UNIVERSITY OF CAPE COAST

SUPPLY CHAIN COST DRIVERS AND OPERATIONAL PERFORMANCE OF MANUFACTURING FIRMS IN GHANA: MODERATING EFFECT OF LEAN MANUFACTURING

ABDUL-NASIR ABDALLAH BUABENG

2023

UNIVERSITY OF CAPE COAST

SUPPLY CHAIN COST DRIVERS AND OPERATIONAL PERFORMANCE OF MANUFACTURING FIRMS IN GHANA: MODERATING EFFECT OF LEAN MANUFACTURING

BY

ABDUL-NASIR ABDALLAH BUABENG

Thesis submitted to the Department of Marketing and Supply Chain Management of School of Business, College of Humanities and Legal Studies, University of Cape Coast in partial fulfilment of the requirements for the award of Master of Commerce degree in Procurement and Supply Chain Management

NOVEMBER 2023

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature ………………………... Date ………………

Name: Abdul-Nasir Abdallah Buabeng

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature ………………. Date ………………...

Name: Prof. (Mrs) Gloria K. Q. Agyapong

Co-Supervisor's Signature ……………………. Date …………………

Name: Dr Edmond Yeboah Nyamah

ABSTRACT

The Food and Beverage industry faces unique challenges and complexities in managing its supply chain operations due to the perishable nature of the products, regulatory requirements, and consumer demand for high-quality and safe food products. One key concern for Food and Beverage manufacturing firms is managing supply chain costs while maintaining operational performance. The study aimed to examine the effect of supply chain cost drivers' effect on operational performance and lean manufacturing's moderating effect on the relationship between IC and OP, TC and OP and QC and OP. The study employed a quantitative research approach and explanatory research design. The data for the study was collected from 110 Food and Beverage manufacturing firms registered with the Association of Ghana Industries. The PLS-SEM technique was used to analyse the data. The SMART-PLS software version 4.0.9.1 was used to process the data for the study. Inventory, transportation, and quality costs were found to have a significant and positive effect on the operational performance of the Food and Beverage manufacturing firms. The study also found that lean manufacturing significantly moderates the relationship between IC and OP and QC and OP of the Food and Beverage manufacturing firms. However, the study also found that LM does not moderate the relationship between TC and OP among the firms. The study concluded that SCCD affects OP, and LM is a significant moderator in the relationship between SCCD and OP. The study recommends that food and beverage manufacturing firms strengthen their lean manufacturing practices to enhance their cost performance, thereby improving operational performance.

KEYWORDS

Supply Chain Cost Drivers

Lean manufacturing

Operation Performance

Inventory Cost

Transportation Cost

Quality Cost

Moderating Effect

ACKNOWLEDGEMENT

I want to express my sincere and unending gratitude to my supervisors, Prof. (Mrs) Gloria K. Q. Agyapong and Dr Edmond Yeboah Nyamah, for their professional guidance and encouragement, which guided this study.

I also thank Dr (Mrs) Evelyn Yeboah Nyamah for her advice and support. Finally, my sincere gratitude goes to my family, especially my beloved sister, Mrs Valentina A. A. Tsidi, for her immense support throughout this academic journey.

DEDICATION

To my family

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

SCCD	Supply Chain Cost Drivers
LM	Lean Manufacturing
OP	Operational Performance
IC	Inventory Cost
TC	Transportation Cost
QC	Quality Cost
PLS	Partial Least Square

CHAPTER ONE

INTRODUCTION

Supply chain management plays a critical role in the operational performance and competitiveness of food and beverage manufacturing firms. As Food and Beverage manufacturing firms face increasing cost pressures, understanding the drivers of supply chain costs and their impact on operational performance becomes crucial. Adopting lean manufacturing has also gained prominence to enhance efficiency and reduce costs. Therefore, this study examined the effect of supply chain cost drivers (SCCD) on operational performance (OP) and assessed the moderating effect of lean manufacturing (LM) in the relationship between SCCD and OP. This chapter of the study presented a discussion of the background to the study. Subsequently, the statement of the problem and the purpose of the study deduced from the problem are presented. The research objectives, questions and hypotheses are also presented in this section, along with a discussion of the justification of the study. Finally, the delimitations, limitations and the organisation of the study are also presented.

Background to the study

In the modern business environment, supply chain management has emerged as a critical area of focus for manufacturing firms (Paliwal *et al.*, 2020) due to supply chains' increasing complexity and globalisation (Davis *et al.*, 2021). As a result, maintaining an efficient supply chain is costly and challenging (Khanfar *et al.*, 2021). The Food and Beverage industry is one of the world's largest and most complex supply chains, with numerous stakeholders and multiple stages involved in the process (Grimm *et al.*, 2014;

Carbone, 2017; Farooque, 2019; Bhat *et al.*, 2021). The Food and Beverage industry, in particular, faces unique challenges in managing its supply chain due to factors such as the perishability nature of the products, volatile commodity prices, strict regulations, and consumer demand for high-quality and safe food products (Khedkar & Khedkar, 2020; Sharma *et al.*, 2021; Zhao *et al.*, 2022).

One key concern for Food and Beverage manufacturing firms is managing supply chain costs while maintaining operational performance (Saryatmo & Sukhotu, 2021). A critical aspect of achieving this goal is understanding the key drivers of supply chain costs and their impact on operational performance (Basheer *et al.*, 2019). Previous studies have classified supply chain costs as production, logistics, inventory, quality, transportation, investments, and procurement (Pettersson & Segerstedt, 2013; Mushabbar, 2019). These costs emanate in manufacturing firms through the interactions with supply chain partners such as suppliers, distributors, wholesalers, retailers and customers (Baah *et al.*, 2022). At the upstream and downstream of the supply chain, input providers and consumers can contribute to the soaring costs of supply chain operations, respectively (Li *et al.*, 2022).

Also, in the current business regime, competition has moved from firms to supply chains (Min *et al.*, 2019). Hence, manufacturing firms must understand and manage their cost structures as they provide the radiography of all costs and are a key enabler of efficiency in the supply chain (Mpwanya & Heerden, 2016). Research has shown that reducing supply chain costs can improve operational performance. For instance, reducing raw materials costs can help a company increase its profit margins, leading to improved operating performance (Siagian *et al.*, 2021). Similarly, reducing transportation costs through better routes can lead to shorter lead times and improved delivery performance (Michaelides *et al.*, 2019).

Moreover, the ability to efficiently move raw materials, ingredients, and finished products to and from various locations forms an essential part of the day-to-day operations of manufacturing firms (Mthimkhulu, 2017). Inbound and outbound transport activities are costly, especially when manufacturing firms face the challenge of vehicle routine (Lari & Asllani, 2013). Food and Beverage manufacturing firms rely on a well-functioning supply chain to ensure a steady flow of raw materials and ingredients to their facilities and the timely and reliable delivery of finished products to retailers and customers (Goyit *et al.*, 2016; Zhou *et al.*, 2022). Delays or disruptions in transportation due to high fuel prices and a shortage of drivers can result in inventory shortages, production bottlenecks, and increased production costs (Burgos & Ivanov, 2021). Therefore, transportation costs directly impact a firm's ability to deliver products on time, in the desired quantities, and in optimal condition (Tien *et al.*, 2019).

Sitienei and Mabemba (2015) assert that inventory (raw, semi-finished and finished products) accounts for about 70 per cent of manufacturing firms' most valuable current assets. Inventory acquisition is associated with ordering, carrying, and shortage costs (Piasecki, 2001; Filbeck & Krueger, 2005; Koumanakos, 2008; Richards & Grinsted, 2020; Song *et al.*, 2020). Inventory management is a critical aspect of the operational performance of Food and Beverage manufacturing firms. The costs associated with inventory directly affect the efficiency and profitability of firms (Saryatmo & Sukhotu, 2021).

Effective inventory cost management is crucial in maintaining optimal stock levels, reducing carrying costs, minimising wastage, and ensuring timely production and delivery (Guluma, 2019).

Furthermore, quality has been promoted as a central customer value and is considered a critical success factor for Food and Beverage manufacturing firms to achieve competitiveness (Aquilani, Silvestri, Ruggieri, & Gatti, 2017). However, any quest to enhance quality must also consider the cost associated with attaining quality (Schiffaurova & Thomson, 2005) since the aim is not only to meet customer requirements but also to do it at a lower cost (Glogovac & Filipovic, 2018). Quality costs, which encompass prevention, appraisal, internal failure, and external failure costs, significantly impact various aspects of operational performance and the long-term success of Food and Beverage manufacturing firms (Ammar *et al.*, 2021). By managing quality costs and maintaining high quality, Food and Beverage manufacturing firms can enhance customer safety and satisfaction, improve production efficiency and foster supply chain collaboration (Zhou et al., 2022).

The Theory of Constraints (TOC) is a widely used management philosophy that seeks to identify and overcome the bottlenecks and constraints that limit the performance of complex systems, such as supply chains (Goldratt, 1990). One of the critical insights of TOC is that the performance of a system is only as good as its weakest link or constraint (Goldratt, 1990). Identifying and managing the most significant cost drivers in supply chains is essential for achieving optimal operational performance (Gutpa *et al.*, 2021). As argued in the preceding, constraints, notably supply chain costs, significantly impact the supply chain operations of Food and Beverage manufacturing firms (Tukamuhabwa, 2023). Hence, by examining the relationship between supply chain cost drivers and operational performance through the lens of TOC, firms can develop a more nuanced understanding of how to identify and manage these constraints (Onufrey & Bergek, 2021).

Also, the cost reduction strategy, which is a lean manufacturing approach, has gained increasing attention to improve supply chain efficiency and reduce costs while maintaining high levels of operational performance (Taghipour *et al.*, 2020). In particular, the Food and Beverage manufacturing industry has shown interest in implementing lean manufacturing practices to address its unique challenges, such as short product lifecycles, increasing customer demands for customisation, and strict regulatory requirements (Anonymous, 2022). However, the effectiveness of a lean manufacturing implementation in the context of Ghanaian Food and Beverage manufacturing firms' supply chain cost drivers and operational performance remains largely unexplored.

Additionally, Dynamic Capabilities Theory (DCT), a popular framework in strategic management that focuses on how firms can develop and sustain competitive advantages through continuous adaptation and innovation, could be a catalyst for cost reduction (Teece, 1997: 2017). Lean emphasises developing a value stream aimed at reducing cost and enhancing efficiency through the elimination of wastes in both inter- and intra-organizational processes (Barinua & Tidjoro, 2022). Therefore, by adopting a lean manufacturing approach, a cost-reduction strategy that requires continuous processes, firms can improve their responsiveness to changing market conditions, reduce costs, streamline their operations, and enhance their dynamic capabilities (Manzoor *et al.*, 2022).

To this end, this research investigates the supply chain cost drivers affecting the operational performance of Ghana's Food and Beverage manufacturing firms. This study also examines the moderating effect of lean manufacturing on the relationship between supply chain cost drivers and operational performance in the Food and Beverage manufacturing industry. Specifically, the study explores how adopting lean manufacturing practices, precisely cost reduction strategy, influences cost drivers' impact on firms' operational performance.

Statement of the Problem

By the nature of their operations, manufacturing firms are engulfed in costs-driving activities more than service-providing firms (Herrigel & Zeitlin, 2010). Hence, manufacturing firms must optimise their supply chain operations to achieve sustainable competitive advantage in today's dynamic and complex marketplace (Madhani, 2019). However, manufacturing firms such as Food and Beverage face challenges as they seek to balance cost efficiency and operational performance due to the complexity of their supply chain (Carbone, 2017). The Ghanaian Food and Beverage industry has experienced significant growth in recent years, with a compound annual growth rate of 6.7% from 2016 to 2020 (Statista, 2021). Ghana's Food and Beverage manufacturing industry is a vital sector of the economy and contributes significantly to employment and GDP growth. According to the Ghana Statistical Service (2020), the Food and Beverage manufacturing sector accounted for 5.5% of the country's GDP in 2019 and employed over 125,000 people.

Notwithstanding, Ghana's Food and Beverage industry faces numerous challenges related to supply chain cost drivers, inefficient operational processes, and difficulties in implementing lean strategies, which have tangible implications for its sustainability and competitiveness. According to recent industry reports, Ghanaian Food and Beverage manufacturers encounter cost drivers such as high transportation costs, fluctuating raw material prices, and inefficient inventory management systems, leading to increased operational expenses. These challenges have led to increased costs, decreased operational efficiency, and reduced competitiveness in the global market (Omari *et al.,* 2020). A World Bank (2019) survey found that Ghanaian manufacturing firms face challenges in managing supply chain costs, with logistics costs accounting for 19.2% of the total cost of goods sold.

Furthermore, studies indicate that lean strategies can potentially optimise operational processes and reduce costs in manufacturing firms (e.g., Rahman *et al.,* 2010; Nimeh *et al.,* 2018; Garcia-Buendia *et al.,* 2021). However, there is a dearth of empirical evidence on implementing lean strategies, specifically in the Ghanaian Food and Beverage industry. Studies assert that implementing lean strategy in the manufacturing industry remains relatively low (e.g., Bakri, 2019; Tomašević *et al.*, 2021; Dieste *et al.*, 2021). This underutilisation of lean strategies limits the potential for waste reduction, process efficiency, and cost savings, ultimately affecting operational performance (Mouzani & Bouami, 2019). Despite the importance of supply chain cost drivers, lean strategy adoption, and operational performance to firms' success, limited research explores the relationship between these factors in the context of Ghanaian Food and Beverage manufacturing firms.

Also, previous empirical studies have looked at supply chain cost drivers homogenously and focused on composite manufacturing firms, making the findings of such studies lack generalisation (e.g., Vlachos, 2013; Jepherson *et al.*, 2021). It also appears that studies from developed nations have significantly influenced the literature on the topic, necessitating investigation in a developing country like Ghana. On this backdrop, this study sought to address the knowledge shortfalls in supply chain cost literature using quantitative explanatory research design to assess how the specific dimensions of supply chain cost drivers (i.e., transportation cost, inventory cost and quality cost) affect the operational performance of the Food and Beverage manufacturing firms in Ghana. The study also examines the moderating effect of lean manufacturing on the relationship between SCCD and OP in the Food and Beverage industry.

Purpose of the Study

This study examined the effects of supply chain cost drivers on the operational performance of Food and Beverage manufacturing firms in Ghana. The study also sought to assess the moderating effect of lean manufacturing on the relationship between supply chain cost drivers and operational performance.

Research Objectives

The following objectives were formulated for the study:

1. To assess the effect of inventory costs on operational performance of Food and Beverage manufacturing firms in Ghana

2. To examine the effect of transportation costs on operational performance of Food and Beverage manufacturing firms in Ghana
3. To analyse the effect of quality costs on operational performance of Food and Beverage manufacturing firms in Ghana
4. To examine the moderating effect of lean manufacturing in the relationship between inventory costs and operational performance of Food and Beverage manufacturing firms in Ghana.
5. To examine the moderating effect of lean manufacturing in the relationship between transportation costs and operational performance of Food and Beverage manufacturing firms in Ghana.
6. To examine the moderating effect of lean manufacturing in the relationship between quality costs and operational performance of Food and Beverage manufacturing firms in Ghana.

Research Hypotheses

The hypotheses of the study were:

H_1: Inventory costs significantly influence operational performance of Food and Beverage manufacturing firms in Ghana

H_2: Transportation costs significantly influence operational performance of Food and Beverage manufacturing firms in Ghana

H_3: Quality costs significantly influence operational performance of Food and Beverage manufacturing firms in Ghana

H_4: Lean manufacturing significantly moderates the relationship between inventory costs and operational performance of Food and Beverage manufacturing firms in Ghana.

H_5: Lean manufacturing significantly moderates the relationship between transportation costs and operational performance of Food and Beverage manufacturing firms in Ghana.

H_6: Lean manufacturing significantly moderates the relationship between quality costs and operational performance of Food and Beverage manufacturing firms in Ghana.

Significance of the Study

The findings of this study will have significant implications for practitioners and policymakers in the Food and Beverage industry, considering the lack of literature on assessing composite cost components of manufacturing firms' supply chains. To the best of the researchers' knowledge, supply chain cost drivers of different kinds have been a subject of study in the literature. However, no attempts have been made to investigate how the cost drivers affect the Food and Beverage manufacturing firm's operational performance. Accordingly, as a first attempt, this study bridges the gap by examining three cost drivers (i.e., transportation, inventory, and quality costs) and their effect on operational performance. In addition, the moderating effect of lean manufacturing is also determined to inform managers of the need to study their business operations and institute an appropriate approach to reduce cost and enhance performance.

