentage distributions. In addition, this section discusses the respondents' gender, age, educational background, job experience, and department within the company. The demographic profile of respondents is annexed in appendix II (table 4.1).

Concerning gender, the majority of respondents were males. That is, they are 51 (81 %). On the other hand, the female staffs are 12 (19 %). Although both genders are available in the company, Male's participation in the SPSC of the company dominate, this implies that both sexes' participation is un-proportional in the sector. On the other hand, the participation of females was seen as very low.

Age-wise, the majority of responders were male. Thus, they are 51 (81%). There are 19% female workers. Males make up the majority in the firm in the firm under the study. The involvement of both sexes seems to be disproportional in the industry. The involvement of women was shallow.

Concerning educational status, the finding shows that two respondents (3.2 percent) graduated from grade 10/12, whereas 16 (25.4 percent) attained a diploma level. A first degree was held by

40 (63.5%) of the respondents. The remaining 7% of the population had a master's degree or above; this implies that the respondents knew enough about the topic to impact the study.

In regards to job experience, 15 respondents (23.80 %) have 1-3 years of experience, 22 (34.90 %) respondents have 4-6 years of experience, and 16 (25.40 %) respondents have 7-9 years of experience. The remaining 10 (15.9%) responders have ten or more years of experience. Thus, the survey shows that respondents have sufficient competence to be involved in the research.

Concerning department, the service department (After-Sale Service) outnumbers sales and marketing by 32 (50.8%) to 18 (28.6%). Then, the import and export department follows with 4 (6.3%) respondents. The parts department is next with three people (4.8 %). Finally, the store and operations department had 1 (1.6%) responder each. In the end, the GM and the DGM participated in the research. Therefore, the departmental composition shows that the organization has relevant supply chain competencies.

4.2. Summary of qualitative responses

A few staff were selected for focus group discussion and asked to brief the researchers about their opinions and understanding of the factors affecting their spare parts supply chain performance. Accordingly, the experts said that the inventory level, information sharing between actors, forecast accuracy, and product pricing issues are crucial elements that affect their company's SPSC performance. Besides, the experts brief the researcher that these factors sometimes simultaneously and sometimes separately affected the supply chain performance of MWE PLC. The qualitative response is briefly described below by the researcher.

A. Information sharing-related factors.

In this regard, the expert's issue is that they cannot share inventory and other information to their customers and vendors due to the limitation of getting bilateral information from different

stakeholders, especially the information they need to know about foreign currency status at banks. Information about the foreign currency issues includes when to get approval and how much will be granted, as per the expert's opinion. Thus, IS has affected the decision about stock inventory level; they sometimes overstock or go under stocks. Further, they fail to provide sufficient information to their vendors and customers about; order status, inventory level requirements, delivery time, and or lead time of product delivery. As a result, their supply chain efficiency and responsiveness are affected.

B. Concerning inventory-related factors

The second issue raised by the company's experts is inventory-related. Because of part innovation and modification, vendors (original equipment manufacturers) have had the experience of collecting parts from dealers worldwide, but the Ethiopian government does not allow re-selling parts back to suppliers. As a result, a significant amount of tied-up inventories are observed at MWE PLC. Moreover, this has affected their efficiency, and MWE PLC is forced to bear the dead stock costs. As a result, significant national resources imported in foreign currency are becoming obsolete, affecting the company's overall efficiency and the spare part supply chain. Moreover, MWE's Vendors are interested in providing certain items when the stock items are depleted, but the National policy does not allow this, which ultimately affects the company's efficiency and responsiveness.

C. Concerning demand forecasting accuracy

As per the expert's opinion, they suffer from errors in demand forecasting. Still, the data they get from stakeholders, for example, Banks, are affecting their performance. Banks do not give them sufficient and clear data's that enables them to make good forecasts; as a result, they used to

forecast demand randomly and in a rush when they got the data from the external stakeholders such as Banks, and as a result, the forecasts are subjected to errors.

D. Concerning product pricing

The other issue raised by experts as a source of concern is product pricing, either directly or indirectly. As per their information, customs and banks consider the invoices from MWE PLC as under-stated, and as a result, they impose a high import tax on the parts imported. Moreover, this cost has affected the company's product pricing strategy, as the cost directly or indirectly goes to the customer, affecting the segment of the customer MWE PLC serves.

E. Other issues raised

The respondent raised issues other than the aforementioned variables, such as transportation and in-house spare part production.

I. Transportation issues

The experts address transportation concerns. First, the Ethiopian regulation obligates using the Ethiopian shipping agency transport service, no other alternative. Besides, the national regulation gives the multimodal transport system mandate to the shipping agency. As a result, the shipping agency has to bring the imported spare parts to one of the Ethiopian dry ports, though MWE PLC seeks to deploy other competent transporters, at least in the inland transport from Djibouti to any Ethiopian dry port, to save time and money. Moreover, due to transportation-related national regulations, significant delays occur beyond the company's control, affecting the delivery time performance, lead time, and supply chain cost.

II. Production issues

Finally, the experts raised an issue concerning in-house spare parts production. Recalling Pedagopu and Woldegiorgis (2018) ideas that Ethiopia does not manufacture branded construction

machines, the experts witnessed that the availability of in-house production firms would have minimized production cost, transaction cost, and transportation costs, and that would enable the SPSC of MWE PLC to be more responsive and efficient.

4.3. Descriptive analysis

A. Mean and standard deviation of responses on Inventory level related factors

Descriptive Statistics			
Inventory level related statement	**N**	**Mean**	**Std. Deviation**
MWE PLC keeps enough stock inventories to meet customer demand	63	2.94	0.801
MWE PLC applies EOQ model to optimize its inventory level.	63	2.68	0.800
MWE PLC applies EOQ model to reduce transportation and shipping costs.	63	2.52	0.895
MWE PLC applies Vendor managed inventory strategy to improve its inventory level.	63	2.67	0.718
MWE PLC determines its inventory level based on customers requirement.	63	2.98	0.833
The JIT model enables MWE PLC to lower inventory levels.	63	2.32	1.029
The JIT model enables MWE PLC to meet acute customer demand.	63	2.59	1.102
Valid N (listwise)	63		

Source: SPSS output survey, 2021

The question "MWE PLC determines its inventory level based on customer's requirement" has a mean and standard deviation score of 2.98 and 0.833, respectively. Then, the question "MWE PLC keeps enough stock inventories to meet customer demand," a mean and standard deviation scores of 2.94 and 0.801, respectively, follows. Thus, according to the detailed descriptive analysis table above, all seven questions asked under inventory level-related factors have a mean score of greater than 2.32, implying that all are focused on the fact that inventory level-related factors affect the

performance of the spare part supply chain. Furthermore, the mean represents the data's average, while the standard deviation represents the departure from the mean.

B. Mean and standard deviation of responses concerning information sharing related factors

Descriptive Statistics			
Information sharing related statement	**N**	**Mean**	**Std. Deviation**
MWE PLC continuously shares information with its partners.	63	3.25	0.761
Information sharing enhanced the service level of MWE PLC.	63	3.29	0.682
Information sharing enabled MWE PLC to reduce unnecessary inventory requirements.	63	3.03	0.822
MWE PLC shares credible and adequate information on time with its partner for better decision-making.	63	3.08	0.789
MWE PLC shares information up to the level where it is a beneficiary for the company.	63	3.00	0.741
MWE PLC deploys Information technology to ease its communications.	63	2.86	0.800
Valid N (listwise)	63		

Source: SPSS output survey, 2021

As per the detailed descriptive analysis table above, among all the six questions asked under the information sharing related factors, the second question, "Information sharing enhanced the service level of MWE PLC," has scored the highest mean of 3.29 with a standard deviation of 0.682. The first question, "MWE PLC continuously shares information with its partner," is answered with a mean and standard deviation of 3.25 and 0.761, respectively. Finally, the sixth question, "MWE PLC uses information technology to improve communications," received a minimum score of 2.86 and a standard deviation of 0.800. Overall, the mean score is above 2.86,

and this implies that the respondents agreed that information sharing-related factors affect the SPSC performance.