Another contribution of this study stems from the novelty of such investigations in Sub-Saharan Africa, hence using the Ghanaian Food and Beverage manufacturing industry as the first study point. In that regard, this study will augment the evolving literature on supply chain cost drivers of manufacturing firms. The findings reached by the study will inform the strategic policy decision-making of the Food and Beverage manufacturing firms. Since cost-related activities are derived from strategic management decisions, the study's findings will enlighten top managers of manufacturing firms on the strategies to minimise cost whilst improving firm performance. The study's findings will also serve as a foundation for future researchers to delve into other manufacturing sectors to obtain relevant information.

Delimitations

For this study, the unit of analysis was the Food and Beverage manufacturing firms in Accra and Tema Metropolises in the Greater Accra Region of Ghana. The exogenous variables under study were transportation, inventory, and quality costs because they are most important costs affecting the sector. The endogenous variable was operational performance with measures: delivery reliability, flexibility and responsiveness, product quality and resource utilisation. Also, lean manufacturing was the moderating variable used in this study due to its philosophy to streamline manufacturing operations thereby reducing cost. Another delimitation of the study was the unit of observation that informed the population. Information for the study was obtained from supply chain managers, procurement managers and operations managers of the selected Food and Beverage manufacturing firms. Geographically, the study is delimited to Accra and Tema Metropolises in Ghana.

Limitations

The study employed the quantitative research approach; hence, a limitation is that there may be an improper representation of the target population, which may affect the study findings. The quantitative approach was employed due to the availability of reliable measuring instrument. Also, the study used structured close-ended questionnaires, which will limit the results since the outcome may not represent the actual occurrence. Further, the opinions of the respondents may also affect the findings.

Definition of Terms

A supply chain cost driver is any activity that creates cost without necessarily adding value to the customer.

Inventory cost represents the expenses incurred by a company in maintaining and storing goods held for production or sale.

Transportation costs are incurred by a firm to move goods and materials from one location to another within its supply chain.

Quality cost is the sum of the costs incurred across a supply chain in preventing poor quality of product or service to the final consumer, the costs incurred to ensure and evaluate that the quality requirement is being met, and any other costs incurred as a result of poor quality

Lean manufacturing is a management approach that aims to minimise waste and improve efficiency in a supply chain.

Operational Performance refers to how well the supply chain functions in meeting customer demands, delivering products on time, and achieving other performance metrics.

Organisation of the Study

This study is organised into five chapters. Chapter two provides a valuable discussion of the theories underpinning the study, an argument on the concepts used in the study, empirical evidence in the literature and the conceptual framework for the study. In chapter three, a detailed methodological approach to the study is presented. The results from the field are presented, and a detailed discussion is carried out in chapter four. Finally, chapter five concludes the manuscript by providing a summary, conclusions, recommendations and suggestions for future research.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This study sought to assess the effect of supply chain cost drivers (SCCD) on manufacturing firms' operational performance (OP) in Ghana. Also, the moderating effect of lean manufacturing in the relationship between SCCD and OP was assessed. This chapter presented the relevant related literature. The literature review was conducted in line with the study's objectives. Chronologically, this chapter provides information on the theories underpinning the study, conceptual review, empirical review and the study's conceptual framework.

Theoretical Review

Given cognisance of the research objectives, this study was underpinned by two main theories: the theory of constraints and the dynamic capabilities theory. This section discussed the underpinning theories in relation to how they support the study's objectives.

Theory of Constraints (TOC)

In 1984, Eliyahu Goldratt developed the theory of constraints in his novel titled 'The Goal' (Goldratt, 1990). The foundation of TOC is that a constraint limits a system's performance. Therefore, enhancing the constraints' performance will directly affect the system's overall performance. Based on this idea, efforts to boost performance focus on locating and managing the system's constraints (Mulyono, 2020). Controlling performance within the TOC is consistent with the difficulties experienced by decision-makers when handling supply chains.

TOC has been widely implemented in the manufacturing sector and has proven to be an excellent strategic management tool (Kumar *et al.*, 2018). The foundation of TOC is the notion that every system has at least one bottleneck, which is any circumstance that prevents the system from performing at a high level in terms of its objectives (Goldratt, 1990). Numerous researchers fully comprehend this management philosophy in the literature. There are several different implementation scales for the theory of constraints. TOC can be used in project management, accounting, research and development, sales, marketing, logistics, supply chain management, and distribution (Simşit *et al.*, 2014).

The core argument of the literature is that every system has at least one weak point called constraint (de Jesus Pacheco *et al.*, 2021). Hence, the first stage in enhancing the performance of TOC-based systems is to analyse the system as a whole. As such, one stage in TOC is constraint identification. It involves identifying each system component's profile, relationships, and impact on the entire system's performance (Mulyono, 2020). Secondly, the constraint handling methodology in the TOC suggests the best long- and short-term solutions. Thirdly, TOC can create a link between operational and strategic solutions. Therefore, TOC provides a stage for formulating strategic, tactical and operational performance measures (Mulyono, 2020).

Profit growth is every company's primary goal. This view contends that constraints are what prevent businesses from attaining their goals. In other words, everything that stands in the way of achieving greater profitability is considered a constraint. Costs related to investment, transportation, procurement, production, inventory and quality cannot be ignored in manufacturing firms' supply chains (Ghayas & Hussain, 2015) since these costs are born from significant operational activities of the firm. However, such costs can hinder the firm's success if not strategically managed. Therefore, if organisations can manage the constraints (costs) in their supply chains, they will have a continuous improvement management system and can improve operational performance, consequently enhancing their profit potential (Singh & Misra, 2018).

Dynamic Capabilities Theory (DCT)

Dynamic capability theory was propounded by Teece (1997). He argued that capabilities impact how company models are designed and run. Hence, business models are generated, refined, implemented, and transformed due to dynamic capabilities. Routines and management skills within an organisation serve as the foundation for dynamic capabilities, which allow the company to integrate, build, and reconfigure internal competencies to address or bring about changes in the business environment (Teece *et al.*, 1997; Teece, 2007; Teece, 2017). A firm's capacity to swiftly integrate and reconfigure to meet the needs of a changing environment is known as dynamic capabilities (Teece *et al.*, 1997; Eisenhardt & Martin, 2000).

Teece and Pisano (1994) extended the resource-based view theory with the concept of dynamic capabilities. They argued that if a company wishes to gain a competitive advantage, it must reorganise its resources into dynamic capabilities (Wu, 2010). Hence, competitive advantage is based on an ongoing series of resource advantages. It has been thoroughly investigated to see if dynamic capacities affect how different organisations perform (Zott, 2003). In an effort to explain how firms' ability to adopt lean manufacturing improves their capability to perform more cost-effectively and efficiently than their competitors, this study will use the dynamic capability theory.

Conceptual Review

This section of the literature review discussed the concepts used in the study and how they were operationalised based on existing literature. The concept of supply chain cost drivers, lean manufacturing and operational performance was discussed.

Supply Chain Cost Drivers (SCCD)

This section discussed the concept of supply chain cost drivers per the existing literature. Supply chain costs (SCC) have been defined in many ways by different authors in the literature. Earlier researchers have defined SCC in relation to specific activities within the supply chain. For instance, Bowersox and Closs (1996) described SCC as "cost components related to order handling, purchasing, stock handling and manufacturing cost". Chen (1997) also asserts that SCC comprises production cost, transportation cost, warehousing cost, inventory carrying cost and internal material handling cost. Sachan *et al.* (2005) and Bryne and Harvey (2006) have done similar definitions. The former defined SCC to comprise inventory holding cost, transportation cost, order processing cost and packing cost. However, the latter had other cost components, such as inventory, production setup, and backorder costs.

Analysis of SCC has been performed in different ways by previous authors. The literature presents various kinds of cost groupings of SCC. However, the operationalisation of the cost components is likened since other terms have been used for the same thing. For example, in the definition by

Chen (1997), the production cost is termed as manufacturing cost in the definition by Bowersox and Closs (1996). Other studies, such as Su *et al.* (2005) and Pettersson and Segerstedt (2013), defined SCC broadly without limiting the different cost types into groups. The literature shows that the cost groupings have focused on the activities or operations within a specific firm or sector supply chain. Therefore, Koivula (2015) assert that supply chain cost drivers (SCCD) are the activities that create cost in a firm's supply chain.

Some common cost drivers in supply chain management include raw material, transportation, labour, and inventory costs (Pettersson & Segerstedt, 2013). Economies of scale, supplier power, and technological advancements can also impact supply chain costs (Thomas & Gilbert, 2014). Other factors that can affect the cost of a supply chain include the level of outsourcing, the use of lean manufacturing techniques, and the level of collaboration within the supply chain (Moyano-Fuentes *et al.*, 2021). It's important to note that different industries and supply chain models may have additional cost drivers. Other studies have looked at other vital cost components in the supply chain, such as the cost of quality (Murumkar, 2018; Sturm *et al.*, 2019), procurement cost (Waithira, 2021) and investment cost (Sari, 2010; Vlachos, 2013). This study adopts the definition of SCCD by Koivula (2015) and operationalises the cost components as transportation, inventory, and quality costs.

Inventory costs

Inventory costs represent the expenses incurred by a company in maintaining and storing goods held for production or sale (Mourtzis *et al.*, 2019). Inventory cost comprises holding or carrying costs, ordering costs and shortage or stockout costs (Singh, 2022). Holding or carrying costs are associated with storing and maintaining inventory, including warehouse rent, utilities, insurance, and labour. Ordering costs are the costs associated with placing and receiving orders for inventory, including freight, handling and paperwork. Shortage or stockout costs are when a firm does not have enough stock to meet customer demand, such as lost sales and expediting fees. A company needs to manage these costs effectively to minimise the total cost of inventory while keeping the inventory level optimal to meet customer demand and avoid stockouts or excess inventory (Mourtzis *et al.*, 2019; Singh, 2022).

Transportation Costs

Transportation costs in the supply chain are the expenses incurred by a firm to move goods and materials from one location to another within its supply chain (Sarkar *et al.*, 2019). Transportation costs can include shipping goods by truck, rail, air, or sea and storing and handling goods in warehouses and distribution centres (Yusifli, 2022). Transportation costs can also include costs associated with packaging and labelling goods and costs related to customs and import/export regulations. Factors such as the distance goods need to be transported, the mode of transportation used, and the size and weight of the goods being transported can affect transportation costs in a supply chain (Hoa *et al.*, 2020).

Izadi *et al.* (2020) classified transportation costs into operational costs, the value of time, and externalities. Chaoyang and Ying (2016) also assert that transportation costs are variable, fixed, joint, and public. Companies often try to minimise transportation costs by optimising their logistics, for example, utilising more efficient transport modes, consolidating shipment, leveraging economies of scale, negotiating better shipping rates with carriers and implementing transportation management systems to plan better and track shipments (Manson *et al.*, 2003). These efforts can help companies to reduce transportation costs and improve overall supply chain efficiency (Manson *et al.*, 2007).

Quality Costs

Juran (1951) initiated the cost of quality, and many definitions have been proposed since its inception. Schiffauerova and Thompson (2006) assert that the cost of quality (CoQ) represents the sum of conformance and non-conformance costs. Conformance costs are paid to prevent poor quality (e.g., inspection and quality appraisal). Non-conformance cost, on the other hand, is the cost of poor quality caused by product and service failure (e.g., rework and returns). Therefore, the cost of quality (COQ) is the total cost incurred for the quality control process and the cost of product defects (Murumkar & Teli, 2018).

Four models have been developed since the inception of quality cost in the 1950s: the PAF (Prevention, Appraisal and Failure) Model, Process Cost Model, Cost-Benefit Model and Taguchi Loss Function Model. Feigenbaum's (1956) PAF model has been widely used in literature, and it appears to be one of the better-known models by quality practitioners (Chopra & Garg, 2011; Murumkar *et al.*, 2018; Sturm *et al.*, 2019). Its application has been seen in both manufacturing and service industries. In the PAF model, costs can be classified into discretionary and consequential. Prevention and appraisal costs are regarded as discretionary, and failure costs as consequential costs (Blank & Solorzano, 1978).

Prevention cost is all of the cost expended to prevent defects from occurring. Examples are the cost of quality planning, design reviews and verification, quality education and training, supplier certification, and quality audits. Appraisal cost is the cost incurred to assure conformance to quality standards. Examples include incoming and source inspection/testing, in-process and final inspection/testing. Consequential cost, on the other hand, consists of internal and external failure. Internal failure costs are the costs incurred before the delivery of products to the customer. Examples are the cost of scraps due to design changes, rework, repair, retest, and re-inspection. External failure costs are the costs occurring after the delivery of products to the customers. They include the cost of warranty claims, returned material costs and customer compensations, and product liability claims (Gryna, 1999; Suthummanon & Einsruch, 2003; Chopra & Garg, 2011; Murumkar *et al.*, 2018).

Lean manufacturing (LM)

Lean manufacturing can benefit organisations of all sizes and industries as it helps improve efficiency, reduce costs, and increase customer satisfaction (Manzoor *et al.*, 2022). Lean in manufacturing has become a widespread phenomenon among manufacturing firms (Dixit *et al.*, 2022). The concept is traced to the Japanese company Toyota and has become a mantra in the manufacturing space in the last decade. According to Vitasek *et al.* (2005), a lean supply chain is made up of several organisations that are directly connected by upstream and downstream flows of goods, services, information, and funds and work together to efficiently pull what is required to satisfy each customer's needs while minimising cost and waste. Lean manufacturing's primary objective is to create a value stream to reduce cost and eliminate waste to enhance inter- and intra-organisational efficiency (Agyabeng-Mensah., 2021).

The "trading attitude," in which profit expectations are short-term and heavily reliant on market prices, as well as the capacity to bargain vigorously and pressure suppliers, is abandoned by LM. On the other hand, LM implementation is built on a long-term commitment to supply chain partners, with cooperative and deliberate cost reduction and waste elimination along the chain (Yusuf *et al.,* 2004; Agarwal *et al.,* 2006). In this sense, the entire flow from raw materials to the final customer is viewed in LM as an integrated whole. The interfaces between companies are seen as the result of economic arrangements of assets governed by several contextual factors, such as labour skills, the location of raw materials, and technological configurations (Wu, 2002; Goldsby *et al.,* 2006; Boonsthonsatit & Jungthawan, 2015).

Cost reduction is essential in lean strategy that helps organisations enhance efficiency by streamlining their manufacturing operations (Reyes *et al.*, 2021). Cost reduction is achieved through value stream mapping, continuous process improvement, just-in-time, and supplier collaboration and integration (Mofolasayo *et al.*, 2022). The value stream mapping process identifies waste and inefficiencies (Stadnicka & Litwin, 2019). Continuous process improvement entails regular monitoring and analysis of manufacturing operations to identify areas for improvement (Ivanov, 2021). JIT is a lean manufacturing approach where products and services needed are produced rather than produced in bulk and storing them (Cekerevac, 2022). JIT inventory reduces the cost of holding inventory and the risk of excess inventory and obsolescence (Das *et al.*, 2023).

Operational Performance (OP)

An organisation's operational performance shows how it can efficiently convert large amounts of raw materials into innovative and quality finished goods on time with minimum costs (Sharma & Modgil, 2019; Prajogo *et al.*, 2012; Green *et al.*, 2011; Zhu *et al.*, 2008). Thus, operational performance is the ability of a firm to meet its operational targets. Firm operational performance can be distinguished across four dimensions: quality, cost, delivery and flexibility (Nabass & Abdallah, 2018; Chavez *et al.*, 2013). The operational performance measures adopted for this study are delivery reliability, flexibility and responsiveness, product quality and resource utilisation (Sharma & Modgil, 2019; Sarode *et al.*, 2008). Conceptually, Rosell *et al.* (2017) suggest that SCC is regarded as a catalyst for operational performance improvements.

Empirical Review

Inventory Costs and Operational Performance

Inventory or stock is an essential current asset of manufacturing firms. Inventory represents the stock of items or resources an organisation uses for operations. Inventories can appear in several forms, such as raw materials, work-in-progress or finished goods and are essential to ensure the smoothness of customers' order fulfilment (Susanto, 2018). Manufacturing firms keep inventories for reasons such as seasonality and unexpected changes in demand, uncertainty in supply and delivery, or the trade-off to achieve cost savings through economies of scale in transportation and procurement

(Koivula, 2015; Hugos, 2018). Inventory management is a critical component in supply chain management. Hence, inventory management's goal in every supply chain is to minimise inventories since it comes with a cost (Samak-Kulkarni & Rajhnas, 2012).

Inventory cost can significantly affect operational performance, representing a substantial portion of a company's expenses (Hanaysha & Alzoubi, 2022). High inventory costs can negatively impact operational performance by reducing profits, limiting cash flow, and increasing the risk of stockouts or excess inventory (Truong, 2023). On the other hand, managing inventory well can help to improve operational performance by reducing the cost of goods sold, improving customer service, and increasing efficiency (Attaran, 2020). For instance, in their studies in Thailand, Jiraruttrakul *et al.* (2017) investigated how the application of EOQ affects inventory cost. The study revealed that inventory carrying costs could be reduced by 47% annually by implementing economic order quantity (EOQ).

Mbugi and Lutego (2022) used the Food and Beverage manufacturing company as a case to study the effect of inventory control management systems on the organisational performance of manufacturing firms in Tanzania. The study employed a qualitative approach and used interviews to collect data. The study's findings revealed that the Food and Beverage manufacturing company had evidence of different inventories, including raw materials, work-in-progress and finished goods managed under the FIFO system for cost reduction and production efficiency. The study also found that inventory control management system such as economic order quantity (EOQ) affects organisational performance regarding cost reduction, production efficiency, flexibility and profitability.

Also, Chiri (2014) assessed the role of inventory management on the performance of manufacturing firms in Kenya. The study had four specific objectives. The study's first objective was to determine how inventory management cost reduction affects the performance of manufacturing firms in Kenya. The study employed a descriptive research design and gathered data from 83 respondents. The study used both descriptive and inferential statistical analysis. The study concluded that holding stocks and ordering costs increase the performance of an organisation. Also, the study found that cost reduction helps prepare employees towards managing the inventory ideology and that cost reduction also equips the organisation with sufficient resources. The findings showed that inventory cost reduction helps the manufacturing firm achieve profitability objectives.

In Ghana, Opoku *et al.* (2020) examined the effect of different inventory management practices on the operational performance of manufacturing firms. The study used ordinary least square regression analysis; the study found that all the various inventory management strategies: ABC, SSP, VMI, JIT, EOQ and MRP, all had a positive and significant association with operational performance. From the reviews, it can be deduced that most studies have focused on composite manufacturing firms in assessing inventory and firm performance. Literature on Food and Beverage manufacturing firms' inventory costs and operational performance is scanty, and a few studies concentrate on Ghana. Hence, using the partial least square structural equation modelling approach, this study hypothesised that inventory cost significantly improves manufacturing firms' operational performance.

Transportation Cost and Operational Performance

Transportation is deemed a significant SCCD in manufacturing companies (Solakivi, 2012) since it forms a more substantial cost component of supply chain logistics costs (Rodrigue *et al.*, 2017). Transportation forms an integral part of the supply chain operations as it is responsible for the shipment of raw materials into the organisation and finished products to customers (Taak & Kumar, 2019). Transportation connects the operational activities between actors in the supply chain. As a result, an efficient mode of transport is necessary to satisfy consumers' needs, increase supply chain efficiency, and, eventually, competitive advantage (Ke et al., 2015). Izadi (2020) asserts that freight transportation cost has become one of the most important supply chain efficiency economic indicators. According to Lapena (2022), inefficient supply chain network planning, routing and deployment of resources can cause an increase in transportation costs.

Mubarik et al. (2012) studied transportation outsourcing and supply chain performance among 30 Pharmaceutical companies in Pakistan. The study's findings found that transportation outsourcing improves supply chain performance and significantly influences the supply chain effectiveness and efficiency of the studied pharmaceutical firms. Feng et al. (2005) examined the system framework for evaluating collaborative transportation management in the supply chain. The study considered manufacturers, distributors and carriers as collaborative transportation management (CTM) partners. The results from the simulation revealed that CTM could significantly reduce the total supply chain cost, including inventory and backlog costs, and improve transportation capacity utilisation.

Also, Jepherson et al. (2021) examined the effect of the transportation management system on the supply chain performance of FMCG in Kenya. The unit of observation was the operations manager of the 51 FMCG manufacturers located in Nairobi. The study employed a descriptive research design and analysed the results using descriptive and inferential statistics. The study's findings revealed a positive and significant relationship between transportation management and the supply chain performance of FMCG in Kenya. Earlier studies by Mason et al. (2003) evaluated the effect of integrating warehousing and transportation functions on the supply chain. The study results demonstrate that the integration of warehousing and transportation functions can improve customer service through improved efficiencies, reduced costs and reduced lead-time variability.

A literature review showed that there had been a focus on logistics costs, which is a major component of transportation. In a doctoral thesis, Mwangangi (2016) assessed the influence of logistics management on the performance of manufacturing firms in Kenya. The study's first objective was to examine the effect of transport management on firm performance. The study used a semi-structured questionnaire and employed quantitative and qualitative data analysis techniques. The findings from the study revealed specifically that transportation management significantly influences the performance of firms. The study found that logistics management positively affects firm performance in terms of cost reduction, timely delivery, reduced lead time, demand realisation, increased market share, quality products and customer service satisfaction.

In a study by Sezen (2005), the role of logistics in linking operations and marketing and its influences on business performance was investigated. The study established that overall business performance is attained when there exists effective coordination between operations and marketing functions than the performance achieved when tasks are performed individually. Expressly, results from regression analyses performed to test the validations of study hypotheses indicated two important implications: coordination between operations and logistics functions in the specific sample was the most prominent issue for the achievement of high performance, and logistics function carries a vital role in linking the two most important tasks of a company: operations and marketing. Hence, the logistics function serves as a link in enhancing operational efficiency.

Logistics resources, capabilities and operational performance of companies were investigated by Lyu *et al.* (2018). The data for the study was obtained from managers in charge of transportation, inventory and logistics systems of 25 companies in China. The study adopted two approaches; contingency and configuration. The contingency results revealed that different logistics resources impact resource integration capability and operational performance differently. Also, the configuration results showed that companies' capabilities and operational performance vary for other logistics resource patterns. From the reviewed studies, transportation is perceived as a catalyst for operational performance. Therefore, this study hypothesised that transportation costs significantly improve the operating performance of Ghana's Food and Beverage manufacturing firms.

Quality Cost and Operational Performance

Quality costs can significantly impact operational performance (Ayach, 2019). Poor quality can result in increased costs, decreased efficiency, and reduced customer satisfaction, ultimately harming a business's profitability and competitiveness (Madhani, 2020). By investing in quality, a company can improve its operational performance by reducing the costs associated with defects and enhancing customer satisfaction (Alzoubi *et al.*, 2022). Therefore, quality cost and operational performance are closely linked, and businesses should strive to balance their investment in quality with their need to maintain operational efficiency and profitability (Oliveira *et al.*, 2017).

Sturm *et al.* (2019) empirically determined the long-run dynamics between the cost of quality and quality performance. The study utilised questionnaires to collect data from 408 supply chain, production, operations and executive managers of manufacturing firms in Germany, Austria and Sweden. The items in the scale were adapted from an empirically tested scale. The questionnaire for the study had indicators adopted from the PAF model for measuring the cost of quality. The study employed the parametric t-test to examine the hypotheses and ordinary least square regression to assess the magnitude of correlations of the variables in the study. The study's findings revealed that in the long run, manufacturing firms can lower their cost of quality while achieving significantly higher quality performance.

The authors also sought to examine the long-run dynamics between the cost component of quality cost. The managerial implications arrived at by the study findings were that managers should channel many resources to prevention and appraisal costs to reduce failure costs in the long run. Also, Colean (2019), in his master's thesis, investigated the influence of quality costs on the performance of the National Cereals and Produce Board (NCPB) in Kenya. Using the PAF model, the study assessed the extent to which each quality cost component affects the performance of NCPB. Data for the study was obtained from 225 sampled farmers out of the 517 registered farmers. Using SPSS, the data were analysed with both descriptive and inferential statistics. The study's findings established that all four components of quality costs: prevention, appraisal, internal failure and external failure costs influence the performance of the NCPB.

The findings further revealed that the failure to institute cost of quality approach results in poor-quality products. Finally, the findings concluded that prevention costs had a more significant influence on the performance of the NCPB. Hence, the managerial implication was that the management of NCPB should invest more in prevention costs activities for a favourable result. Hong *et al.* (2019) examined the effect of supply chain quality management (SCQM) practices and capabilities on operational and innovation performance of Chinese manufacturing firms. Data for the study were collected through the survey method, and a structural equation modelling approach was employed. The study's findings revealed that SCQM practices have a direct positive effect on SCQM capacities and an indirect positive effect on innovation performance. The results also showed that SCQM capacities could significantly affect operational and innovation performance.

Given the forgoing studies, it can be concluded that quality and its related activities in the supply chain significantly affect the operational performance of manufacturing firms in Ghana. However, previous studies on quality cost and operational performance are limited. Also, no study was found on the Ghanaian manufacturing industry and, to an extent, Food and Beverage manufacturing. This study concludes that quality cost significantly improves the operational performance of Ghana's Food and Beverage manufacturing firms.

Moderating Effect of Lean Manufacturing (LM)

The most successful firms have efficient and effective internal operations and successfully link their internal processes with external customers and suppliers (Frohlich & Westbrook, 2001; Krajewski *et al.*, 2015). In this sense, supplier and customer integration emerge as an essential element to improve competitiveness beyond the organisational boundaries (Flynn *et al.*, 2010; Frazzon *et al.*, 2015). Such a concept perfectly aligns with classical supply chain management (SCM) definitions since it comprises the flow of goods from suppliers through manufacturing and distribution chains to the end user (Power, 2005). Adopting LM entails a different business model in which improved profits arise from cooperation rather than bargaining or imposing power over supply chain partners (Alves Filho *et al.*, 2004; Naim & Gosling, 2011; Chiromo *et al.*, 2015).

Literature on the direct relationship between LM and operational performance is adequate in developing and developed countries (e.g., Rahman *et al.*, 2010; Nimeh *et al.*, 2018; Garcia-Buendia *et al.*, 2021). The findings revealed a significant positive relationship between the two concepts. Also, the moderating effect of LM has been investigated. For example, Marodin *et al.* (2017) studied the moderating effect of lean supply chain management on the impact of lean shop floor practices on quality and inventory. The study employed a survey approach and collected data from 110 plants in Brazil. The Ordinary least square regression results revealed that the lean supplier relationship positively moderates the effect of lean shop floor practices on inventory turnover. However, lean customer relationship was found to negatively moderate the relationship between lean shop floor practices on inventory turnover. The results further showed that lean supplier relationship positively moderates the effect of lean shop floor practices on quality.

Karakadilar and Hicks (2015) also explored the moderating role of lean production on supplier performance in the Turkish automotive industry. The study aimed to investigate the effect of strategic partnership, information technology and lean production techniques on the operational performance of Turkish automotive part suppliers. The study used a structural equation modelling (SEM) path analysis for data collected from 207 automotive part suppliers. The study's findings revealed that internal lean production techniques implementation level and information technology tools positively affect a supplier's operational performance. In contrast, no significant statistical relationship was found between strategic partnership and operational performance, except for the condition where the moderating effect of internal lean production techniques was involved.

In another study, Rana *et al.* (2016) investigated the moderating effect of lean strategy on the drivers of retail supply chain efficiency. The study examined the moderating effect of supply chain drivers and performance. The study employed a structured questionnaire from 115 selected retail chain stores in Bangladesh. The partial least square structural equation modelling approach was employed. The study's findings revealed that inventory management, use of IT, transportation management and coordination were the most significant determinants of retail supply chain efficiency. The study also found that lean strategy moderated the relationship between transportation management, coordination and supply chain efficiency.

Furthermore, an empirical investigation into how supply chain strategies moderate the relationship between innovation capabilities and business performance was conducted by Zimmermann *et al.* (2020). Based on the resource-based view theory, the study was conducted among 329 firms from Portugal and Brazil. The study used linear and hierarchical regression analytical techniques, finding that core and supplementary innovation capabilities positively impact business performance. Also, supply chain strategies (lean and agile) were found to moderate the relationship between innovation capabilities and business performance. These empirical findings show that lean strategy significantly moderates the relationship between supply chain activities and firm performance. Hence, this study proposes that lean manufacturing significantly moderates the relationship between supply chain cost drivers and operational performance of Food and Beverage manufacturing firms in Ghana.

Conceptual Framework

According to Mathieson *et al.* (2011), a conceptual framework is a visual or textual product that depicts or narratively summarises the main study issues, such as the significant concepts, variables, or factors, as well as the linkages that are thought to exist between them. It also indicates the factors in a connection that impact the disputed subject. The study's conceptual framework below presents the relationships among the variables as hypothesised. The independent variables were inventory costs (IC), transportation costs (TC), and quality costs (QC). The independent variables form the supply chain cost drivers (SCCD) construct. The dependent variable was operational performance (OP) with delivery reliability, flexibility and responsiveness, product quality and resource utilisation measures. The moderating variable for the study was lean manufacturing (LM).

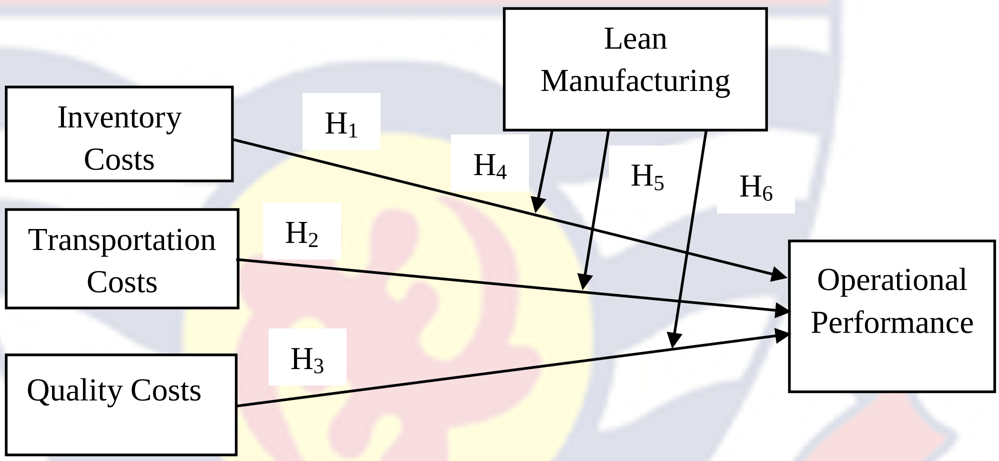

Figure 1: Conceptual Framework
Source: Author's construct (2022)

Chapter Summary

The chapter presented an extensive literature review related to the study's objectives to provide a basis and justifications for the study's findings. The review was grouped under four headings: theoretical review, conceptual review, empirical review and conceptual framework. The theoretical review presented the justification for the choice of theories. The conceptual review discussed the concepts used in the study; the empirical reviews of related literature were also presented. Finally, the conceptual framework of the study was also presented.

CHAPTER THREE

RESEARCH METHODS

Introduction

The study sought to assess the effect of SCCD on the OP of manufacturing firms in Ghana. It also sought to moderate the relationship between SCCD and OP with LM. This chapter presents the methods employed in conducting the study. Sections of the chapter presented were the research philosophy, research design and approach, study area, population, sampling procedure, data collection instruments, data collection procedure and data processing and analysis.

Research Philosophy

Research philosophy typifies a researcher's opinion of tolerable knowledge and the procedures through which knowledge is established (Saunders *et al.*, 2016). The positivist research philosophy guided this study. The positivist philosophy assumes that knowledge is objective and quantifiable (Antwi & Hamza, 2015). Hence, it adopts scientific methods and systematises the knowledge generation process to uncover and present truth empirically (Rahi, 2017). For positivists, the nature of social reality exists from empirical facts rather than personal ideas or thoughts (Tubey *et al.*, 2015). The Positivist paradigm goes with the quantitative research methodology. Thus, the emphasis is on measuring variables and testing hypotheses linked to general causal explanations (Amaratunga *et al.*, 2002).

Positivism relates to the natural scientist's philosophical stance and entails working with an observable social reality to produce law-like generations (Saunders *et al.*, 2016). The philosophy enables the generation of generalisable replicable findings (Wahyuni, 2012). Given the above, the researcher believes there are no alternatives to truth, requiring a scientific and systematic process to generate the study results. However, the philosophy faces criticism as focusing much on only observable phenomena at the expense of unobservable phenomena. Notwithstanding, the philosophy best fits the study due to the research objectives.

Research Approach

The study used the quantitative research approach. A quantitative research approach is grounded in positivist philosophy and involves an unbiased assessment of existing knowledge, theory, hypothesis formulation, data collection, data analysis and testing formulated hypothesis (Bell *et al.*, 2022; Eisend & Kauppi, 2019; Zyphur & Pierides, 2019). The quantitative research approach goes with deductive reasoning, which entails collecting numerical data and using quantitative techniques to analyse the data (Creswell & Creswell, 2017; Kumar, 2019). Although the approach has been criticised with weaknesses such as being rigid and ineffective in generating theories (Crotty, 1998), it was employed due to its relevance for examining the cause-and-effect relationship between the supply chain cost drivers: IC, TC and QC and operational performance with LM as moderating variable.

Research Design

In line with the research approach, the explanatory research design was employed to examine the effect of SCCD on the OP of manufacturing firms in Ghana. The explanatory research design was adopted for its suitability for the study since it applies to situations or problems to explain the relationships between variables (Saunders *et al.* 2016). Also, explanatory research design uses primary data collection instruments such as structured questionnaires to obtain a large amount of numerical data and perform analysis using descriptive and inferential statistical tools (Wahyuni, 2012; Beins & McCarthy, 2017). Explanatory studies also enable the researcher to specify hypotheses concerning the nature, strength and direction of the relationship between or among the variables studied (Birru *et al.*, 2019).