C. The mean and standard deviation of responses concerning forecast accuracy-related factors

Descriptive Statistics			
Demand forecasting related factors	**N**	**Mean**	**Std. Deviation**
MWE PLC has encountered forecasting errors in the last three years in its spare part supply chain.	63	2.78	0.975
MWE PLC usually made a forecast for less than three months' time.	63	2.40	0.943
MWE PLC and its partners collect as much as sufficient data to forecast demand.	63	3.10	0.928
Accurate forecasting has enabled MWE PLC to lower inventory.	63	2.71	1.054
Accurate forecasting has enabled MWE PLC to lower its lost sales.	63	2.98	0.907
The forecaster's capability has negatively affected MWE PLC forecast accuracy.	63	2.17	1.100
MWE PLC and its partners use different forecasting tools to reduce forecasting errors.	63	2.48	0.759
Valid N (listwise)	63		

Source: SPSS output survey, 2021

The third question, "MWE PLC and its partners collect as much as sufficient data to forecast demand," scored highest with a mean of 3.10 and a standard deviation of 0.928, as shown in the table above. Then, with mean and standard deviation ratings of 2.98 and 0.907, came "accurate forecasting has enabled MWE PLC to lower its lost sales.". Moreover, The mean value of all other

questions is higher than 2.17, indicating that forecast accuracy-related variables impact the company's SPSC performance.

D. Mean and standard deviation of responses concerning product pricing-related factors.

Descriptive Statistics			
Demand forecasting related factors	**N**	**Mean**	**Std. Deviation**
MWE PLC has encountered forecasting errors in the last three years in its spare part supply chain.	63	2.78	0.975
MWE PLC usually made a forecast for less than three months' time.	63	2.40	0.943
MWE PLC and its partners collect as much as sufficient data to forecast demand.	63	3.10	0.928
Accurate forecasting has enabled MWE PLC to lower inventory.	63	2.71	1.054
Accurate forecasting has enabled MWE PLC to lower its lost sales.	63	2.98	0.907
The forecaster's capability has negatively affected MWE PLC forecast accuracy.	63	2.17	1.100
MWE PLC and its partners use different forecasting tools to reduce forecasting errors.	63	2.48	0.759
Valid N (listwise)	63		

Source: SPSS output survey, 2021

"MWE PLC follows an everyday low pricing strategy to meet stable demand" once again gets the highest mean score of 2.84 and standard deviation of 1.050. The question "MWE PLC follows a menu pricing system to meet particular customer demand " continues, with a mean of 2.73 and a standard deviation of 0.919. The mean value of all other questions is higher than 2.49, indicating that pricing-related variables impact the company's SPSC performance.

E. Mean and standard deviation of responses concerning performance (Responsiveness).

Descriptive Statistics			
Responsiveness related statement	**N**	**Mean**	**Std. Deviation**
In previous years MWE PLC spare part supply chain was characterized by a complete fill rate.	63	2.41	0.927
In previous years MWE PLC spare part supply chain was characterized by a short Lead time.	63	2.14	1.030
In the previous year's MWE PLC has collected enough data about customer complaints.	63	2.62	1.007
In previous years MWE PLC has minimized shipping errors.	63	2.56	0.912
MWE PLC keeps optimum inventory to meet customer requirements.	63	2.84	0.902
Valid N (listwise)	63		

Source: SPSS output survey, 2021

Referring to the table above, "MWE PLC maintains optimum inventory to meet customer requirements" gets the highest mean score of 2.84 and a standard deviation of 0.902 in terms of responsiveness (performance).

"In previous years, MWE PLC had gathered enough data about customer complaints" follows, with mean and standard deviation ratings of 2.62 and 1.007, respectively. The lowest mean is 2.14, with a standard deviation of 1.030, while "in previous years, MWE PLC spares part supply chain was characterized by a short lead time" The remaining questions are justified in describing MWE PLC's SPSC performance (responsiveness) since they all have a mean score of greater than 2.14.

F. Mean and standard deviation of responses concerning performance (Efficiency).

Descriptive Statistics			
Efficiency reated statement	**N**	**Mean**	**Std. Deviation**
In previous years MWE PLC has properly utilized its resource.	63	3.22	0.750
MWE PLC keeps minimum inventory to lower its inventory holding costs.	63	2.86	0.931
In previous years MWE PLC has lower transportation, distribution, and transaction costs.	63	2.78	0.812
MWE PLC delivers services to its customers in the utmost economical way.	63	3.1905	0.85868
Valid N (listwise)	63		

Source: SPSS output survey, 2021

Regarding performance (efficiency), "In previous years MWE PLC has properly utilized its resources" has the highest mean score of 3.22 and a standard deviation of 0.75. The fourth question, "MWE PLC provides services to its customers in the utmost economical way," has a mean and standard deviation of 3.1905 and 0.859, respectively follows. The question "MWE PLC keeps minimum inventory to lower its inventory holding costs" has the third men score of 2.86 and a standard deviation of 0.931. The third question, "in previous years MWE PLC has lower transportation, distribution, and transaction costs," has a minimum mean score of 2.78 and 0.812. The questions under this category imply that the MWE PLC is efficiency-focused.

4.4. Correlation Relation

The Pearson correlation coefficient is used to determine how closely the variables are related. The Pearson correlation coefficient depicts the connection between the independent and dependent variables and the direction of the association (Field, 2006).

Accordingly, a Pearson correlation coefficient value of 0.1 to 0.29 indicates a weak connection, 0.30 to 0.49 indicates a moderate relationship, and a value over 0.50 indicates a strong relationship, while the positive and negative signs indicate the relationship's direction. The Pearson correlation

of the variables in this research is shown in the table below. The Pearson Correlation Matrix of the study is annexed in Appendix II Table 4.2

The correlation table (annexed in table 4.2) illustrates the relationship between predictor variables, inventory level-related variables, information sharing-related variables, forecast accuracy-related variables, pricing-related variables, and the dependent variable, heavy construction SPSC Performance (responsiveness and efficiency).

Accordingly, the performance of the heavy construction SPSC is highly correlated with inventory levels-related factors and forecast accuracy-related factors, with Pearson's correlation coefficients (r) of 0.541 and 0.565, respectively.

Whereas variables associated with information sharing and price show a modest and positive connection, with Pearson's correlation coefficient (r) values of 0.474 and 0.455, respectively.

It should be emphasized that all associations are at the P 0.01 levels and are two-tailed.

4.5. Regression Analysis

The correlation coefficient evaluates the linear connection between variables, showing how closely the variables move together. On the other hand, regression analysis is needed to investigate how an independent variable is quantitatively linked to the dependent variable. Besides, the effect of a unit change in the independent variable on the dependent variable is shown through regression analysis. As a result, a multiple regression analysis was performed in this research to evaluate the impact of independent variables on the dependent variable.

Some assumptions must be met to use multiple regression models and demonstrate the validity and generalization of the theory (Balance, 2004). Consequently, the researcher double-checked the required assumptions, such as normality, multi-collinearity, linearity, and homoscedasticity, before conducting multiple regression analysis.

4.5.1. Normality Distribution Test

Multiple regressions necessitate that the independent variables be normally distributed.

In order to draw valid conclusions from the regression results, this test requires that there is no significant deviation from normality. Skewness and kurtosis are statistical tools that are used to determine whether data is normally distributed or not. Kurtosis is a distribution property that expresses the thickness of the tails (Smith and Wells, 2006). In Kurtosis distribution, the tail thickness is determined by the number of scores that fall at the extremes of the normal distribution. Skewness is an asymmetry metric. If a distribution or data set appears the same to the left and right of the center point, it is symmetric.