However, the explanatory research design has weaknesses that could affect the study's findings (Wildermuth, 2016). It is criticised because the information gathered depends on the respondents' perspectives and emotions, which could give room for one-sided reactions (Wildermuth, 2016) and may affect the findings' objectiveness (Creswell & Creswell, 2017). Despite this weakness, the design was relevant to achieving the purpose of the study. The study had SCCD as the latent exogenous variable (independent variables) and OP as the latent endogenous variable (dependent variable). Lean manufacturing (LM) was treated as the moderating variable.

Study Area

The study was conducted within the Ghanaian manufacturing industry, specifically the Food and Beverage sector. Ghana's manufacturing industry plays a crucial role in the country's economic development, contributing 10.7% of the Gross Domestic Product in 2021 (World Bank, 2022). The Food and Beverage manufacturing firms are classified under agro-processing. Agro-processing industries are typically comprised of upstream and downstream sectors. Upstream firms are those engaged in the initial processing of agricultural commodities, such as rice and flour milling, leather tanning, cotton ginning, and fish canning (Owoo & Lambon-Quayefio, 2018).

Downstream firms are processing intermediate products made from agricultural materials, including bread, biscuits, textiles, paper, clothing, and footwear (FAO, 1997).

This study focused on the downstream sector, specifically the Food and Beverage manufacturing firms. The specific geographical area for the study was Accra and Tema Metropolises. Accra and Tema are two metropolitans in Ghana with strategic significance relative to commercial and industrial activities. Accra is the national capital of Ghana and the most significant metropolitan area in the Southern sector and the entire country. Tema Metropolis is also an industrial hub, with many manufacturing firms ranking second to Accra Metropolis in the Greater Accra Region in Ghana as per the Integrated Business Establishment Survey report of Ghana Statistical Service (GSS) (Ghana Statistical Service, 2015).

Population

The study's target population was Ghana's Food and Beverage manufacturing firms. According to the Association of Ghana Industries (AGI, 2019), the Food and Beverage sector has 110 registered firms as members. The registered firms are spread across all 16 regions in Ghana. The accessible population for the study were 99 firms located in the southern part of Ghana. However, about 90% of the firms are in Accra and Tema Metropolises. Hence, the study's target population was 99 Food and Beverage manufacturing firms.

Sampling Procedure

The study employed the census technique to collect data from all the firms in the target population. Due to the study population, the census technique was used to provide a high degree of accuracy and reliability of the findings (Creswell, 2014). One representative from all 99 accessible Food and Beverage manufacturing firms in Accra and Tema Metropolises in Ghana registered with the AGI formed the sample for the study. The unit of observation from the firms was personnel in job positions directly involved in their respective firms' supply chain operations. Also, the study further estimated the suitable sample size using Hair *et al.* (2019) minimum sample size for PLS-SEM. Hair *et al.* (2019) posited that the minimum sample size for PLS-SEM should exceed ten times the maximum number of inner or outer paths pointing to a latent variable or construct in the structural model. The formula is called the '10-times rule' (Hair *et al.*, 2019; Goodhue *et al.*, 2017). This study's maximum structural path pointing to a latent variable was 3. Thus, the minimum sample size per the 10-time rule was 3*10 = 30.

Data Collection Instruments

Given cognisance of the study design and research approach, the study used primary data utilising structured questionnaires as the main data collection instrument. Saunders *et al.* (2009) argued that a structured questionnaire enables the researcher to obtain objective responses for statistical analysis, hence suited to the study. The questionnaire had close-ended and direct questions requiring respondents to select the appropriate numerical value for each. The indicator items for the variables were adapted from the literature. The structured questionnaires for the study comprised four sections, A to D. Section A contained three supply chain cost drivers as independent variables, section B had lean manufacturing as the moderating variable, and section C included operational performance as the dependent variable. The last section contained the demographic information of the respondents and the firms.

A 7-point Likert scale based on the extent of agreement, with 1 = strongly disagree and 7 = strongly agree, was used to measure the question items in sections A, B, and C. The independent variables of the study were transportation costs (5 items), inventory costs (3 items) and quality costs (7 items). The moderating variable was lean manufacturing (6 items). The dependent variable, operational performance (delivery reliability, flexibility and responsiveness, product quality and resource utilisation), had 8 question items. The 7-point Likert scale was adopted because a 7-point scale provides more options, increasing the probability of meeting the objective reality of respondents. Also, chances are that a 7-point scale may perform better than a 5-point scale owing to the choice of items on the scale defined by the survey construct and are more reliable (Cox, 1980; Chang, 1994; Joshi *et al.*, 2015).

Measurement of variables

The measurement of the study's variables was based on a review of relevant literature in the context of manufacturing firms to achieve the research objectives. The study's independent variables were transportation, inventory, and quality costs. The moderating variable was the lean manufacturing. The dependent variable, operational performance, was measured with delivery reliability, flexibility and responsiveness, product quality and resource utilisation. Table 1 presents the variables, measurement items, and relevant sources adapted. The extent to which the measurement items could measure each item in the Food and Beverage sector context was unclear. Hence, a pretesting of the research instrument was conducted on some 20 selected Food and Beverage firms in Accra (see results in table 2).

Table 1: Measurement of variables

Variable	Measurement indicators	Sources
Transportation Costs	Inbound logistics, outbound logistics, insurance cost, routine schedule and third-party logistics.	(Petterson & Sagerstedt, 2013)
Inventory Costs	Ordering cost, holding cost and shortage/stockout cost.	Piasecki, 2001
Quality Costs	Prevention costs, appraisal costs and failure (internal and external) costs.	(Srivastava, 2008; Lari & Asllani, 2013)
Lean manufacturing	Supplier selection and involvement, value stream mapping, Just-in-Time and process improvement.	(Rivera *et al.* 2007; Shah & Ward 2007; Qi *et al.* 2009; Stavrulaki & Davis 2010; Qi *et al.*, 2011; Soni & Kodali, 2016; Mishra *et al.*, 2015; Jasti & Kodali, 2015; Qi *et al.*, 2017; Vonderembse *et al.*, 2006; Moyano-Fuentes *et al.*, 2019)
Operational Performance	Delivery reliability, flexibility and responsiveness, product quality and resource utilisation.	(Sarode *et al.* 2008; Hofer *et al.*, 2012; Flynn *et al.*, 2010)

Source: Literature Review

Validity and Reliability

A research instrument's validity and reliability demonstrate how well it captures the parameters it was designed to measure (Saunders *et al.*, 2016). While validity measures the extent to which the measurement items accurately measure the construct in a quantitative study, reliability relates to the consistency of a measure (Haele & Twycross, 2015). With this study, some of the measurement items were adapted; hence, significant changes were made. Therefore, to validate and refine the question items in the questionnaire, pretesting was carried out among 20 Food and Beverage manufacturing firms in Accra that were registered with the Food and Beverage Association (FABAG) but not with AGI. Hunt *et al.* (1982) assert that a sample size between 12 and 30 is appropriate for pretesting. As such, the pre-test sample size was adequate to determine the validity and reliability of the instrument.

Pretesting is relevant for testing the reliability and validity of research instruments where there has been a significant alteration to an existing or newly developed research instrument (Saunders *et al.*, 2009; Sekaran, 2010; Zikmund, 2012). The Cronbach's alpha test was used to assess the reliability and validity of the research instrument. Previous studies have found that a Cronbach alpha value closer to 1 gives higher reliability of the questionnaire items (Saunders *et al.*, 2012; Creswell, 2014; Beins & McCarty, 2017). However, the threshold many researchers accept is that an alpha value of 0.7 or more shows that the indicator is reliable. Table 2 presents the results of the research instrument's pretesting. The results from Table 2 show that all the study variables met the acceptability criteria.

Table 2: Validity and reliability of data collection instrument

Variables	**Cronbach's alpha value**
IC	0.903
LM	0.923
OP	0.944
QC	0.884
TC	0.953

Source: Field Survey, (2022)

Common Method Bias

Common-method bias has been found as a significant concern when obtaining data from respondents. It occurs when the same approach is applied to measure multiple constructs in a study (Schaller, Patil & Malhotra, 2015). Questionnaire items for the data collection were worded vividly to avoid common method bias. It, therefore, enabled the elimination of the possibility of the respondents relying on a systematic response tendency, such as extreme or midpoint responses, in responding to the questions (Podsakoff *et al.*, 2012). Collinearity statistics computed in the PLS-SEM were used to check for common method bias. The metric used for the evaluation was the inner variance inflation factor (VIF). VIF values from 3 – 5 were considered sufficient (Mason & Perreault, 1991; Becker *et al.*, 2015).

Data Collection Procedure

The primary data collection exercise commenced after the receipt of ethical clearance from the Institutional Review Board (IRB) of the University of Cape Coast. Also, an introductory letter was obtained from the Department of Marketing and Supply Chain Management, School of Business. The letter and consent form were sent to the Food and Beverage firms in Accra and Tema Metropolises seeking their consent and approval for the study. A six-week duration (September 24 – November 5, 2022) was used for the data collection to ensure a maximum response rate. It enabled the researcher to reach out to all the firms and gather more responses for the study. The questionnaires were administered physically at the firms' premises through a drop-and-pick method and online through email using Google Forms. To enhance the response rate, the researcher provided assurances that the data was purely for academic purposes only. Upon request, some respondents were given adequate duration to complete the questionnaires at their convenience. A total of 94 usable responses were used for the study, indicating a response rate of 94.9%.

Ethical Considerations

Firstly, the principal investigator obtained ethical clearance from the University of Cape Coast Institutional Review Board to reduce the risk of harm and comply with research ethics in the field data collection process. Also, an introductory letter from the researcher's department, the Department of Marketing and Supply Chain Management, outlining the purpose of the study and how the respondents can help achieve the research objectives were obtained and given to the Food and Beverage manufacturing firms studied. An informant consent form was used to sort for respondents' consent.

Secondly, a significant area of concern in research is the confidentiality of the data provided by the study participant and the anonymity of the organisation and individual participants (Saunders *et al.*, 2016). The study participants were assured that the data or information provided should be confidential and that their organisation's identity shall not be known or revealed. In line with this, as promised, the questionnaire had no items that breached confidentiality and anonymity. The participants were assured that the data would not be shared with anyone and that the information provided was only for academic purposes. The findings of the data analysis were duly reported as generated.

Data Processing and Analysis

Quantitative data collected through questionnaires requires coding, data entry and cleaning (Zikmund, 2012). The Statistical Package for Social Sciences (SPSS version 26.0) was used for data coding, entry and cleaning. The final data was then imported into the SMART PLS application (version 4.0.8.4) for the model configuration. This study used the SMART PLS application due to its ability to estimate the hypothesised model (Hair *et al.*, 2018; Sharma *et al.*, 2019). Structural Equation Modelling (SEM) techniques were employed because they could estimate complex models and relaxed data requirements. When using the PLS-SEM technique, two analytical procedures are undertaken. First, the measurement model assessment was conducted to determine the association between the measurement indicators and their latent variables. Second, the structural model assessment helped to define the hypothesised relationship between the exogenous and endogenous latent variables (Hair *et al.*, 2019).

The PLS-SEM algorithm was applied in the calculation of the measurement model assessment. The path weighing scheme was used, and the initial weight was set by default (Henseler *et al.*, 2009; Henseler, 2010; Hair *et al.*, 2011). The maximum number of iterations was 300 (Ringle *et al.*, 2005). The model for the study had reflective indicators; hence, the reflective measurement model criteria were applied. First, the model was assessed using indicator reliability, internal consistency reliability, convergent validity and discriminant validity. The assessment of the indicator reliability was to show how much each indicator's variance is explained by its construct (Hair *et al.*, 2021). The indicator loadings revealed the indicator's reliability. The threshold recommended is that all indicator loadings should be >= 0.70. Indicators below the stipulated threshold were deleted to improve the model (Junk & Park, 2018; Hair *et al.*, 2021).

Although Cronbach's alpha and composite reliability were computed, the internal consistency reliability was assessed using rho_A. The rho_A is the most consistent reliability measure (Dijkstra & Henseler, 2015) between the conservative Cronbach's alpha and the liberal composite reliability metrics (Hair *et al.*, 2021). The convergent validity was assessed using the average variance extracted (AVE) for all items on each construct. Convergent validity is the extent to which the construct converges to explain the variance of its items. AVE scores >= 0.50 indicated that the construct explains at least 50 per cent of the variance of its items (Hair *et al.*, 2019). Also, the discriminant validity was assessed using the heterotrait-monotrait ratio of correlation (HTMT). Ali *et al.* (2017) posited that the HTMT criterion is superior for testing discriminant validity. HTMT value less than 0.90 indicates that discriminant validity was established between the two constructs (Henseler *et al.*, 2015).

The next step was the assessment of the structural model of the study. The model configuration treated the supplier chain cost drivers (SCCD) as exogenous latent variables and operational performance (OP) as the endogenous latent variable (Objectives 1 – 3). Lean manufacturing (LM) was treated as a moderating variable (Objective 4 – 6). The structural model deals with the evaluation of the inner model. The procedure assessed the collinearity issues, the significance and relevance of the structural relationships, the model's explanatory power, and the predictive power (Hair *et al.*, 2022). The

PLS-SEM algorithm calculation gave the output for the collinearity and explanatory power. The variance inflation factor (VIF) was used to check for multicollinearity. VIF values above 5 indicate multicollinearity, whilst VIF values of 3 – 5 show no collinearity issues (Mason & Perreault, 1991; Becker *et al.*, 2015).

The explanatory power was assessed using R-squared (coefficient of determination) and the effect size (f^2). Hair *et al.* (2010) argued that the acceptable R-squared value depended on the research context. However, Henseler *et al.* (2009) corroborated Hair *et al.* (2011) assertion that R-squared values of 0.75, 0.50 and 0.25 are considered substantial, moderate and weak, respectively. The effect size (f^2) was evaluated based on Cohen's threshold: 0.02, 0.15 and 0.35 were considered weak, moderate and strong effects of the exogenous variable on the endogenous variable, respectively (Cohen, 1988). A bootstrapping technique was used with subsamples set at 5000 for the estimation. The confidence interval method applied was percentile bootstrap and significance level set at 0.05 (Chin, 1998; Henseler *et al.*, 2009; Hair *et al.*, 2011; AguirreUrreta & Rönkkö, 2018).

The non-directional nature of the research objectives warranted using the two-tailed test of hypotheses (Nikitina *et al.*,2019). Regarding relevance, path coefficients range between −1 and +1, with coefficients closer to −1 representing strong negative relationships and those closest to +1 indicating strong positive relationships (Hair *et al.*, 2014). The PLS predict function was used to calculate the model's predictive relevance (Q^2) (Shmueli *et al.*, 2016). Each indicator's mean absolute error (MAE) value was compared with a naïve linear regression model (LM) benchmark to interpret the predictive relevance.

The MAE was used because the prediction error distribution was non-symmetric (Shmueli *et al.*, 2019).

The moderation analysis assessed the measurement and structural model using the PLS algorithm and bootstrapping, respectively. Descriptive statistics such as frequencies and percentages were used to interpret the respondents' demographic data. SPSS (version 26.0) was used to analyse the data for the demographic information of the respondents and firms.

Chapter Summary

The chapter provided information on the methodological approaches employed by the researcher: positivism research philosophy and explanatory-quantitative research. Primary data was collected using a structured questionnaire on a 7-point Likert scale from Food and Beverage manufacturing firms in the Accra and Tema Metropolises. Both descriptive and inferential statistical techniques were applied.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The study sought to examine the effect of SCCD on the operational performance of manufacturing firms in Ghana. It also assessed the moderating effect of LM on the relationship between SCCD and OP. This chapter presented the results obtained from the data analysis using the partial least square structural equation modelling (PLS-SEM) technique. The results were presented in tables and discussed in relation to relevant related literature, giving cognisance to their managerial, practical and theoretical implications.

Demographic Characteristics of Respondents and Firms

The nature of the demographic features of the target population warranted the use of frequencies and percentages in the analysis of the demographic data collected. Table 4 presents the results from the analysis of the demographic characteristics of respondents and their respective firms. Most respondents were males, 73 (77.7%), whilst the remaining were females, 21 (22.3%). The results implied that the managerial positions of the firms studied had high gender disparity. The finding aligns with studies such as Bortey and Dodoo (2005) and Boohene *et al.* (2008). They argued that the traditional sex-role identification, leaving arrangement and right to higher education necessary for managerial roles in Ghana establishes clear delineation placing men in the authority of responsibility over women (Bortey & Dodoo, 2005). Men are perceived to be assertive, risk-taking, innovative, independent and achievement-oriented. In contrast, women are perceived not to develop such qualities and are restricted to higher education due to domestic duties (Boohene *et al.* 2008).