Table 4.3 Normality test (Skewness and Kurtosis)

Descriptive Statistics						
Variables	N	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Inventoryrelatedfactors	63	18.6984	0.273	0.302	-0.031	0.595
Informationsharingrelated	63	18.5079	-0.015	0.302	-0.766	0.595
Forecataccuracyrelated	63	14.6825	0.068	0.302	-0.153	0.595
Pricingrelatedfactors	63	13.4603	-0.346	0.302	0.242	0.595
Valid N (listwise)	63					

Source: SPSS output survey, 2021)

As indicated in the above table of skewness and kurtosis test results, the data are within the allowed range (-1.0 to +1.0), indicating that the data is normally distributed. Furthermore, the table above displays the constant standard error for each variable.

A histogram (with a slightly skewed normal curve) and a Normal Q-Q Plot of each variable may also be used to test the normality assumption. The histogram and Q-Q plot of the dependent variable are annexed in appendix II, charts 1 (A and B, respectively).

4.5.2. Multi-collinearity Test

Multi-collinearity occurs when two or more independent variables in a multiple regression model are highly linked, and therefore one can be accurately predicted from the others (Hair et al., 2010). When independent variables are correlated, we say that "collinearity" or "overlap" occurs (Dillon, 1993), and this may have the paradoxical consequence of fitting the regression model effectively but having no meaningful influence on the dependent variable (Robert, 2006).

Tolerance and VIF are often used to assess for multi-collinearity between two or more independent variables. Moreover, tolerance values less than 0.1 (10%) indicate multi-collinearity, and VIF> 10 and VIF < 1 imply multi-collinearity.

The correlation coefficient table below shows that the tolerance and VIF of the study are observed to be in the normal range.

Table 4.4 Result for Multicollinearity Test

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	0.729	3.663		0.199	0.843		
	Inventory related factors	0.111	0.213	0.081	0.520	0.605	**0.396**	**2.528**
	Information sharing related	0.516	0.212	0.306	2.430	0.018	**0.613**	**1.633**
	Forecast accuracy related	0.414	0.238	0.264	1.739	0.087	**0.420**	**2.379**
	Pricing related factors	0.363	0.223	0.214	1.631	0.108	**0.563**	**1.777**
a. Dependent Variable: Responsivenessandefficency								

Source: SPSS output survey, 2021)

4.5.3. Linearity test

One of the assumptions of multiple linear regression analysis is linearity. Linearity assumption assumed that the dependent and independent variables have a linear relationship. As shown in the figure below, the residuals nearly touch the straight line in the P-P plot, indicating that they are

roughly normally distributed, implying no issue with linearity. The P-P plot is annexed in appendix II charts 1. C.

4.5.4. Homoscedasticity assumption

Based on Tsegaye (2018), if homoscedasticity is assumed, the error variance is identical for all levels of the independent variables. Thus, errors are distributed uniformly among the variables. The regression line is scattered consistently across all values of the predictor variable.

Homoscedasticity may be detected using a histogram of the residuals shown against the regression-predicted value. Residuals should appear on a horizontal line that is evenly distributed. When dispersion is not even, we will see many complex forms like the butterfly and fan.

To check for homoscedasticity, the researcher used a scatter plot of standardized residuals against standardized predicted values in SPSS and discovered that heteroscedasticity was not a significant issue. The scattered plot is annexed in appendix II, charts 1. D.

4.6. Model Summary

After confirming that the data met all of the previously mentioned multiple regression assumptions, multiple regression analysis was conducted to evaluate how well the regression model matches the data (model summary).

Table 4.5 Model summary

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.660[a]	0.436	0.397	4.35510
a. Predictors: (Constant), Pricing related factors, Information sharing related, Forecast accuracy related, Inventoryrelatedfactors				
b. Dependent Variable: Responsivenessandefficency				

Source: SPSS output survey, 2021

The multiple correlation coefficients (R) measure the linear correlation between the observed and model-predicted values of the dependent variable or the correlation between the predicted and actual values of the dependent variable in a linear regression model. Its high value shows the relationship's strength.

In this study, R has a value of 0.66 (66 %t), indicating that there is a strong positive correlation between the independent and dependent variables; as a result, working on those selected factors has a positive effect on the performance of the Road Construction Heavy- Machinery SPSCin the case company under study.

The R-squared (Coefficient of Determination) statistic indicates the percentage of variation in the dependent variable explained by the independent variables. Referring to the model shown earlier, the R square value of 0.436 (43.6 %) indicates a strong relationship between all predictors and the dependent variable exists. Alternatively, we may state that the predictors collectively account for 0.436 (43.6 %) of the dependent variable.

The adjusted R square may be defined as the percentage of total variation or dispersion in the dependent variable that can be explained by variance in the independent variables in the regression (Gujarati, 2004). The adjusted R-squared is a variant of the R-squared statistic that has been adjusted for the model's predictor count. It expresses the proportion of variance explained by independent factors that influence the dependent variable in reality.

The adjusted R Square of this study (0.397, 39.7%) indicates that the variance in the dependent variable was explained by the linear connection between all predictor variables. On the other hand, the study model failed to account for 60.3 percent of the variance in the dependent variable, implying that 60.3 percent of the change in the dependent variable is due to unobserved factors.

Therefore, a high adjusted R square value indicates that the study's predictors substantially impacted the dependent variable.

4.7. ANOVA Model Fit

Analysis of variance (ANOVA) may be used to determine the overall fit of the regression model. The ANOVA table's primary purpose is to determine if the overall regression model fits the data well using the F-ratio. The F statistic's significance value must be less than 0.05 to indicate that the independent variables adequately explained the variance in the dependent variable. The ANOVA table indicates that the independent factors statistically predict the dependent variable (F= 11.219), (P0.001), indicating that the regression model fits the data well.

Table 4.6 ANOVA (Source: SPSS output survey, 2021)

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	851.191	4	212.798	11.219	.000[b]
	Residual	1100.078	58	18.967		
	Total	1951.270	62			

a. Dependent Variable: Responsivenessandefficency

b. Predictors: (Constant), Pricingrelatedfactors, Informationsharingrelated, Forecataccuracyrelated, Inventoryrelatedfactors

4.8. Regression Coefficients

Following ANOVA testing of the model's fitness, the next step is to evaluate the contribution of each independent variable to the prediction of the dependent variable. Standardized beta enables an evaluation of the component based on its impact on the dependent variable. Thus, a factor with a high standardized beta has much clout.

Table 4.7 Regression coefficients of the study (Source: SPSS output survey, 2021)

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.729	3.663		0.199	0.843
	Inventory related factors	0.111	0.213	0.081	0.520	0.605
	Information sharing related	0.516	0.212	0.306	2.430	0.018
	Forecast accuracy related	0.414	0.238	0.264	1.739	0.087
	Pricing related factors	0.363	0.223	0.214	1.631	0.108
a. Dependent Variable: Responsiveness and efficiency						

According to the coefficient table above, information sharing-related variables have the most outstanding contribution to predicting responsiveness and efficiency (the dependent variable), with a value of (0.306 or 30.6 %). Forecast accuracy-related factors come next, with a score of 0.264. (26.4 %). Further, price-related variables with a value of 0.214 (21.4 %) and inventory-related factors with a value of 0081 (8.1 percent) rank third and fourth in terms of their relative significance in predicting responsiveness and efficiency in the study topic.

4.8.1. Standardized Coefficients β

According to the regression coefficient table, among the other predictors (independent variables), information sharing-related components with a significant value of 0.018 are statistically significant in predicting performance (responsiveness and efficiency) since their p-values are less than 0.05.

However, the p-values for Inventory-related factors, Forecast accuracy-related factors, and Product pricing-related factors, which are 0.605, 0.087, and 0.108, respectively, are higher than the alpha level of 0.05, indicating that they are not statistically significant. Thus, Inventory-related factors,

forecast accuracy-related factors, and Product pricing-related factors are not associated with changes in the dependent variable (responsiveness and efficiency).

The researcher discovered a positive relationship between the independent variables; Inventory related factors, forecast accuracy-related factors, pricing-related factors, and the dependent variable during descriptive and correlation analysis. However, multiple linear regression analysis revealed that these three variables play no role in predicting performance (responsiveness and efficiency); this may be due to improper execution of those techniques or because these three variables coexist and complement each other or issues linked to information sharing have exacerbated the impact of the other aspects.

4.8.2. Unstandardized coefficients and Regression Equation

Unstandardized coefficients enable determining how the dependent variable changes with the independent factors while all other independent variables are constant. For instance, we may examine the relationship between performance (responsiveness and efficiency) and inventory level-related variables in this situation.

Most crucially, the unstandardized coefficients of each variable allow for the development of a regression model, as shown below. According to Ho (2006), the multiple regression equation of the study is as indicated below,

$$Y = C + \boldsymbol{\beta}_1 X_1 + \boldsymbol{\beta}_2 X_2 + \ldots\ldots + \boldsymbol{\beta}_n X_n + \boldsymbol{\varepsilon}$$

Where; Y = dependent variable, C = constant, B = Unstandardized regression coefficients of each variable and X = Value of the predicted coefficient and ε is the error.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.729	3.663		0.199	0.843
	Inventory related factors	0.111	0.213	0.081	0.520	0.605
	Information sharing related	0.516	0.212	0.306	2.430	0.018
	Forecast accuracy related	0.414	0.238	0.264	1.739	0.087
	Pricing related factors	0.363	0.223	0.214	1.631	0.108
a. Dependent Variable: Responsiveness and efficiency						

Referring to the above table and the general model of Ho (2006), the researcher has developed the following regression model of the study.

$Y = C + \beta_1 (IL) + \beta 2 (IS) + \beta_3 (FA) + \beta 4 (P) + \varepsilon$

Where in this study case;

Y (performance) = Dependent variable (Responsiveness and efficiency)

C = Constant

IL = Inventory related factors (IL)

IS = Information Sharing related factors

FA=Forecast accuracy related (FA)

P= Product pricing related factors (P)

Y = 0.729 + 0.111 (IL) + 0.516 (IS) + 0.414 (FA) + 0.363 (P)

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

Introduction

This thesis examined the variables that influence the road construction heavy-machinery spare part supply chain performance: A Case Study of MWE PLC.., a heavy machinery spare part dealer in Addis Ababa, Ethiopia. This chapter summarizes the main results and concludes in light of the study's goals. The researcher then makes suggestions for a future researcher and the organization under study's development. Finally, it makes recommendations for further investigation by other scholars.

5.1. Summary of the Findings

- The study established 63 respondents; about 76% have over four years of work experience in the organization. Additionally, the respondent's educational background reveals that most of them (about 96.8 %) are well educated, and they are diploma graduated.
- From descriptive analysis, all statements concerning inventory level-related factors have a mean score higher than 2.32, meaning that the respondents agree with all statements concerning inventory level-related factors. Furthermore, under correlation analysis, the study results show a significantly strong correlation between Inventory level-related factors and road Construction-heavy Machinery Spare Parts supply Chain performance as measured with responsiveness and efficiency in the case company with a correlation coefficient of (r=0.541) with a significance value less than 0.01. However, the output from regression analysis shows that Inventory level related factors are a statistically insignificant predictor of the performance under the study with a beta coefficient of 0.081 (8.1%) at a significance level of 0.605 because of its p-value 0.605 is greater than the alpha level of

0.05, which shows that Inventory level related factors are not adequately addressed in the case company.

- Concerning information sharing-related factors, the descriptive analysis shows that the mean score is higher than 2.86, meaning that the respondents agree with all the statements about information sharing-related factors. Furthermore, the study's result shows a positive and significantly moderate relationship under correlation analysis, with a correlation coefficient of 0.474 with a significance value less than 0.01. Moreover, it is a statistically significant predictor of performance (responsiveness and efficiency with a beta coefficient of 0.306 because its p-value of 0.018 is less than the alpha level of 0.05.
- Based on the descriptive analysis, the mean score of forecast accuracy-related factors is higher than 2.17; this means that the respondents agree with the statements of forecast accuracy-related factors. Besides, based on the correlation analysis, the result from the study shows a positive and significantly strong relationship between forecast accuracy-related factors performance, with a correlation coefficient of 0.565 (r= 0.565) with a significance value less than 0.01. In addition, the regression analysis shows that forecast accuracy-related factors is a statistically insignificant predictor of performance with a beta coefficient of 0.264 at a significance level of 0.087 because of its p-value 0.087 is greater than the alpha level of 0.05, which shows that forecast accuracy-related factors are not addressed correctly in MWE PLC.
- According to the descriptive analysis, the mean score of product pricing-related factors is higher than 2.49, indicating that the respondents agreed with all the statements about how pricing-related factors affect the SPSC performance. Furthermore, considering the correlation analysis, the study results show a positive and significantly moderate

correlation between pricing-related factors performance (responsiveness and efficiency), with a correlation coefficient of 0.455 (r=0.455 2) with a significance value less than 0.01. On the other hand, the regression analysis indicates that pricing-related factors are a statistically insignificant predictor of performance (responsiveness and efficiency) with a beta coefficient of 0.214 at a significance level of 0.108 (<0.05).

- Based on descriptive analysis mean score of performance(responsiveness) is higher than 2.14, the question "MWE PLC keeps optimum Inventory to meet customer requirements" has the highest mean score with a value of 2.84.
- Further, based on descriptive analysis mean score of performance (efficiency), the question "in previous years MWE PLC has properly utilized its resource has the highest." has a higher value of 2.78.
- As indicated in the regression coefficient table, among the other predictors (independent variables), information sharing related factors with significant value of 0.018 is statistically significant in predicting performance (responsiveness and efficiency) because it has a p-value less than 0.05. However, the p-values for Inventory-related factors, Forecast accuracy-related factors, and Product pricing-related factors, which are 0.605, 0.087, and 0.108, respectively, are higher than the alpha level of 0.05, indicating that they are not statistically significant. Thus, Inventory-related factors, forecast accuracy-related factors, and Product pricing-related factors are not associated with changes in the dependent variable (responsiveness and efficiency). Hence, it seems that Inventory-related, forecasting-related, and pricing-related concepts are not well-practiced in MWE PLC, although literature outlined these as necessary.

- Further, the model summary indicates that adjusted R2 = 0.436 (43.6%) shows that the model accounts for 43.6% of the variation in performance (responsiveness and efficiency) is explained by the linear combination of all the independent variables. Again, the ANOVA test result showed that R and R2 found from the model summary was statistically significant at (F= 11.219), P<0.001).

5.2. Conclusions

The following conclusions are made in light of the above findings.

The study concludes from the descriptive statistical analysis of the effect of inventory-related factors, information-sharing-related factors, forecast accuracy-related factors, and pricing-related factors in MWE PLC that:

- All factors (inventory-related factors, information-sharing-related factors, forecast accuracy-related factors, and pricing-related factors) have affected performance.

The correlation study indicates that all the variables have a positive and robust connection with performance:

- Inventory-related and forecast accuracy-related factors have a positive and strong relationship with performance (responsiveness and efficiency), whereas variables relating to information sharing and price have a good and modest relationship with performance (responsiveness and efficiency).