On the age of the respondents, the results show that the majority, 59 (62.8%) of them, were between the ages of 36 – 45 years, 17 (18.1%) were between 28 – 35 years, 14 (14.9%) were between 46 – 55 years while the remaining 4 (4.3%) were between the ages of 55 – 60 years. The results reveal that most respondents are over 35 years old and hence fall within the active working age. The implication is that the personnel in the managerial positions of the firm studies are energetic and active. Studies have found that the demographic profile of managers, including age, is correlated with the firms' decisions and performance (e.g., Carpenter, 2004; Hambrick, 2005; Finkelstein *et al.*, 2009). Existing studies such as Hart and Mellors (1970), Child (1974) and Bhabra and Zhang (2016) suggest that the managers' youth is associated with corporate growth.

Concerning the respondents' position, most study participants were supply chain managers 29 (30.9%), followed by operations managers 22 (23.4%). Procurement and general managers were 18 (19.1%) each, whilst the remaining 7 (7.4%) were in the others category. This implies that almost all the respondents, by their positions, have adequate knowledge and experience to provide appropriate answers to the items in the questionnaire.

Table 3: Demographic information of respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	73	77.7
	Female	21	22.3
	Total	94	100.0
Age	28 - 35	17	18.1
	36 - 45	59	62.8
	46 - 55	14	14.9
	56 - 60	4	4.3
	Total	94	100.0
Sector	Food and Beverage manufacturing	94	100
Position	Supply Chain Manager	29	30.9
	Operations Manager	22	23.4
	Procurement Manager	18	19.1
	General Manager	18	19.1
	Other	7	7.4
	Total	94	100.0
Years of Experience	3 years	37	39.4
	4 - 7 years	43	45.7
	More than 7 years	14	14.9
	Total	94	100.0
Educational Qualification	HND only	4	4.3
	First Degree Only	5	5.3
	First Degree with Professional Certificate	25	26.6
	Master's Degree only	22	23.4
	Master's Degree with professional Certificate	38	40.4
	Total	94	100.0
Firm Size	Small (Less than 100 employees)	24	25.5
	Medium (100 – 500 employees)	55	58.5
	Large (More than 500 employees)	15	16.0
	Total	94	100.0

Source: Field survey, Buabeng (2022)

On the issue of the years of experience of respondents, the result shows that the majority, 43 (45.7%) of the respondents, had between 4 – 7 years of experience, 37 (39.4%) had 3 years of experience, and 14 (14.9%) had more than 7 years experience as managers in their respective companies. The study's findings depict that most managers had an average of 5 years and more work experience in their current job positions. This implies that the managers have worked for an appreciable number of years as managers for their respective firms and have garnered enough knowledge and experience. Hence, the information retrieved from the survey could arguably be relevant for policymaking.

Table 4 also presents the academic qualifications of the respondents. The result revealed that the majority of the respondents, 38 (40.4%), had a master’s degree with a professional certificate, 25 (26.6%) had a first degree with a professional certificate, 22 (23.4%) had a master’s degree only, 5 (5.3%) had first degree only while the remaining 4 (4.3%) had HND certificate. This implies that most managers have attained higher education and professional courses in their fields of study. This means that the majority of the managers have adequate capacities and qualifications to hold the positions they are currently occupying. Furthermore, the result implies that the managers had sufficient knowledge in the field of inquiry, giving authenticity and confidence to the survey data.

Lastly, the size of the firms studied was assessed based on the number of employees. The result revealed that the majority, 55 (58.5%) of the firms surveyed, were medium-scale, 24 (25.5%) were small-scale, and 15 (16%) were large-scale Food and Beverage manufacturing firms. The result implies that most firms employ between 100 to 500 employees. Also, about one-third of the firms studied employ less than 100 employees, while about a quarter use more than 500. This means that the firms studied contribute to employment in the country. This supports the argument that government support in areas such as subsidies, reduced tariffs on imports of key raw materials, and flexible loan schemes, among others, would invariably induce the firms to expand their operations, thereby contributing to the reduced unemployment rate in the country.

Assessment of PLS-SEM

The study's objectives were achieved using the partial least square structural equation modelling (PLS-SEM) technique. The model specification for the PLS-SEM technique involves two stages. First, the measurement model is evaluated to reveal the association between the indicators and their constructs. Second, the structural model is evaluated after all requirements or underlying assumptions have been met under the measurement model assessment. The structural model assessment is carried out to determine the hypothesized relationship between the exogenous, moderating and endogenous variables (Henseler *et al.*, 2009; Ringle *et al.*, 2011; Hair *et al.*, 2014; Hair *et al.*, 2019).

Effect of Supply Chain Cost Drivers on Operational Performance

The first three objectives of the study were to assess the effect of the drivers of supply chain cost on the operational performance of the Food and Beverage manufacturing firms studied.

Measurement Model Assessment

The measurement model was evaluated to assess the structural model's quality (Benitez *et al.,* 2020). The key underlying assumptions that were looked for were the factor loadings (indicator reliability), internal consistency reliability, convergent validity, discriminant validity, and collinearity statistics. The model structure was specified by indicating the exogenous and endogenous variables of the study. The exogenous variables of the study were inventory cost (IC), transportation cost (TC) and quality cost (QC). The exogenous variable was operational performance (OP).

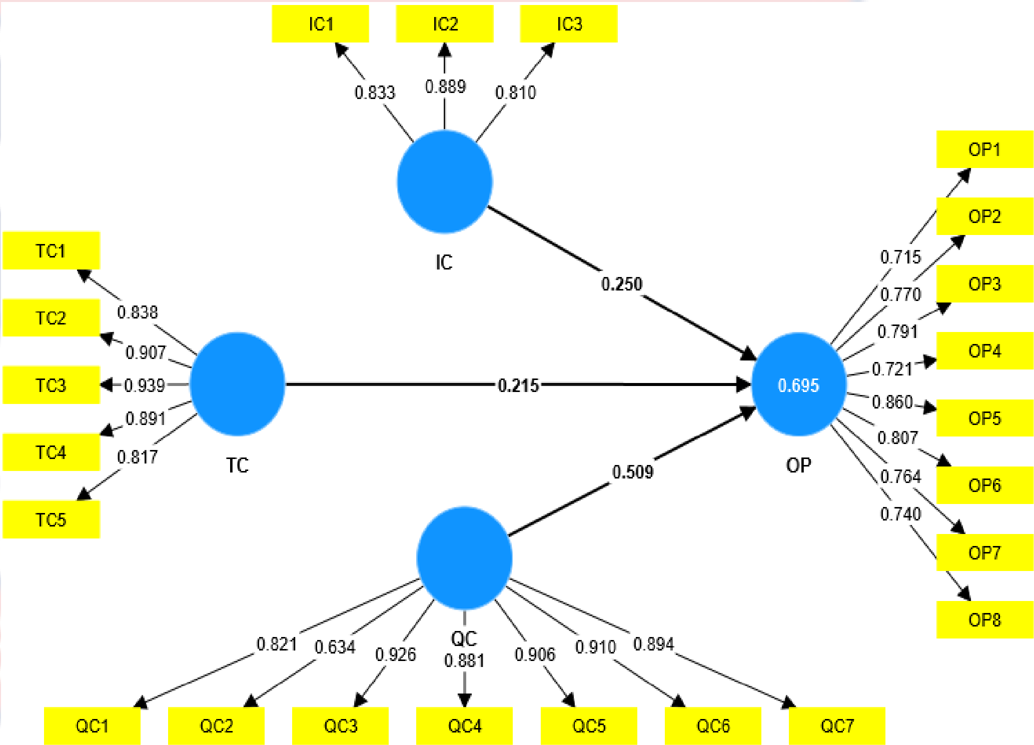

Figure 2: Initial Model (Objectives 1 to 3)
Source: Author's construct, Buabeng (2022)

Figure 2 above presents the initial model of the study. The exogenous and endogenous variable indicators and their loadings are shown. The exogenous variables were Inventory Cost (IC1, IC2 and IC3) Transportation Cost (TC1, TC2, TC3, TC4 and TC5) and Quality Cost (QC1, QC2, QC3, QC4, QC5, QC6 and QC7). The endogenous variable was Operational Performance (OP1, OP2, OP3, OP4, OP5, OP6, OP7 and OP8).

The initial model was assessed by evaluating the indicator loadings of the latent variables. The model had reflective indicators, and individual item reliability (indicator reliability) was assessed. This was done to check the quality of the indicators measuring each construct in the model. The rule of thumb was that each indicator loading should be >= 0.70 (Junk & Park, 2018; Hair *et al.*, 2021). All indicator loadings below the recommended thresholds were eliminated from the model. This indicated that although such indicators were obtained from literature, they did not measure the constructs among the firms studied. From Figure 2, one indicator: QC2, had its loading below the recommended threshold; hence, it was eliminated from the model.

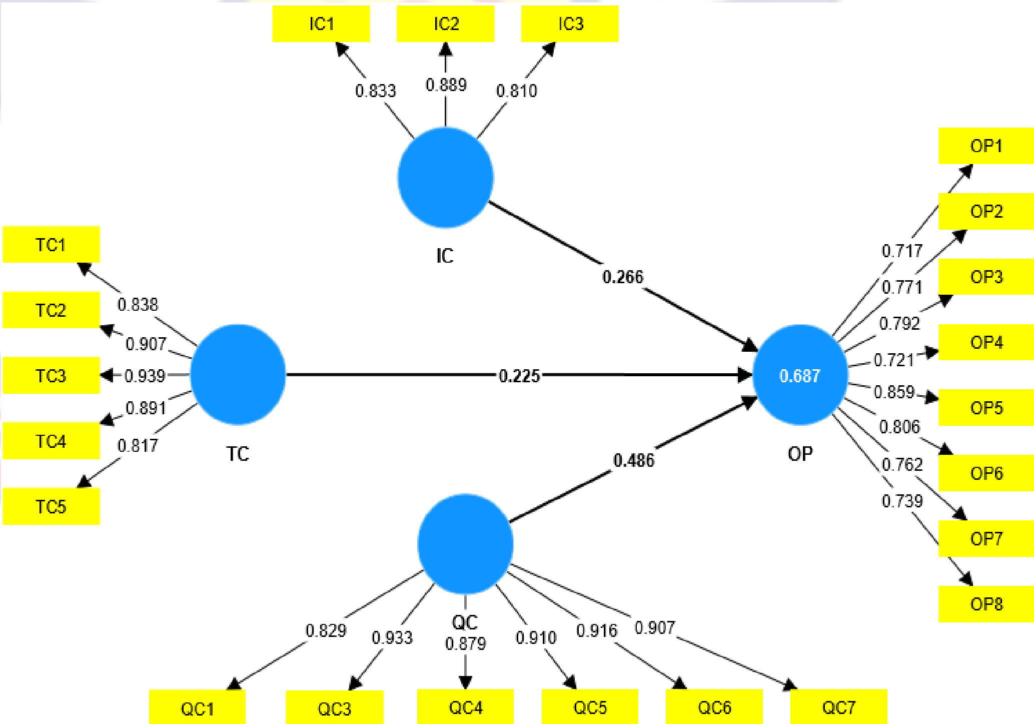

Figure 3: Final Model (Objectives 1 to 3)
Source: Author's construct, Buabeng (2022)

The final model, figure 3, was used for the measurement and structural model assessment. All indicators met the recommended measurement criteria of >= 0.70. The internal consistency reliability, convergent validity, discriminant validity and collinearity statistics were also assessed. The results are presented in Tables 5 and 6.

Internal Consistency Reliability

The next step in reflective measurement model assessment involves the examination of internal consistency reliability. The internal consistency reliability indicates the extent to which the indicators measuring the same constructs are associated (Hair *et al.*, 2021). In PLS-SEM, Jöreskog's (1971) composite reliability has been a primary metric for internal consistency reliability. Cronbach's alpha is also another measure used for internal consistency reliability. Cronbach's alpha assumes that all indicator loadings are the same and is also sensitive to the number of indicators in the scale; hence, it generally underestimates the internal consistency reliability. This is not the case for composite reliability. The composite reliability is an upper-bound metric, while Cronbach's Apla is a lower-bound measure (Trizano-Hermosilla & Alvarado, 2016).

Within these two extreme values, Cronbach's alpha is considered conservative and composite reliability is considered too liberal; the accurate measure of the construct's internal consistency reliability lies between. Hence, Dijkstra (2010) proposed an alternative measure, the rho_A, as an exact measure of internal consistency reliability (Dijkstra, 2014; Dijkstra & Henseler, 2015). The rho_A was used to measure the internal consistency reliability because it usually lies between the two extreme values and is considered an acceptable compromise (Hair *et al.*, 2021). All three metrics have the same rule of thumb; thus, construct reliability (internal consistency reliability) should be (>= 0.70). The results in Table 5 show that all the rho_A values were > 0.70. This shows that construct reliability was measured. The implication was that all the indicators assigned to the construct had strong mutual relationships, and they indeed measured their respective constructs.

Table 4: Internal consistency reliability, validity and collinearity

Variables	CA	rho_A	CR	AVE	Inner VIF
IC	0.801	0.812	0.882	0.714	1.339
TC	0.926	0.938	0.945	0.773	2.078
QC	0.951	0.954	0.961	0.803	2.061
OP	0.903	0.907	0.922	0.596	

Note: Cronbach's Alpha (CA), Composite Reliability (CR), Average Variance Extracted (AVE) and Variance Inflation Factor (VIF)
Source: Field survey, Buabeng (2022)

Convergent Validity

The convergent validity of a construct measures the extent to which the construct converges to explain the variance of its indicators. The average variance extracted (AVE) was used to assess the convergent validity. The recommended threshold is that AVE should be >= 0.5. An AVE of 0.5 or more indicates that the construct explains 50 per cent or more of the indicators' variance that constitutes the construct (Hair *et al.*, 2022). The AVE values ranged from 0.596 to 0.803. This implies that there was convergent validity; hence, the constructs explain more than half of the variance of the indicators. Therefore, convergent validity was assured.

Collinearity Statistics

The model was also checked for collinearity issues using the inner Variance Inflation Factor (VIF). According to Hair *et al.* (2014), the basis for checking collinearity issues is to enable the path coefficients to be free from bias and minimize the significant level of collinearity among the exogenous constructs. VIF values above 5 indicate multicollinearity (Mason & Perreault, 1991; Becker *et al.*, 2015). From Table 4, all the inner VIF values of the exogenous variables were below 5 (IC = 1.339, TC = 2.078 and QC = 2.061). This indicates that there were no collinearity issues (multicollinearity).

Discriminant Validity

The discriminant validity of the constructs was also measured in the study. Discriminant validity shows the extent to which the construct of the study is empirically measured distinctly from other constructs in the structural model. Put succinctly, it indicates how the construct measures what it intends to measure. This is achieved by assessing the correlations among the indicators measuring the constructs in the structural model (Hair *et al.*, 2014; 2021). The heterotrait-monotrait ratio (HTMT) of correlations was used to assess discriminant validity. The discriminant validity was evaluated with a threshold value of < 0.9 for all correlations among the constructs (Heseler *et al.*, 2015). Table 6 presents the result of the analysis. There were no discriminant validity issues since all correlation values were below the threshold. Therefore, each construct in the model is genuinely measured by distinct indicators.

Table 5: Heterotriat-Monotrait (HTMT) ratio

	IC	OP	QC	TC
IC				
OP	0.685			
QC	0.511	0.815		
TC	0.544	0.736	0.742	

Source: Field survey, Buabeng (2022)

Structural Model Assessment

After assessing the measurement model and meeting all PLS-SEM criteria, the study evaluated the structural model to determine the hypothesized relationship between the exogenous and endogenous latent variables. This section provides the results from assessing the significance of the path coefficients, the explanatory power (i.e., coefficient of determination and effect size) and the structural model's predictive power (PLS predict). The results were presented and discussed based on the study's objectives (i.e., objectives 1 to 3).

Significance of Path Coefficients

The first three objectives of the study sought to examine the effect of supply chain cost drivers on operational performance among Food and Beverage manufacturing firms in some selected metropolises (i.e. Accra and Tema) in Ghana. The path hypotheses anticipate a positive association between the exogenous and endogenous variables. Precisely, the path hypotheses predicted the following relationships: Inventory Cost (IC) and OP; Transportation Cost (TC) and OP; and Quality Cost (QC) and OP among the firms studied. The path coefficient (beta) was obtained with two-tailed t-test statistics and a 0.5 level of significance through 5000 bootstrapping subsamples to test the strength and direction of the hypotheses. The hypotheses of the study were tested, and a decision was arrived at using the t-statistics threshold of > 1.96 (i.e. two-tailed), p-values <0.05 and beta coefficient (significant impact) (Hair *et al.*, 2014).