In terms of independent variable predictive power, the research found that:

- Among the other predictors (independent variables), information sharing-related characteristics had a more remarkable predictive ability for MWE PLC performance (responsiveness and efficiency). In contrast, the other variables relating to inventory level, demand forecasting accuracy, and the product price had no impact on predicting MWE

PLC's performance (responsiveness and efficiency); this indicates that these variables are not associated with changes in the dependent variable (responsiveness and efficiency), as far as the other variable information sharing-related factors exist.

5.3. Recommendations

The study's findings showed that the variables; inventory-related factors, information sharing-related factors, forecast accuracy-related factors, and product pricing-related factors impacted MWE PLC SPSC performance. Thus, MWE PLC and other SPSC actors can benefit from enhancing information sharing across SC members by employing the latest IT facilities that enable real-time information sharing.

5.4. Suggestion for future studies

This study was made to analyses factors affecting road construction-heavy machinery SPSC performance: a case of MWE PLC located in Addis Ababa, Ethiopia.

Hence, it would be better if future researchers include respondents from different stakeholders, which may provide a better result representing the sector. Moreover, future researchers would also include other variables that might affect the SPSC performance:

REFERENCES

Abdissa D. (2003). Claims in Ethiopian Construction Industry. Addis Ababa, Ethiopia. Retrieved from http://etd.aau.edu.et/handle/123456789/80/recent-submissions.

Achetoui, Z., Mabrouki, C. and Mousrij, A. (2019) "A review of spare parts supply chain management," *Jurnal Sistem dan Manajemen Industri*, 3(2), p. 67. doi: 10.30656/jsmi.v3i2.1524.

Ajayi, N. and Maharaj, M. (2010) "Effects of Information Sharing within Supply Chains," *Academia*, 35–42(Pretoria: University of Pretoria.), p. 2010. Available at: http://www.academia.edu/467536/Effects_of_Information_Sharing_within_Supply_Chains.

Al-Najjar, B. and Alsyouf, I. (2004) "Enhancing a company's profitability and competitiveness using integrated vibration-based maintenance: A case study," *European Journal of Operational Research*, 157(3), pp. 643–657. doi: 10.1016/S0377-2217(03)00258-3.

Alvarez, D. (1994). Solving the puzzle of industry's rubic cube-effective supply chain management', Logistics Focus, Vol. 2, No. 4, pp.2–4.

Andy Fild. (2006). Discovering statistics using SPSS (2 nd ed.). London: SAGE Publications.

Andy Fild. (2006). Discovering statistics using SPSS (2nded.): London: .SAGE Publications.

Aramyan, L. H. *et al.* (2007) "Performance measurement in agri-food supply chains: A case study," *Supply Chain Management*, 12(4), pp. 304–315. doi: 10.1108/13598540710759826.

Arts, J. J. (2014) *Spare parts planning and control for maintenance operations*, *Civil-Comp Proceedings*. doi: 10.4203/ccp.104.301.

Barkawi and Partners GmbH. (2002) 'Global Study on Spare Parts Logistics', Munich.

Beamon, B. M. (1999) "Measuring supply chain performance," *International Journal of Operations and Production Management*, 19(3), pp. 275–292. doi: 10.1108/01443579910249714.

Bharosa, N., Lee, J. and Janssen, M. (2010) "Challenges and obstacles in sharing and coordinating information during multi-agency disaster response: Propositions from field exercises," *Information Systems Frontiers*, 12(1), pp. 49–65. doi: 10.1007/s10796-009-9174-z.

Bolstorff, P. and Rosenbaum, R. (2012). Supply Chain Excellence - A Handbook for Dramatic Improvement Using the SCOR Model (3rd Edition).

Botter, R. and Fortuin, L. (2000) "Stocking strategy for service parts - A case study," *International Journal of Operations and Production Management*, 20(6), pp. 656–674. doi: 10.1108/01443570010321612.

Cepheus Research & Analytics. (2019, July 10). Ethiopia's 2019-20 Budgets. *Macro Research Ethiopia.*

Chopra, S. & Meindl, P. (2007). *Supply chain management: strategy, planning, and operation* (3rd ed.). United States of America.: Pearson Education.

Chopra, S. & Meindl, P. (2013), Supply chain management: strategy, planning, and operation", 5th ed. United States of America.: Pearson Education.

Corbetta, P. (2003) Social Research: Theory, Methods and Techniques, London, Sage.

D.Lewis, C. (2000). Demand Forecasting and Inventory Control. A computer aided learning approach- Woodhead Pub. in association with the Institute of Operations Management.

Dagne Abebaw W.(2014). Loss Assessment Of Construction Equipment Productivity And Its Impact On Equipment Financial Performance In Federal Road Projects: A Case Study On, Three Federal Asphalt Road Projects In SNNPR, Addis Ababa, Ethiopia. Retrieved from http://etd.aau.edu.et/handle/123456789/80/recent-submissions.

Datalliance (2007), Vendor Managed Inventory: Two-year Cumulative Study, Unpublished White Paper, Cincinnati, Ohio: Datalliance.

Daugherty, P.J., Ellinger, A.E. and Rogers, D.S. (1995), "Information accessibility: customer responsiveness and enhanced performance", International Journal of Physical Distribution & Logistics Management, Vol. 25 No. 1, pp. 4-17.

Dawei Lu. (2011). Fundamentals of SCM. Dawei Lu. & Ventus Publishing. ISBN 978-87-7681-798-5. Available at bookboon.com.

Day D. A., & Benjamin, N. B. H. (1991). Construction equipment guide. *Choice Reviews Online*, *29*(04), 29-2122-29–2122. https://doi.org/10.5860/choice.29-212.

DHL, (2008). DHL Logbook - in cooperation with Technical University Darmstadt. [Online].

Donald J. Bowersox, David J. Closs, M. Bixby Cooper.(2002). Supply Chain Logistics Management. New York, NY: McGraw-Hill/ Irwin.

Donald R. Cooper and Pamela S. Schindler. (2014). *Business research methods. (12th edn)*. New York, NY: McGraw-Hill/Irwin.

Emran Hassen A. (2017). A Study on Development of a Conceptual Risk Management Framework: A Case Study on Addis Ababa City Roads Authority. Addis Ababa, Ethiopia. Retrieved from http://etd.aau.edu.et/handle/123456789/80/recent-submissions.

Eveline, C. *et al.* (2019) "Effects of Inventory Management Techniques on Procurement Performance: An Empirical Study," *International Journal of Innovative Research and Development*, 8(8). doi: 10.24940/ijird/2019/v8/i8/aug19072.

Feldmann, M & Müller, S (2003), 'An incentive scheme for true information providing in supply.

Field, A. (2006). Discovering Statistics Using SPSS (2nd ed.). London: Sage Publication.

Flowers, A. D., and O'Neill II, J.B. (1978).An Application of Classical Inventory Analysis to a Spare Parts Inventory. Interfaces, 8(2), 76-79.

Flynn, B. B., Huo, B. and Zhao, X. (2010) "The impact of supply chain integration on performance: A contingency and configuration approach," *Journal of Operations Management*, 28(1), pp. 58–71. doi: 10.1016/j.jom.2009.06.001.

Gaiardelli, P., Saccani, N. and Songini, L. (2007) "Performance measurement systems in after-sales service: An integrated framework," *International Journal of Business Performance Management*, 9(2), pp. 145–171. doi: 10.1504/IJBPM.2007.011860.

George, J. and Madhusudanan Pillai, V. (2019) "A study of factors affecting supply chain performance," *Journal of Physics: Conference Series*, 1355(1). doi: 10.1088/1742-6596/1355/1/012018.

Golafshani, N. (2015) "Understanding Reliability and Validity in Qualitative Research," *The Qualitative Report*, 8(4), pp. 597–606. doi: 10.46743/2160-3715/2003.1870.

Gopalakrishnan, P. and Banerji, A. K. (2013) "Maintenance and Spare Parts Management," p. 400. Available at: https://books.google.com/books?id=FZ0LudKUcJgC&pgis=1.

Guajardo, M. *et al.* (2012) "Inventory management of spare parts in an energy company," *Journal of the Operational Research Society*, 66(2), pp. 331–341. doi: 10.1057/jors.2014.8.

Gujarati, D. (2004). *Basic Econometrics*. (4th ed.). New York, NY, McGraw-HiII/lrwin.

Heizer, J., Render, B. and Munson, C. (2017). *Operations Management*. 12th ed. United States of America: Pearson Education.

Ho, R. (2006). Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS. USA: Chapman and Hall/CRC.

Hokey Min, (2015). The Essentials of Supply Chain Management. Bowling Green State University: Paul Boger.

Hopp, W. J., Spearman, M. L. and Zhang, R. Q. (1997) "Easily implementable inventory control policies," *Operations Research*, 45(3), pp. 327–340. doi: 10.1287/opre.45.3.327.

Hugoss, M.H., (2011), Essentials of supply chain management, third edition. New Jersey: .John Wiley & Sons, Hoboken.

Inderfurth, K. & Mukherjee, K., (2008). Decision support for spare parts acquisition in post product life cycle.. Central European Journal of Operations Research, 16(1), pp. 17-42.

J. P. Hatala and J. G. Lutta. (2009). Managing informantion sharing within an organizational setting: a social network perspective," Perform. Improv. Q., vol. 21, no. 4. pp. 5–33.

Joel D. Wisner, Keah-Choon Tan, G. Keong Leong. (2012). Principles of Supply Chain Management. 3rd ed. South-Western Natorp Boulevard: Cengage Learning.

John Adams, Hafiz T.A. Khan, Robert Raeside and David White, (2007). Research Methods For Graduate Business And Social Science Students", 1st edition. New Delhi : Response Books from SAGE.

Kennedy, W. J., Wayne Patterson, J. and Fredendall, L. D. (2002) "An overview of recent literature on spare parts inventories," *International Journal of Production Economics*, 76(2), pp. 201–215. doi: 10.1016/S0925-5273(01)00174-8.

Korpela, & Tuominen. (1996). Inventory forecasting with a multiple criteria decision tool. *Int. Journal of production economics* V (45), P 159-168.

Kothari, C. R. (2004). Research methodology: Methods and techniques. (8th ed.) New Delhi; New Age International.

Kotler, P. (2002). Social Marketing Improving the Quality of Life, 2nd edition. Prentice Hall, New Jersey Ltd., UK.

Krosnick and Fabrigar (eds.) (1997). Designing rating scales for effective measurements in surveys.

Lambert, D., Cooper, M. & Pagh, J. (1998). Supply Chain Management: Implementation Issues and Research Opportunities, International Journal of Logistics Management, 9(2), pp. 1-19.

Lee, H. L., Padmanabhan, V. and Whang, S. (2004) "Information distortion in a supply chain: The bullwhip effect," *Management Science*, 50(12 SUPPL.), pp. 1875–1886. doi: 10.1287/mnsc.1040.0266.

Li, S. and Lin, B. (2006) "Accessing information sharing and information quality in supply chain management," *Decision Support Systems*, 42(3), pp. 1641–1656. doi: 10.1016/j.dss.2006.02.011.

Luksch, S. (2014) “After sales supply chain risk management,” (May). Louisville: University of Louisville. Available at: https://ir.library.louisville.edu/etd (accessed 10 may 2021) ttps://doi.org/10.18297/etd/865.

Madhani, P. M. (2017). "Leveraging IT: Building a Customer-Focused Supply Chain Strategy", Materials Management Review, Vol. 14, No. 1, pp. 12-14.

Mankazana, S. and Mukwakungu, S. C. (2018) “The Impact of Just-in-Time (JIT) in Inventory Management System and the Supplier Overall Performance of South African ’ s Bed Mattress Manufacturing Companies,” pp. 239–249.

Mason-Jones, R., & Towill, D.R. (1999). “The International Journal of Logistics Management” Using the Information Decoupling Point to Improve Supply Chain Performance. 10, 13-26.

Mcadam, R. and Mccormack, D. (2001) “Integrating business processes for global alignment and supply chain.

Mehmeti, G., Musabelliu, B. and Xhoxhi, O. (2016) “The Review of Factors that Influence the Supply Chain Performance,” *Academic Journal of Interdisciplinary Studies*, (February 2017). doi: 10.5901/ajis.2016.v5n2p181.

Mendes, K. *et al.* (2012) “Information Sharing - Benefits on,” 12(2), pp. 49–55.

Mentzer, J.T. and Konrad, B.P. (1991). Journal of Business Logistics. *An Efficiency/Effectiveness Approach to Logistics Performance Analysis*, 12, 33-62.

Michael, George C. (1979). Sales Forecasting, Monograph No. 10. Chicago: American Marketing Association.

Moberg, C. R. *et al.* (2002) “Identifying antecedents of information exchange within supply chains,” *International Journal of Physical Distribution and Logistics Management*, 32(9), pp. 755–770. doi: 10.1108/09600030210452431.

Morlidge, S. (2014). Do forecasting methods reduce avoidable error ? Evidence from forecasting competitions. Foresight: The International Journal of Applied Forecasting. Issue 32, 34-39.

Mugenda, O.M. and Mugenda, A.G. (2003). Research Methods: Quantitative and Qualitative Approaches. African Centre for Technology Studies, Nairobi.

Neely, A., Gregory, M. and Platts, K. (1995) "Performance measurement system design: a literaturer review," *International Journal of Operations & Production Management*, 15(4), pp. 80–116.

Oluwaseyi, J. A., Onifade, M. K. and Odeyinka, O. F. (2017) "Evaluation of the Role of Inventory Management in Logistics Chain of an Organisation," *LOGI – Scientific Journal on Transport and Logistics*, 8(2), pp. 1–11. doi: 10.1515/logi-2017-0011.

Patterson, K. A., Grimm, C. M. and Corsi, T. M. (2003) "Adopting new technologies for supply chain management," *Transportation Research Part E: Logistics and Transportation Review*, 39(2), pp. 95–121. doi: 10.1016/S1366-5545(02)00041-8.

Patton, J. D. & Feldmann, H. C., (1997). Service Parts Handbook. New York: The Solomon Press Publishers.

Paulraj, A. and Chen, I. (2007) "Strategic buyer–supplier relationships, information technology and external" *Journal of Supply Chain Management*, pp. 2–15. Available at: http://www3.interscience.wiley.com/journal/118537084/abstract.

Phung, OJ (2011). The Impact Of Just-In-Time Inventory Systems On Small Businesses ‘’,Journalof Accountancy, vol. 46.

Prajeesh, V. P. and Sakthivel, N. (2016) "Management of Equipment & Machinery in Construction," *Ijiset*, 3(5), pp. 113–118. Available at: www.ijiset.com.

S. De Leeuw and L. Beekman, (2008). Supply chain-oriented performance measurement for automotive spare parts," Int. J. Automot. Technol. Manag., vol. 8, no. 1, pp. 56–70, 2008. doi: 0.1504/IJATM.2008.018768.

Salcedo, S. and Grackin, A. (2000). "The e-value chain." *Supply Chain Management Review*, 3 (4): 63-70.

Schnaars, S. P. (1984) "Situational Factors Affecting Forecast Accuracy," *Journal of Marketing Research*, 21(3), pp. 290–297. doi: 10.1177/002224378402100306.

Schnaars, S. P. (1984) "Situational Factors Affecting Forecast Accuracy," *Journal of Marketing Research*, 21(3), p. 290. doi: 10.2307/3151605.