Table 6: Path Coefficients and effect size

Hypotheses	Beta	Effect size (f^2)	T statistics	P values	Result	Decision
IC -> OP	0.266	0.169	3.210	0.001	Supported	Accept
TC -> OP	0.225	0.078	2.524	0.012	Supported	Accept
QC -> OP	0.486	0.366	5.305	0.000	Supported	Accept

Source: Field survey, Buabeng (2022)

Effect of Inventory Cost on Operational Performance

In objective one, the effect of inventory cost on operational performance was examined. The hypothesis (H_1) for the study was stated as follows: inventory cost significantly improves the operational performance of Food and Beverage manufacturing firms in Ghana. The PLS-SEM structural model results in Table 6 revealed a positive and significant relationship between inventory cost and operational performance (Beta = 0.266, t = 3.210, p = 0.001: $p < 0.05$). The results supported the hypothesised relationship; hence, H_1 was accepted. The results imply that a unit increase of 26.6% in inventory cost comprising holding /carrying cost, ordering cost and stockout/shortage cost would improve operational performance also by 26.6%.

The theory of constraints supported the finding of objective 1 of the study. TOC argues that Food and Beverage manufacturing firms could be exposed to constraints such as inventory cost, which could be addressed through proper inventory management systems along the supply chain of the manufacturing firms. The study's finding also suggests that the firms studied have appropriate inventory management systems that reduce the cost and inefficiencies associated with inventory carrying, ordering and shortage. The results of the study also corroborate the findings of previous studies by Chiri (2014), Jiraruttrakul *et al.* (2017), Opoku *et al.* (2020) and Mbugi and Lutego (2022).

In a study by Chiri (2014) on the role of inventory management on the performance of manufacturing firms in Kenya, the study concluded that holding and ordering costs increase the manufacturing firms' performance. Jiraruttrakul *et al.* (2017) also found that applying Economic Order Quantity (EOQ) can reduce inventory costs by 47% annually. In Ghana, Opoku *et al.* (2020) found that different inventory management strategies have a significant and positive relationship with the operational performance of manufacturing firms. In a current study by Mbugi and Lutego (2022) in Tanzania, the effect of inventory control systems was examined among the Food and Beverage manufacturing firms. The study found that inventory control management systems such as EOQ affect organizational performance regarding cost reduction, production efficiency, flexibility and profitability among the studied Food and Beverage manufacturing firms.

In addition, the study's findings revealed that the Food and Beverage manufacturing company had evidence of different types of inventories, including raw materials, work-in-progress and finished goods managed under the FIFO system for cost reduction and production efficiency. Fonseca and

Azevedo (2020) assert that inventory cost can significantly affect operational performance, as it represents a substantial portion of a company's expenses. However, high inventory costs can impact operational performance by reducing profits, limiting cash flow, and increasing the risk of stockouts or excess inventory (Truong, 2023). On the other hand, managing inventory can help to improve operational performance by reducing the cost of goods sold, improving customer service, and increasing efficiency (Chuang, Oliva & Heim, 2019). Inventory cost is, therefore, a catalyst for enhancing the operational performance of Food and Beverage manufacturing firms.

Effect of Transportation Cost on Operational Performance

Objective two sought to assess the effect of transportation costs on operational performance. The hypothesis (H_2) was stated as follows: transportation cost significantly improves the operational performance of Ghana's Food and Beverage manufacturing firms. The results from the test revealed that transportation cost has a significant and positive impact on operational performance among the Food and Beverage manufacturing firms studied (Beta = 0.225, t = 2.524, p = 0.012: $p < 0.05$). The decision rule was to accept since the results supported the study's hypothesis. The beta coefficient value implies that a unit increase in transportation cost by 22.5% will lead to a unit increase by the same margin (22.5%) in operational performance (i.e., delivery reliability, flexibility and responsiveness, product quality and resource utilization).

The study results imply that the firms studied undertake transportation activities such as transporting raw materials from their suppliers to their organisation (inbound) and transporting finished products to customers (outbound). Also, the firms undertake frequent maintenance and repairs due to the product routine schedule and frequency of shipment in the supply chain. In addition, the firm engages third-party logistics providers (3PL) and has insurance covers for their vehicles. These activities that create transportation costs are found to improve the operational performance of the studied Food and Beverage manufacturing firms.

The theory of constraints is in support of the findings of the study. According to the Theory of Constraints (TOC), the effective implementation and management of transportation activities in the supply chain could reduce costs, thereby enhancing the operational performance of Food and Beverage manufacturing firms (Goldratt, 1990). The study's findings also align with previous studies, such as Mwangangi (2016), who examined the influence of logistics management on the performance of manufacturing firms in Kenya. The study's first objective was to investigate the effect of transport management on firm performance. The findings revealed that transportation management significantly influences the performance of firms. The study found that logistics management positively affects the firms' performance in terms of cost reduction, timely delivery, reduced lead time, demand realization, increased market share, quality products and customer service satisfaction.

The study's findings align with the study by Jepherson *et al.* (2021), who examined the effect of the transportation management system on the supply chain performance of FMCG in Kenya. The study revealed a positive and significant relationship between transportation management and the supply chain performance of FMCG in Kenya. Moreover, earlier studies by

Mason *et al.* (2003) also found that integrating warehousing and transportation functions can improve customer service through improved efficiencies, reduced costs and reduced lead-time variability. Furthermore, studies such as Sezen (2005), Feng *et al*. (2005), and Lyu *et al.* (2018) support the findings of the study. It can, therefore, be deduced from the foregoing that transportation cost is a crucial supply chain cost driver. When managed adequately, it can improve the operational performance of Ghana's Food and Beverage manufacturing firms.

Effect of Quality Cost on Operational Performance

The effect of quality cost on the operational performance of Food and Beverage firms in Ghana was also examined in objective 3. The hypothesis (H_3) was that quality cost significantly improves operational performance of Food and Beverage manufacturing firms in Ghana. The results from Table 6 indicate that the hypothesised relationship was supported. Quality cost had a positive and significant relationship with operational performance among the firms studied (Beta = 0.486, t = 5.305, p = 0.000: p< 0.05). Therefore, the study failed to reject the hypothesised relationship; hence, H_3 was accepted. This implies that an increase in quality cost by 48.6% will lead to an increase in operational performance of Food and Beverage manufacturing firms by the same margin (48.6%).

The theory of constraints supported the findings of the study. TOC posits that Food and Beverage manufacturing firms are exposed to constraints such as quality costs in their supply chain. Hence, managing this constraint could enhance the operational performance of the firms (Goldratt, 1990). In line with the theory of constraints, the prevention-appraisal-failure (PAF) approach to quality management could be implemented by the firms studied to combat the constraints (quality cost) in their supply chain. This is because poor quality can result in increased costs, decreased efficiency, and reduced customer satisfaction, ultimately harming a firm's profitability and competitiveness (Zhang *et al.*, 2021). Through quality investment, manufacturing firms can improve their operational performance by reducing the costs associated with defects and enhancing customer satisfaction (Alzoubi *et al.*, 2022).

Quality is a central theme amongst Food and Beverage manufacturing companies. Their operations are characterised by processing raw materials with a high perishability rate into finished and semi-finished products (Dora *et al.*, 2020). Humans consume the end product of Food and Beverage firms. Hence, throughout their activities, Food and Beverage manufacturing firms are expected to comply with strict food safety and quality standards to ensure the safety of consumers. Throughout the supply chain, various quality control measures should be in place to ensure that the products meet safety and quality standards (Qian *et al.*, 2022).

The finding of the study is supported by previous studies such as Sturm *et al.* (2019), Colean, (2019) and Hong *et al.* (2019). Determining the long-run dynamics between the cost of quality and quality performance, Sturm *et al.* (2019) found that manufacturing firms can reduce their cost of quality while achieving higher quality performance (operational performance). Hong *et al.* (2019) also found that supply chain quality management capacities significantly affect manufacturing firms' operational and innovation performance. Colean (2019) also found that the failure of firms to institute a quality cost approach results in poor quality. Moreover, the findings further revealed that prevention costs influence firm performance more. The foregoing indicates that quality cost is key to improving operational performance of Food and Beverage manufacturing firms.

Co-efficient of determination (R^2)

The next step after assessing the significance and relevance of the structural model relationship is to evaluate the model's explanatory power. The coefficient of determination (R^2) of the exogenous variables was examined. According to Hair *et al.* (2011), R^2 explains the combined effect of the exogenous variables (IC, TC and QC) on the endogenous variable (OP). The R^2 also represents the variance explained in the endogenous variable caused by the exogenous variables. The R^2 measures the model's explanatory power (Shmueli & Koppius, 2011), also called in-sample predictive power (Rigdon, 2012). As a general guideline in many social science disciplines, R^2 values of 0.75, 0.50, and 0.25 can be considered substantial, moderate, and weak (Hair, Ringle, & Sarstedt, 2011). Table 7 presents the R^2 obtained from the analysis.

The results show that the supply chain cost drivers (IC, TC and QC) together accounted for a moderate positive variance (R^2 = 0.687) in the operational performance when all other factors not captured in the study but affecting the OP of the Food and Beverage manufacturing firms studied are statistically controlled. This implies that the three endogenous variables, IC, TC and QC, moderately explain 68.7% of the variation in OP of the Food and Beverage manufacturing firms. The results also depict that the factors not captured in the model could account for a 31.3% variance in OP. The foregoing supports the argument that SCCD is essential to firms' success since it is multifaceted; hence, much attention should be given to it to ensure its continuing success.

Table 7: Coefficient of determination (R^2)

	R-square	R-square adjusted
OP	0.687	0.676

Source: Field survey, Buabeng (2022)

Effect Size (f^2)

Another explanatory power assessment that was carried out was the effect size (f^2). The f^2 assesses how removing a predictor variable affects an endogenous R^2 value in the model. Cohen's thresholds 0.02, 0.15 and 0.35, considered weak, moderate and strong, were used to assess the effect size of each exogenous variable on the endogenous variable, respectively (Cohen, 1988). The result of the effect size from Table 6 reveals that Quality Cost (QC) with $f^2 = 0.366$ strongly affected operational performance in the model. Inventory Cost (IC) had a moderate effect ($f^2 = 0.169$), while transportation cost (TC) had f^2 values of 0.078 which implies a weak effect size. The result suggests that QC had a higher effect on operational performance among the Food and Beverage manufacturing firms studied. IC follows this with a moderate effect size and TC with a small effect size.

Predictive Relevance (Q^2)

The PLS predict function was used to calculate the model's predictive relevance (Q^2) (Shmueli *et al.*, 2016). The non-symmetric nature of the distribution warranted the use of mean absolute error (MAE) value to compare with the naïve linear regression model (LM) benchmark to interpret the predictive relevance (Shmueli *et al.*, 2019). The underlining guidelines are that: If all PLS-SEM MAE values < LM MAE benchmark values, the model has a high predictive power; if the majority (or same number) of PLS-SEM MAE values < LM MAE benchmark values, the model has a moderate predicted power; if the minority of PLS-SEM MAE values < LM MAE values, the model has low predictive power and finally, if PLS-SEM MAE values < LM MAE values for none of the indicators, the model lacks predictive power (Shmueli *et al.*, 2019).

The result in Table 8 reveals that the majority (OP1, OP3, OP4, OP5, OP6, OP7 and OP8) of the PLS-SEM MAE values are lower than the LM MAE benchmark values; hence, the model has moderate predictive power. The result implies that the exogenous variables (IC, TC and QC) moderately predict the model.

Table 8: Predictive Relevance (Q^2)

	Q^2 predict	PLS-SEM_MAE	LM_MAE
OP1	0.357	0.806	0.827
OP2	0.462	0.703	0.660
OP3	0.379	0.845	0.909
OP4	0.206	0.966	1.010
OP5	0.348	0.805	0.848
OP6	0.478	0.689	0.738
OP7	0.472	0.756	0.825
OP8	0.292	0.780	0.818

Source: Field survey, Buabeng (2022

Moderating Effect of Lean Manufacturing on the Relationship Between Supply Chain Cost Drivers and Operational Performance

Objectives 4 to 6 of the study sought to examine the moderating effect of LM in the model's relationship between IC, TC and QC and OP. Based on

Dynamic Capabilities Theory (DCT), the study examined the moderating effect of LM in the relationship between IC, TC, QC and OP. LM was introduced in the model to determine whether it will affect the strength and direction of the impact of each cost driver (IC, TC and QC) on OP of Food and Beverage manufacturing firms in Ghana. Figure 4 below shows the structural model for objectives 4 to 6.

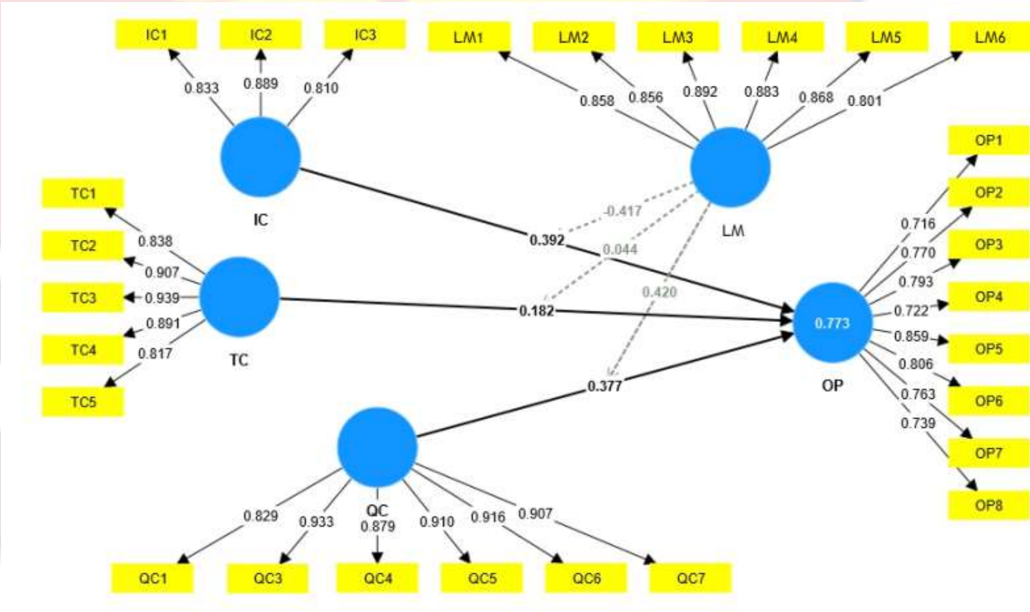

Figure 4: Structural Model (Objectives 4 to 6)
Source: Author's construct, Buabeng (2022)

Measurement Model Assessment

In assessing the internal consistency reliability, the rho_A was used as it is recognised as the most important reliability measure in reflective models (Dijkstra & Henseler, 2015; Henseler, 2017). Internal consistency reliability was assured since all rho_A values were > 0.70. AVE values were > 0.5, indicating convergent validity (Henseler, 2017). The VIF scores were used to assess the collinearity statistics and check the common method bias problem. The VIF scores in Table 9 show that all the values were < 5. Hence, the inner model portrays no common method bias (multicollinearity).

Table 9: Internal consistency reliability and validity

	CA	rho_A	CA	AVE	VIF
IC	0.801	0.812	0.882	0.714	1.683
LM	0.932	0.928	0.945	0.74	1.344
OP	0.903	0.907	0.922	0.596	
QC	0.951	0.954	0.961	0.803	3.083
TC	0.926	0.938	0.945	0.773	2.57

Discriminant Validity

The discriminant validity was evaluated with a threshold value of > 0.9 for all correlations among the constructs (Heseler *et al.*, 2015). Table 10 presents the result of the analysis. There were no discriminant validity issues since all correlation values were below the threshold. Therefore, each construct in the model is genuinely measured by distinct indicators.

Table 10: Heterotriat-Monotrait (HTMT) ratio

	IC	LM	OP	QC	TC	LM x IC	LM x TC	LM x QC
IC								
LM	0.166							
OP	0.685	0.195						
QC	0.511	0.201	0.815					
TC	0.544	0.067	0.736	0.742				
LM x IC	0.425	0.227	0.142	0.191	0.319			
LM x TC	0.327	0.085	0.462	0.505	0.2	0.048		
LM x QC	0.23	0.225	0.517	0.464	0.546	0.465	0.164	

Source: Field survey, Buabeng (2022)

Structural Model Assessment

Objectives 4 to 6 examined the moderation effect of LM in the relationship between IC and OP, TC and OP and QC and OP among Food and Beverage manufacturing firms in some selected metropolises (i.e., Accra and Tema) in Ghana. The path hypotheses anticipate a positive association between the exogenous, moderating and endogenous variables. The path hypotheses predicted the following relationships: LM x IC -> OP, LM x TC -> OP and LM x QC -> OP among the firms studied.