Seidmann, A. and Sundararajan, A. (1998) "Sharing Logistics Information Across Organizations: Technology, Competition and Contracting," *Information Technology and Industrial Competitiveness*, pp. 107–136. doi: 10.1007/978-1-4615-5485-1_7.

Shang, J. S., Li, S. and Tadikamalla, P. (2004) "Operational design of a supply chain system using the Taguchi method, response surface methodology, simulation, and optimization," *International Journal of Production Research*, 42(18), pp. 3823–3849. doi: 10.1080/00207540410001704050.

Shang, J. S., Li, S. and Tadikamalla, P. (2004) "Operational design of a supply chain system using the Taguchi method, response surface methodology, simulation, and optimization," *International Journal of Production Research*, 42(18), pp. 3823–3849. doi: 10.1080/00207540410001704050.

Sheikhi, M. *et al.* (2018) "The role of information sharing on supply chain," *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 2018(JUL), pp. 181–188.

Simchi-Levi, D., Kaminsky, P. & Simchi-Levi, E., (2008). Designing & Managing the Supply Chain. 3rd ed. Boston: McGraw-Hill Irwin.

Singh, S. (2014) "Critical Skills for the Business Forecaster," *Foresight*, Winter(2014), pp. 5–11.

Skinner, W. (1974) "The focused factory," 52(3), pp. 113–121.

Smith, Z. & Wells, C. (2006). Central Limit Theorem and Sample Size. annual meeting of the Northeastern Educational Research Association.

T. Moyaux, B. Chaib-Draa, and S. D'Amours. (2007). Information sharing as a coordination mechanism for reducing the bullwhip effect in a supply chain. IEEE Trans. Syst. Man Cybern. Part C Appl. Rev., vol. 37, no. 3, pp. 396–409.

Trapero, J. R., Fildes, R. and Davydenko, A. (2011) "Nonlinear identification of judgmental forecasts effects at SKU level," *Journal of Forecasting*, 30(5), pp. 490–508. doi: 10.1002/for.1184.

Tsadikovich, D. *et al.* (2016) "Integrated demand-responsive scheduling of maintenance and transportation operations in military supply chains," *International Journal of Production Research*, 54(19), pp. 5798–5810. doi: 10.1080/00207543.2016.1178864.

Wagner, S., Jönle, R. & A.B, E., (2012). A Strategic Framework for Spare Parts Logistics. California Management Review, 54(4), pp. 66-92.

Woldegiorgis, M. M. (2018) "The current scenario of automotive industry in ethiopia," 8(1), pp. 74–80.

Wright, D. and Yuan, X. (2008) "Mitigating the bullwhip effect by ordering policies and forecasting methods," *International Journal of Production Economics*, 113(2), pp. 587–597. doi: 10.1016/j.ijpe.2007.10.022.

Zhao, X. and Xie, J. (2002) "Forecasting errors and the value of information sharing in a supply chain," *International Journal of Production Research*, 40(2), pp. 311–335. doi: 10.1080/00207540110079121.

Zhao, X.D., Xie, J.X. & Wei, J. C. (2002). The impact of forecast errors on early order commitment in a supply chain. Decision Sciences. Vol. 33 Issue 2, 251-280.

Appendices

Appendix I

Addis Ababa University

College of Business & Economics, School of Commerce.

Questionnaire to be filled by MWE P.L.C. staffs.

Dear Participants;

This questionnaire is developed for an academic effort planned for the collection of data to conduct a thesis paper on the title "**Assessing Factors affecting Road Construction – Heavy Machinery SPSC performance; a case of MWE P.L.C."** in order to fulfill the Addis Ababa University's requirement set for awarding of a Master's Degree in Logistics and Supply Chain Management. The information obtained from this questionnaire will be kept confidential and will not be used for any other purposes. Hence, respondents are kindly requested to give their unbiased information.

Please note that;

- No need of writing your name.
- Please give more attention and return the completed as fast as possible.
- If there is a need for further explanation, contact the researcher through the address shown below.

Tesfai Habteab

Mobile: +251911370640

E-mail: teshab2003@gmail.com

Thanks in advance for the cooperation.

A. PART ONE: GENERAL INFORMATION (Demographic profile of respondents)

1. **Profile of respondent**

✓ Gender

Male ☐ Female ☐

✓ Age

Under 25 ☐ 26-3☐ 36-4☐ above 4☐

✓ Marital status

Married ☐ Single ☐

✓ Education status

Grade 10/12 complete ☐ Diploma ☐ First degree ☐

Master's Degree and above ☐

2. **Years of experience at the organization:**

1-3 years ☐ 4-6 years ☐ 7- 9 years ☐ Above 10 years ☐

3. **Department**

Sales and marketing ☐ Store department ☐ Import & Export department ☐

Service department ☐ Parts department ☐ Training Department ☐ Planning ☐

Other (Please specify) _____

4. **Position** _____

B. PART TWO

Assessments of the respondent's response towards the Factors (inventory level, information sharing, demand forecasting accuracy, and pricing) affecting Road Construction Heavy Machinery SPSC performance (Responsiveness and efficiency).

✓ **Please rate the following using the following five points rating scale where;**

- **1 = Strongly Disagree, 2 = Disagree 3 = Neutral 4 = Agree and 5 = Strongly Agree.**

✓ **Please use " √ " mark only in one box.**

✓ **Note the following abbreviation's**

- **MWE P.L.C.= My wish enterprise P.L.C.**
- **EOQ = Economic order quantity**
- **JIT = Just in time**

S.no	Inventory level related statement	1.	2.	3.	4.	5.
1.	MWE P.L.C. keeps enough stock inventories to meet customer demand					
2.	MWE P.L.C. applies Economic order quantity model to optimize its inventory level.					
3.	MWE P.L.C. applies EOQ model to reduce transportation and shipping costs.					
4.	MWE P.L.C. applies Vendor managed inventory strategy to improve its inventory level.					
5.	MWE P.L.C. determines its inventory level based on customers requirement.					
6.	The Just in time (JIT) model enables MWE P.L.C. to lower inventory levels.					
7.	The Just in time (JIT) model enables MWE P.L.C. to meet acute customer demand.					

S.no	Information sharing related statement	1.	2.	3.	4.	5.
1.	MWE P.L.C. continuously shares information with its partners.					
2.	Information sharing enhanced the service level of MWE P.L.C..					
3.	Information sharing enabled MWE P.L.C. to reduce unnecessary inventory requirements.					
4.	MWE P.L.C. shares credible and adequate information on time with its partner for better decision-making.					
5.	MWE P.L.C. shares information up to the level where it is a beneficiary for the company.					
6.	MWE P.L.C. deploys Information technology to ease its communications.					
S.no	**Demand forecasting accuracy related statement**	**1.**	**2.**	**3.**	**4.**	**5.**
1.	MWE P.L.C. has encountered forecasting errors in the last three years in its spare part supply chain.					
2.	MWE P.L.C. usually made a forecast for less than three months' time.					
3.	MWE P.L.C. and its partners collect as much as sufficient data to forecast demand.					
4.	Accurate forecasting has enabled MWE P.L.C. to lower inventory.					
5.	Accurate forecasting has enabled MWE P.L.C. to lower its lost sales.					
6.	The forecaster's capability has negatively affected MWE P.L.C. forecast accuracy.					
7.	MWE P.L.C. and its partners use different forecasting tools to reduce forecasting errors.					
S.no	**Product Pricing related statement**	**1.**	**2.**	**3.**	**4.**	**5.**

1.	The price of the spare parts MWE P.L.C. set has negatively affected customer demand.					
2.	MWE P.L.C. follows an everyday low pricing strategy to meet stable demand.					
3.	MWE P.L.C. varies its product price high and low periodically					
4.	MWE P.L.C. follows a menu pricing system to meet particular customer requirements.					
5.	MWE P.L.C. follows a fixed price strategy irrespective of some attributes that customer needs.					
6.	MWE P.L.C. set competitive prices compared to the competitors.					
S.no	**Responsiveness related statements**	**1.**	**2.**	**3.**	**4.**	**5.**
1.	In previous years MWE P.L.C. spare part supply chain was characterized by a complete fill rate.					
2.	In previous years MWE P.L.C. spare part supply was characterized by a short Lead time.					
3.	In the previous year's MWE P.L.C. has collected enough data about customer complaints.					
4.	In previous years MWE P.L.C. has minimized shipping errors.					
5.	MWE P.L.C. keeps optimum inventory to meet customer requirements.					
S.no	**Efficiency related statements**	**1.**	**2.**	**3.**	**4.**	**5.**
1.	In previous years MWE P.L.C. has properly utilized its resource.					
2.	MWE P.L.C. keeps minimum inventory to lower its inventory holding costs.					

3.	In previous years MWE P.L.C. has lower transportation, distribution, and transaction costs.					
4.	MWE P.L.C. delivers services to its customers in the utmost economical way.					

C. PART THREE

Questionnaire for selected MWE P.L.C. staffs and Focused group discussion

1. Please brief your opinion on how the inventory level-related factors, information sharing-related factors, demand forecasting-related factors, and product pricing-related factors affect the spare part supply performance of MWE P.L.C..

Appendix II

1. Table

A. Table 4.1 Demographic Profile of Respondents.

			Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Valid	male	51	81.00	81.00	81.00
		female	12	19.00	19.00	100.00
		Total	63	100.00	100.00	
Age	Valid	under 25	9	14.30	14.30	14.30
		26-35	40	63.50	63.50	77.80
		36-45	9	14.30	14.30	92.10
		above 45	5	7.90	7.90	100.00
		Total	63	100.00	100.00	
Education background	Valid	grade 10/12	2	3.20	3.20	3.20
		diploma	16	25.40	25.40	28.60
		first degree	40	63.50	63.50	92.10
		Master's Degree and	5	7.90	7.90	100.00
		Total	63	100.00	100.00	
Years of experience at the organization	Valid	1 to 3	15	23.80	23.80	23.80
		4 to 6	22	34.90	34.90	58.70
		7 to 9	16	25.40	25.40	84.10
		Above 10 years	10	15.90	15.90	100.00
		total	63	100.00	100.00	
Department	Valid	Sales and marketing	18	28.6	28.6	28.6
		Store department	1	1.6	1.6	30.2
		Import and export department	4	6.3	6.3	36.5
		Service department (After sale service)	32	50.8	50.8	87.3
		Parts department	3	4.8	4.8	92.1
		Customer relation departmen	2	3.2	3.2	95.2
		Operations department	1	1.6	1.6	96.8
		GM	1	1.6	1.6	98.4
		DGM	1	1.6	1.6	100.0
		Total	63	100.0	100.0	

Source: SPSS output survey, 2021

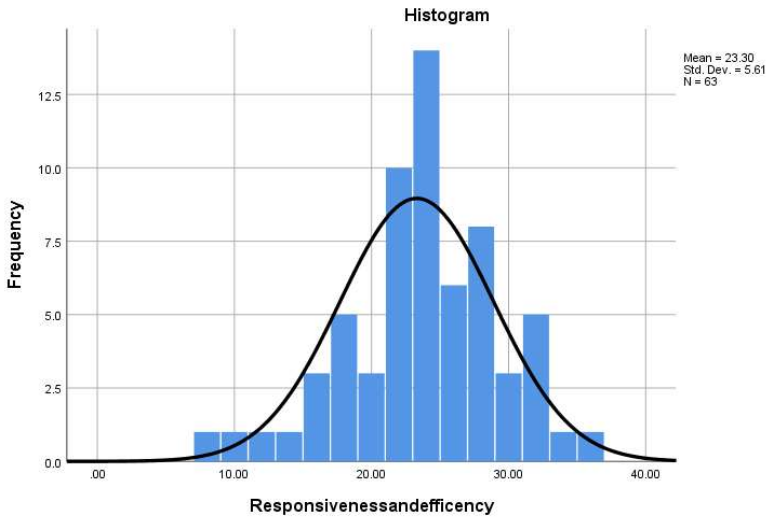
B. Table 4.2 Pearson Correlation Matrix of the study

Correlations[b]						
Variables		Inventory related factors	Information sharing related	Forecast accuracy related	Pricing related factors	Responsiveness and efficiency
Inventory related factors	Pearson Correlation	1	.592**	.670**	.472**	.541**
	Sig. (2-tailed)		0	0	0	0
Information sharing related	Pearson Correlation	.592**	1	.361**	0.114	.474**
	Sig. (2-tailed)	0		0.004	0.372	0
Forecast accuracy related	Pearson Correlation	.670**	.361**	1	.633**	.565**
	Sig. (2-tailed)	0	0.004		0	0
Pricing related factors	Pearson Correlation	.472**	0.114	.633**	1	.455**
	Sig. (2-tailed)	0	0.372	0		0
Responsiveness and efficiency	**Pearson Correlation**	**.541****	**.474****	**.565****	**.455****	**1**
	Sig. (2-tailed)	**0**	**0**	**0**	**0**	
**. Correlation is significant at the 0.01 level (2-tailed).						
b. Listwise N=63						

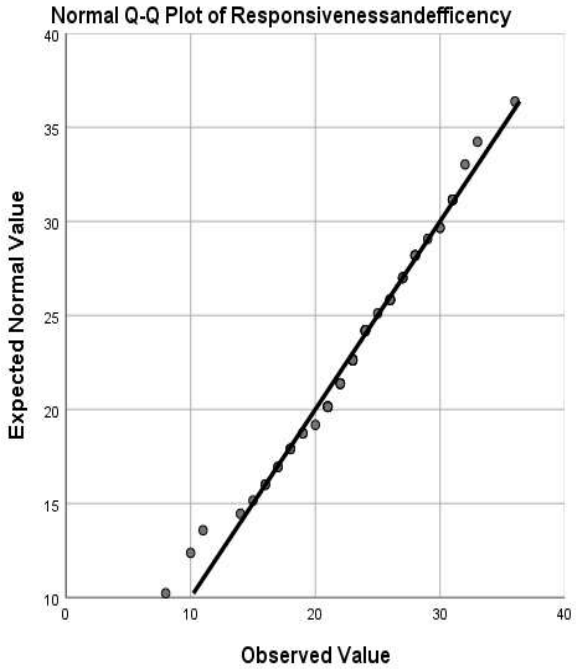
Source: SPSS output survey, 2021

2. Chart 1

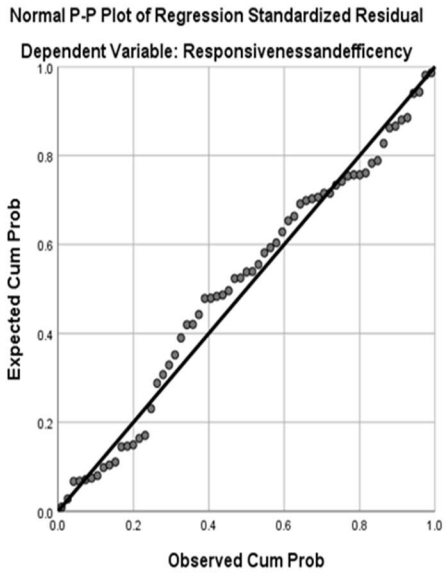
A. Histogram (Source: SPSS output survey, 2021)



B. Q-Q Plot Source (Source: SPSS output survey, 2021)



C. P-P Plot (Source : SPSS output survey, 2021)



D. The scattered plot (Source: SPSS output survey, 2021)