Significance of Path Coefficient

Table 11: Path Coefficients and Effect Size

	Beta	f^2	T statistics	P values
LM x IC -> OP	-0.417	0.278	2.577	0.010
LM x TC -> OP	0.044	0.003	0.394	0.694
LM x QC -> OP	0.420	0.194	2.171	0.030

Moderating Effect of Lean Manufacturing on the Relationship Between Inventory Costs and Operational Performance

In relation to objective 4, the moderation effect of LM in the relationship between IC and OP was examined. The hypothesis (H_4) for the study was that lean manufacturing significantly moderates the relationship between inventory cost and operational performance of Food and Beverage manufacturing firms in Ghana. The result in Table 11 reveals that LM significantly moderated the predictive relationship between IC and OP of the Food and Beverage manufacturing firms studied (Beta = -0.417, t = 2.577 and $p = 0.010$: $p < 0.05$). The results supported the hypothesised relationship;

hence, H_4 was accepted. LM had a moderate effect (f^2=0.278) on the relationship.

Moreover, figure 5 presents the interaction effect of the variables. The result shows that when LM is reduced or not implemented, the strength and direction of the relationship between IC and OP are not altered. However, an increase in the institution of LM shows much upward steepness in the gradient, indicating improvement in the endogenous variable. This means that the institution or an increase in LM improves the strength of the relationship between IC and OP. Hence, adopting and implementing LM is a deciding factor in enhancing the relationship between IC and OP among the surveyed Food and Beverage manufacturing firms.

The result from the moderation analysis is supported by the claims established under the Dynamic Capabilities Theory (DCT). DCT posits that Food and Beverage manufacturing firms could improve their operational performance if they develop the capacity to swiftly integrate lean approaches into their supply chain activities, such as inventory management (Teece *et al.*, 1997; Eisenhardt & Martin, 2000). The finding confirms earlier claims that LM moderates supply chain activities and operational performance of manufacturing firms (Karakadilar & Hicks, 2015; Rana *et al.*, 2016; Marodin *et al.*, 2017; Zimmermann *et al.*, 2020).

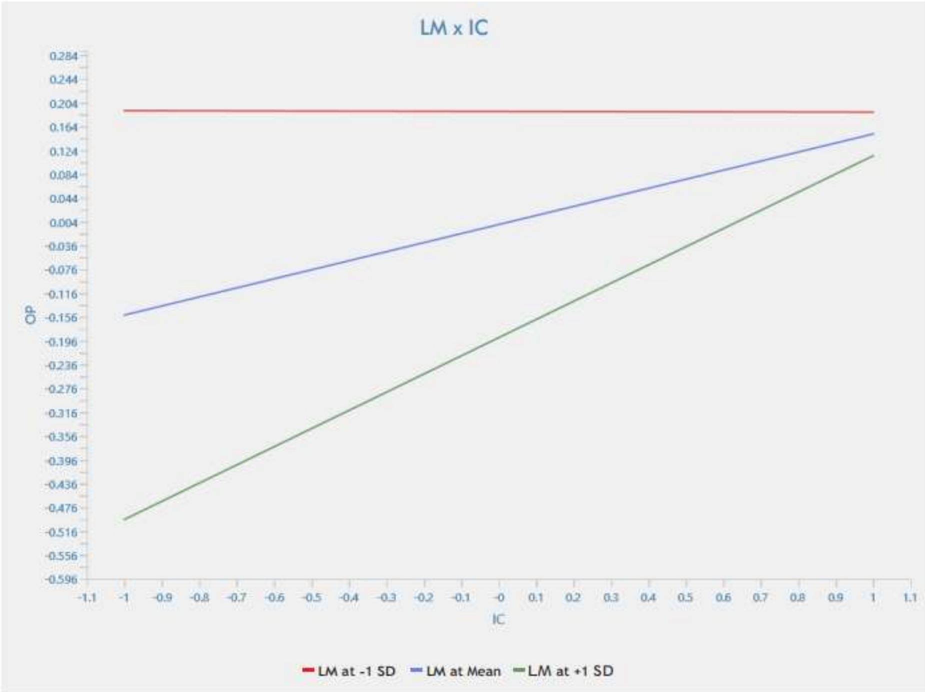

Figure 5: Interaction Effect (Objective 4)
Source: Field survey, Buabeng (2022)

Moderating Effect of Lean Manufacturing on the Relationship Between Transportation Costs and Operational Performance

Objective 5 examined the moderating effect of lean manufacturing on the relationship between TC and OP. The hypothesis (H_5) for the study was that lean manufacturing significantly moderates the relationship between transportation cost and operational performance of Food and Beverage manufacturing firms in Ghana. The result shows that LM is statistically insignificant in the predictive relationship between TC and OP of the Food and Beverage manufacturing firms studied (Beta = 0.044, t = 0.394 and p = 0.694: $p < 0.05$). The results did not support the hypothesised relationship. Hence, H_5 was not accepted. LM had a weak effect size (f^2=0.003). The result means that LM does not impact the relationship between TC and OP.

From the interaction effect in Figure 6 below, a reduction in LM activities shows a much steeper gradient, indicating improvement in the relationship between TC and OP. However, an increase in LM depicts a less steep gradient, indicating a slight increase in the strength and direction of the relationship between TC and OP. The Dynamic Capabilities Theory argues that Food and Beverage manufacturing firms can increase the connection between TC and OP when properly implementing LM (Teece *et al.*, 1997). However, the findings prove contrary to this assertion, which implies that there could be factors impeding the impact of LM on the relationship between TC and OP.

The Food and Beverage manufacturing firms could face implementation challenges such as a lack of proper alignment of transportation operations, inflexible transport infrastructure, contextual factors such as market demand fluctuations or regulatory constraints and measurement or data limitations. The finding of this study objective contradicts the findings of previous studies that found lean as a significant moderator of supply chain activities such as transportation and operational performance of manufacturing firms (Karakadilar & Hicks, 2015; Rana *et al.*, 2016; Marodin *et al.*, 2017; Zimmermann *et al.*, 2020).

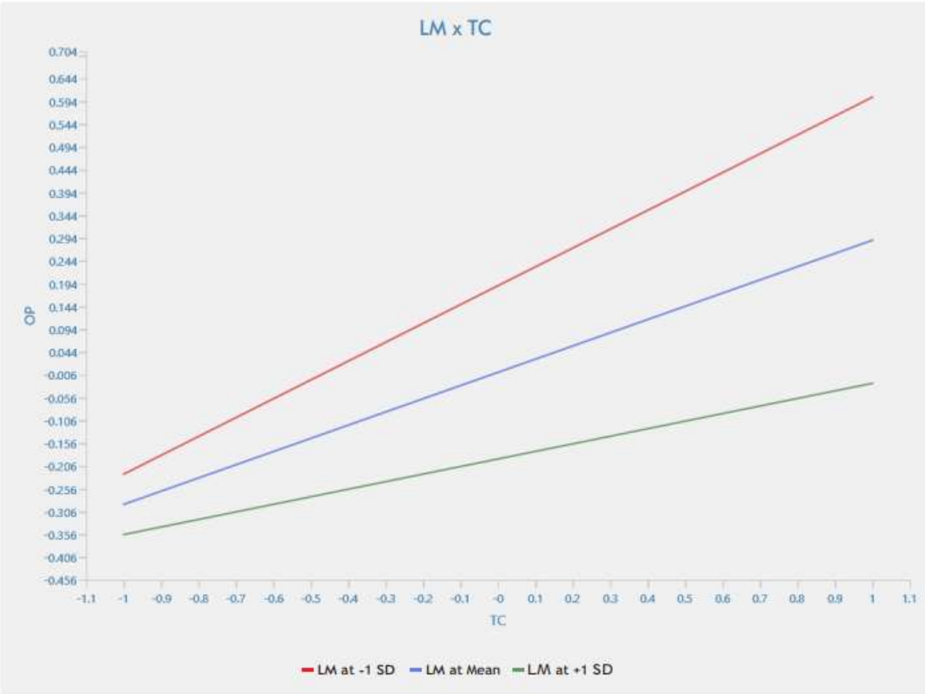

Figure 6: Interaction Effect (Objective 5)
Source: Field survey, Buabeng (2022)

Moderating Effect of Lean Manufacturing on the Relationship Between Quality Costs and Operational Performance

Objective 6 examined the moderation effect of LM in the relationship between QC and OP. The hypothesis (H_6) for the study was that lean manufacturing significantly moderates the relationship between quality cost and operational performance of Food and Beverage manufacturing firms in Ghana. The result reveals that LM moderated significantly and positively the predictive relationship between QC and OP of the Food and Beverage manufacturing firms studied (Beta = 0.420, t = 2.171 and p = 0.030: $p < 0.05$). The results supported the hypothesised relationship between QC and OP. Hence, H_6 was accepted. LM has a moderate effect size (f^2=0.194) and improves the strength of the relationship between QC and OP.

The interaction effect from Figure 7 shows that the introduction of LM in the relationship between QC and OP has a significant impact. An increase in LM shows a steeper gradient, depicting an improvement in the relationship between QC and OP. In contrast, a reduction in LM shows a less steep gradient. The result from the moderation analysis is supported by the Dynamic Capabilities Theory (DCT). DCT posits that Food and Beverage manufacturing firms could improve their operational performance if they develop the capacity to properly integrate cost reduction strategy, a lean approach, into their supply chain activities such as quality management (Teece *et al.*, 1997; Eisenhardt & Martin, 2000). The finding confirms earlier claims that LM moderates supply chain activities and operational performance of manufacturing firms (Karakadilar & Hicks, 2015; Rana *et al.*, 2016; Marodin *et al.*, 2017; Zimmermann *et al.*, 2020).

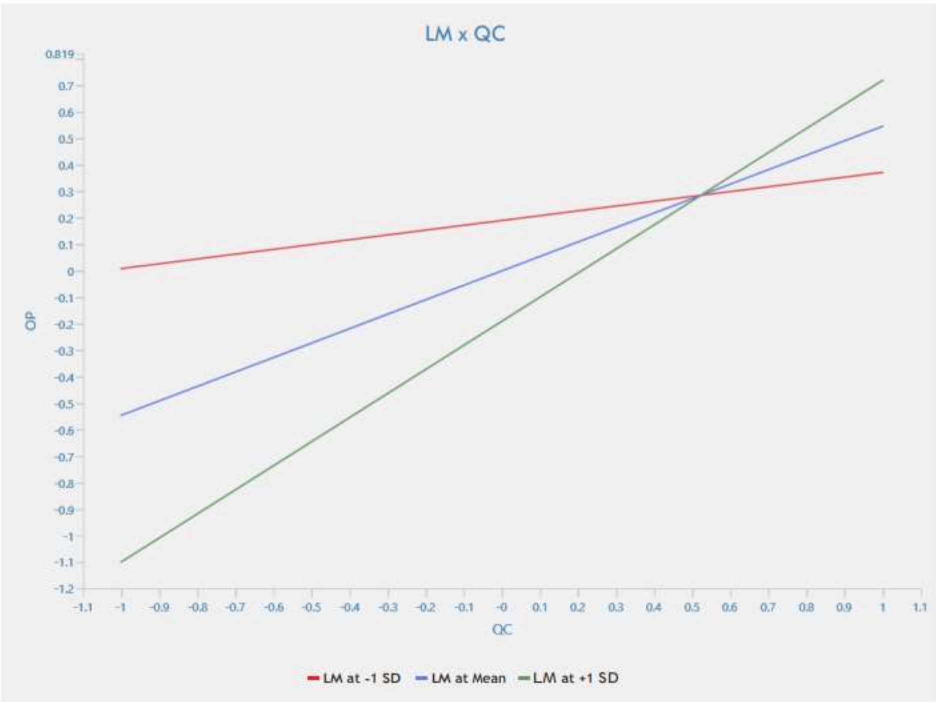

Figure 7: Interaction Effect (Objective 6)
Source: Field survey, Buabeng (2022)

Coefficient of Determination

Table 12 presents the R^2 of the model with the interaction effect. The result shows that SCCD and LM and their moderating effect accounted for a substantial positive variance in OP (R^2=0.773) when all other factors not accounted for in the study but affected OP of the Food and Beverage manufacturing firms studied are statistically controlled. Thus, 77.3% positive variance in OP is attributed to changes in SCCD, LM and its interaction effect. Also, the results reveal that implementing LM can statistically cause a significant improvement in the OP of Food and Beverage manufacturing firms in Ghana. The addition of LM as a moderating effect in the model shows an increase in the predictive capacity of SCCD on OP from 68.7% to 77.3%. This implies that LM implementation by Food and Beverage manufacturing firms is decisive in achieving higher operational performance.

Table 12: Coefficient of determination

	R-square	R-square adjusted
OP	0.773	0.755

Chapter Summary

This chapter presented the results obtained from the hypotheses test using the PLS-SEM and discussed the findings in relation to relevant related literature. The study found that IC, TC and QC affect the OP of the Food and Beverage manufacturing firms studied. The study also found that LM significantly moderates the relationship between IC, OP, and QC and OP. LM was found not to significantly moderate TC and OP.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The study sought to examine the effect of SCCD on the OP of Food and Beverage manufacturing firms in Ghana. The moderating effect of lean manufacturing was also evaluated. This section provides information on the summary of the study's findings, as elucidated in the previous chapter. It also presented the study's conclusions and, finally, the recommendations and suggestions for future research.

Summary

The study conceptually argued the significant impact of supply chain cost drivers on the operational performance of Food and Beverage manufacturing firms. The study specifically aimed to examine the effect of supply chain cost drivers on the operational performance of Food and Beverage manufacturing firms in Ghana and the moderating effect of lean manufacturing.

Based on the research objectives, the study developed and tested six hypotheses. The study adopted a positivist philosophy and employed an explanatory research design and quantitative research approach. The study used a census sampling technique, and a structured questionnaire based on extensive review was developed to collect data from 94 Food and Beverage manufacturing firms in Accra and Tema Metropolises. The data was processed using IBM SPSS Statistics (version 26) and Smart PLS (version 4.0.9.1). Descriptive statistics (frequencies and percentages) were used to analyse the demographic characteristics of the respondents and the firms. The structural equation modelling technique was employed in testing all six hypotheses of the study, with the significance of the path coefficients determined at t-statistics > 1.96 and p-value < 0.05.

The findings of the study based on the research objectives were as follows:

In research objective one, the study found that inventory costs with moderate effect size had a significant and positive effect on the operational performance of the Food and Beverage manufacturing firms studied. The finding implies that inventory carrying, holdings and stockout costs significantly enhanced the Food and Beverage manufacturing firms' operational performance.

For the second research objective, the study found that transportation costs significantly and positively affected the operational performance of the studied Food and Beverage manufacturing firms. The finding implies that transportation cost, even with a weak effect size, positively improves the operational performance levels among the surveyed Food and Beverage manufacturing firms.

Objective three of the study found that quality cost positively and significantly affected the operational performance of Food and Beverage manufacturing firms. The findings indicated that quality cost with a strong effect size substantially enhances the operating performance of the studied Food and Beverage manufacturing firms.

In objective four, the study found that lean manufacturing significantly moderates the relationship between inventory cost and operational performance of the studied Food and Beverage manufacturing firms. The finding of the objective indicated that LM had a moderate effect size in the relationship between IC and OP.

In relation to objective five, the study found that lean manufacturing with a weak effect size does not moderate the relationship between transportation cost and operational performance of the Food and Beverage manufacturing firms studied. This implies that LM did not play any role in enhancing the operational performance levels among the surveyed Food and Beverage manufacturing firms regarding their transportation activities.

The last objective of the study found that lean manufacturing significantly and positively moderates the relationship between quality cost and operational performance of the studied Food and Beverage manufacturing firms. The finding revealed a strong moderation effect of LM in the relationship between QC and OP.

Theoretical Implications of Findings

The study's findings partly shed light on Goldratt's (1990) Theory of Constraints (TOC) and Tecee et al. (1997) Dynamic Capability Theory (DCT). As a theory widely recognized as a management philosophy that seeks to identify and overcome the bottlenecks within a system, TOC, through the findings of this study, suggests that manufacturing firms must pay attention to managing supply chain cost drivers. The theoretical contribution is that inventory, transportation and quality costs are essential cost drivers among Food and Beverage Manufacturing firms due to the perishability nature of products, seasonal demand and production. It implies that managing these cost drivers will enhance the efficiency of the cost activity, thereby influencing operational performance.

In addition, the study highlights the theoretical contributions of the dynamic capability theory. It suggests that a supply chain strategy such as lean manufacturing is a catalyst for enhancing Food and Beverage manufacturing firms' supply chain activity's efficiency and effectiveness, thereby improving operational performance. It implies that implementing lean manufacturing is a conduit through which Food and Beverage manufacturing firms can enhance their supply chain activities and operating efficiency.

Managerial and Policy Implications of Findings

The outcome of this study is helpful to Food and Beverage manufacturing firms and, by extension, all manufacturing firms since these cost drivers cut across all manufacturing sectors in the industry. The study findings provide insight into the management of Food and Beverage manufacturing firms and the importance of instituting appropriate management strategies to enhance their supply chain activities. This study has highlighted strategies such as lean manufacturing to effectively remove non-value-added activities and reduce cost and waste from inter-and -intra-firm processes. Management of the Food and beverage manufacturing firms is encouraged through the findings of this study to pay adequate attention to supply chain cost drivers such as inventory costs, transportation costs, quality costs and the implementation of lean manufacturing.

Conclusions

Based on the findings of the study and in relation to the research objectives, the study draws the following conclusions:

In relation to objective one, the practical implication is that management of the Food and Beverage manufacturing firms should consider inventory cost as an important supply chain cost driver that affects the firm's operational performance. This is because inventory cost moderately contributes to operational performance among the studied Food and Beverage manufacturing firms. The result means that the manufacturing firms have appropriate inventory management strategies that ensure proper management of inventory ordering, handling and stockout or shortage costs. The finding is consistent with previous empirical studies. Conclusively, this finding provides grounds that inventory cost affects Food and Beverage manufacturing firms' operational performance regarding delivery reliability, flexibility and responsiveness, product quality and resource utilization.

For the second research objective, the study found that transportation cost is a vital component of the supply chain of Food and Beverage manufacturing firms and enhances operational performance. Hence, the practical implication is that the management of the firms should develop an efficient transport routine system and manage transportation activities to improve firm performance. Effective management of the transportation system could reduce the cost of transportation while enhancing product delivery reliability, flexibility and responsiveness, product quality and better resource utilization.

For research objective three, it can be concluded that quality cost is a key supply chain component affecting the Food and Beverage manufacturing firms' operational performance. Quality cost had a strong effect on the operational performance of the manufacturing firms studied. This implies that quality cost is a major contributor to operational performance among all the supply chain cost drivers studied. Hence, management of the Food and

Beverage manufacturing firms should consider the Prevention-Appraisal-Failure (PAF) approach as the best quality management strategy in their supply chain since it contributes to improving operational performance levels. The study concluded that the nature of Food and Beverage manufacturing operations requires strict adherence to food safety and quality standards; hence, quality cost plays a key role in their supply chains.

Research objectives 4 to 6 examined the moderating effect of LM (cost reduction strategy) in the relationship between IC and OP, TC and OP and QC and OP. LM significantly moderates the relationship between IC and OP and QC and OP. However, LM does not moderate the relationship between TC and OP. The study concludes that the Food and Beverage manufacturing firm's management should consider the cost reduction strategy of lean approach as a key strategy in all the supply chain activities. Hence, as a continuous implementation process, Food and Beverage firms should apply a cost-reduction strategy (lean approach) in all supply chain activities. A cost reduction strategy eliminates cost and inefficiencies from the system, thereby improving performance. This finding is supported by previous empirical studies where lean approach moderates the relationship between supply chain operations and operational performance.

Recommendations

In light of the research findings and conclusion drawn, the following conclusions were made:

The study recommended that managers of Food and Beverage manufacturing firms should pay adequate attention to quality costs within their supply chains. Management should strengthen the prevention-appraisal-failure

(PAF) approach to quality management since it is proven to be a better-quality management approach among the studied Food and Beverage manufacturing firms. Also, as indicated earlier, the Food and Beverage manufacturing firms are complex and face stringent regulations such as meeting specific quality standards. Therefore, the management of the Food and Beverage manufacturing firms should ensure that the PAF quality management approach is effectively implemented.

The study also recommended that management of the Food and Beverage manufacturing firms should implement appropriate inventory management strategies to reduce inventory holding, carrying and shortage costs. This is because inventory cost significantly improves the operational performance of Food and Beverage manufacturing firms. The inventories of Food and Beverage manufacturing firms are delicate and fragile, with a high perishability rate. Hence, implementing proper inventory management strategies and instituting appropriate stock levels can help reduce carrying, ordering, spoilage and stockout costs.

Further, the study recommended that the Food and Beverage manufacturing firms' management plan an optimal transportation route for their inbound and outbound activities that reduces travel times and fuel costs. Transportation is vital to Food and Beverage manufacturing firms, supporting upstream and downstream activities in the supply chain. An adequate transport route system that aligns with a cost-reduction strategy helps avoid any product defect and delays that may lead to the perishability of raw materials. The Food and Beverage manufacturing firms benefit from transportation in terms of delivery reliability, product quality, flexibility and responsiveness and resource utilisation when management institutes a cost-effective, well-planned and managed transportation system along the supply chain.

The study also recommends that management of the Food and Beverage manufacturing firms should continuously implement a cost reduction strategy, which is a lean manufacturing approach in their firms' supply chain processes. The study found that implementing a lean approach in supply chain processes is key in impacting the relationship between supply chain cost drivers and operational performance. Moreso, it is recommended that government should ensure the efficient management of the economy and institute national policies that encourage agriculture. This is because Food and Beverage firms rely on raw materials from agriculture products for production.

Suggestions for Future Studies

Further studies should be conducted in other Sub-Saharan African Countries' Food and Beverage manufacturing industries to expand the existing knowledge and help generalise findings. Also, further studies can look at different supply chain cost drivers and performance dimensions since this study was limited to only three SCCD and operational performance.

REFERENCES

Agyabeng-Mensah, Y., Tang, L., Afum, E., Baah, C., & Dacosta, E. (2021). Organisational identity and circular economy: are inter and intra organisational learning, lean management and zero waste practices worth pursuing? *Sustainable Production and Consumption*, *28*, 648-662.

Akbayev, E. T., & Tishtykbaeva, A. Z. (2014). The effectiveness of the use of the basic means of production and ways of its improvement. *Education and Science Without Borders*, *5*(10), 7.

Alzoubi, H. M., In'airat, M., & Ahmed, G. (2022). Investigating the impact of total quality management practices and Six Sigma processes to enhance the quality and reduce the cost of quality: the case of Dubai. *International Journal of Business Excellence*, *27*(1), 94-109.

Ammar, M., Haleem, A., Javaid, M., Walia, R., & Bahl, S. (2021). Improving material quality management and manufacturing organizations system through Industry 4.0 technologies. *Materials Today: Proceedings*, *45*, 5089-5096.

Anklesaria, J. (2008). *Supply chain cost management: the aim & drive process for achieving extraordinary results*. Amacom Books.

Aquilani, B., Silvestri, C., Ruggieri, A., & Gatti, C. (2017). A systematic literature review on total quality management critical success factors and the identification of new avenues of research. *The TQM Journal*.

Attaran, M. (2020) Digital technology enablers and their implications for supply chain management. In *Supply Chain Forum: An International Journal* (Vol. 21, No. 3, pp. 158-172). Taylor & Francis.

Ayach, L., Anouar, A., & Bouzziri, M. (2019). Quality cost management in Moroccan industrial companies: Empirical study. *Journal of Industrial Engineering and Management (JIEM)*, *12*(1), 97-114.

Baah, C., Opoku Agyeman, D., Acquah, I. S. K., Agyabeng-Mensah, Y., Afum, E., Issau, K., ... & Faibil, D. (2022). Effect of information sharing in supply chains: understanding the roles of supply chain visibility, agility, collaboration on supply chain performance. *Benchmarking: An International Journal*, *29*(2), 434-455.

Baah, C., Opoku-Agyeman, D., Acquah, I. S. K., Agyabeng-Mensah, Y., Afum, E., Faibil, D., & Abdoulaye, F. A. M. (2021). Examining the correlations between stakeholder pressures, green production practices, firm reputation, environmental and financial performance: evidence from manufacturing SMEs. *Sustainable Production and Consumption*, *27*, 100-114.

Bakri, M. (2019). Implementing Lean tools to streamline banking operations: A case study of a small Lebanese bank. *Management Studies and Economic Systems*, *4*(2), 131-144.

Basheer, M., Siam, M., Awn, A., & Hassan, S. (2019). Exploring the role of TQM and supply chain practices for firm supply performance in the presence of information technology capabilities and supply chain technology adoption: A case of textile firms in Pakistan. *Uncertain Supply Chain Management*, *7*(2), 275-288.

Bell, E., Bryman, A., & Harley, B. (2022). *Business research methods*. Oxford university press.

Bhat, S. A., Huang, N. F., Sofi, I. B., & Sultan, M. (2021). Agriculture-food supply chain management based on blockchain and IoT: A narrative on enterprise blockchain interoperability. *Agriculture*, *12*(1), 40.

Björkdahl, J. (2020). Strategies for digitalization in manufacturing firms. *California Management Review*, *62*(4), 17-36.

Bowersox, D. J., & Closs, D. J. (1996). *Logistical management: the integrated supply chain process*. McGraw-Hill College.

Bryman, A. (2016). *Social research methods*. Oxford university press.

Burgos, D., & Ivanov, D. (2021). Food retail supply chain resilience and the COVID-19 pandemic: A digital twin-based impact analysis and improvement directions. *Transportation Research Part E: Logistics and Transportation Review*, *152*, 102412.

Byrne, P. J., & Heavey, C. (2006). The impact of information sharing and forecasting in capacitated industrial supply chains: A case study. *International Journal of Production Economics*, *103*(1), 420-437.

Carbone, A. (2017). Food supply chains: coordination governance and other shaping forces. *Agricultural and Food Economics*, *5*(1), 3.

Cekerevac, Z., Dvorak, Z., & Prigoda, L. (2022). Lean manufacturing vs Covid-19. *MEST Journal*, *10*(1), 1-11.

Chopra, S., & Meindl, P. (2016). Global Edition.

Cohen, S., & Roussel, J. (2013). *Strategic supply chain management: the five disciplines for top performance*. McGraw-Hill Education.

Das, K., Rani, H., & Ray, S. (2023). Excess Inventory Management. *International Journal of Recent Advances in Multidisciplinary Topics*, *4*(4), 73-81.

Davis, K. F., Downs, S., & Gephart, J. A. (2021). Towards food supply chain resilience to environmental shocks. *Nature Food*, *2*(1), 54-65.

de Jesus Pacheco, D. A., Junior, J. A. V. A., & de Matos, C. A. (2021). The constraints of theory: What is the impact of the Theory of Constraints on Operations Strategy? *International Journal of Production Economics*, *235*, 107955.

Dieste, M., Panizzolo, R., & Garza-Reyes, J. A. (2021). A systematic literature review regarding the influence of lean manufacturing on firms' financial performance. *Journal of Manufacturing Technology Management*, *32*(9), 101-121.

Dixit, A., Jakhar, S. K., & Kumar, P. (2022). Does lean and sustainable manufacturing lead to Industry 4.0 adoption: The mediating role of ambidextrous innovation capabilities. *Technological Forecasting and Social Change*, *175*, 121328.

Dora, M., Wesana, J., Gellynck, X., Seth, N., Dey, B., & De Steur, H. (2020). Importance of sustainable operations in food loss: Evidence from the Belgian food processing industry. *Annals of operations research*, *290*, 47-72.

Farooque, M., Zhang, A., & Liu, Y. (2019). Barriers to circular food supply chains in China. *Supply Chain Management: An International Journal*, *24*(5), 677-696.

Fayezi, S., Zutshi, A., & O'Loughlin, A. (2017). Understanding and development of supply chain agility and flexibility: a structured literature review. *International journal of management reviews*, *19*(4), 379-407.

Feng, C. M., YUAN, C. Y., & LIN, Y. C. (2005). The system framework for evaluating the effect of collaborative transportation management on supply chain. *Journal of the Eastern Asia Society for Transportation Studies*, *6*, 2837-2851.

Filbeck, G., & Krueger, T. M. (2005). An analysis of working capital management results across industries. *American journal of business*.

Ghayas, M. M., & Hussain, J. (2015). Job satisfaction, service quality and the customer satisfaction in the IT sector of Karachi. *IJASOS-International E-journal of Advances in Social Sciences*, *1*(3), 443-451.

Given, L. M. (Ed.). (2008). *The Sage encyclopedia of qualitative research methods*. Sage publications.

Glogovac, M., & Filipovic, J. (2018). Quality costs in practice and an analysis of the factors affecting quality cost management. *Total Quality Management & Business Excellence*, *29*(13-14), 1521-1544.

Goodhue, D. L., Lewis, W., & Thompson, R. (2017). A Multicollinearity and Measurement Error Statistical Blind Spot. *Mis Quarterly*, *41*(3), 667-A15.

Goyit, K., Amagon, K. I., & Dangiwa, D. A. (2016). An assessment of drug supply chain system in selected facilities in Abuja and Plateau State, Nigeria.

Gregson, N., Crang, M., & Antonopoulos, C. N. (2017). Holding together logistical worlds: Friction, seams and circulation in the emerging 'global warehouse'. *Environment and Planning D: Society and Space*, *35*(3), 381-398.

Grimm, J. H., Hofstetter, J. S., & Sarkis, J. (2014). Critical factors for sub-supplier management: A sustainable food supply chains perspective. *International journal of production economics*, *152*, 159-173.

Guluma, D. A. (2019). Inventory management practices, challenges and prospects-the case of Asella Malt Factory. *ICTACT J. Manag. Stud*, *5*, 1095-1107.

Gupta, H., Kumar, S., Kusi-Sarpong, S., Jabbour, C. J. C., & Agyemang, M. (2021). Enablers to supply chain performance on the basis of digitization technologies. *Industrial Management & Data Systems*, *121*(9), 1915-1938.

Hair Jr, J. F., Sarstedt, M., Matthews, L. M., & Ringle, C. M. (2016). Identifying and treating unobserved heterogeneity with FIMIX-PLS: part I–method. *European Business Review*.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review*, *31*(1), 2-24.

Hanaysha, J. R., & Alzoubi, H. M. (2022). The effect of digital supply chain on organizational performance: An empirical study in Malaysia manufacturing industry. *Uncertain Supply Chain Management*, *10*(2), 495-510.

Herrigel, G., & Zeitlin, J. (2010). Inter-firm relations in global manufacturing: Disintegrated production and its globalization. *The Oxford handbook of comparative institutional analysis*, 527-561.

Hoa, H. T. T., Lien, B. T. B., Tam, T. T. A., Van Hinh, N., & Van Thanh, L. (2020). Critical Factors of Total Logistics Cost: A Survey of Vietnam-Based Logistics Service Providers. *Research in World Economy*, *11*(1), 202-111.

Hong, J., Liao, Y., Zhang, Y., & Yu, Z. (2019). The effect of supply chain quality management practices and capabilities on operational and innovation performance: Evidence from Chinese manufacturers. *International Journal of Production Economics*, *212*, 227-235.

Hu, J., Hu, Q., & Xia, Y. (2019). Who should invest in cost reduction in supply chains? *International Journal of Production Economics*, *207*, 1-18.

Hugos, M. H. (2018). *Essentials of supply chain management*. John Wiley & Sons.

Ivanov, D. (2022). Lean resilience: AURA (Active Usage of Resilience Assets) framework for post-COVID-19 supply chain management. *The International Journal of Logistics Management*, *33*(4), 1196-1217.

Izadi, A., Nabipour, M., & Titidezh, O. (2020). Cost models and cost factors of road freight transportation: A literature review and model structure. *Fuzzy Information and Engineering*, 1-21.

Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Gonzalez, E. S. (2022). Understanding the adoption of Industry 4.0 technologies in improving environmental sustainability. *Sustainable Operations and Computers*.

Jepherson, M. E., Ngugi, P. K., & Moronge, M. (2021). Effect of transportation management systems on supply chain performance of FMCG in Kenya.

Jiraruttrakul, R., Smutkupt, S., Marksin, W., Liu, L., & Thanathawee, C. (2017). Applying an EOQ model to reduce an inventory cost. *Journal of Supply Chain Management: Research and Practice*, *11*(1), 46-55.

Kaaria, L., Mburugu, K. N., & Kirima, L. K. (2020). The Effect of Procurement Practices on Supply Chain Performance of Selected Public Universities in Kenya.

Kariuki, M., Wanjau, K. L., & Gakure, R. W. (2011). Relationship between Corporate Governance and Growth of Organizations: A survey of Companies listed in Nairobi Stock Exchange. In *Proceedings of Kabarak University First International Conference*.

Ke, J. Y. F., Windle, R. J., Han, C., & Britto, R. (2015). Aligning supply chain transportation strategy with industry characteristics: Evidence from the US-Asia supply chain. *International Journal of Physical Distribution & Logistics Management*, *45*(9/10), 837-860.

Khanfar, A. A., Iranmanesh, M., Ghobakhloo, M., Senali, M. G., & Fathi, M. (2021). Applications of blockchain technology in sustainable manufacturing and supply chain management: A systematic review. *Sustainability*, *13*(14), 7870.

Khedkar, D., & Khedkar, R. (2020). New innovations in food packaging in food industry. *Emerging Technologies in Food Science: Focus on the Developing World*, 165-185.

Kiplagat, P. H. I. L. I. P. (2010). *The impact of strategic procurement in Communications Commission of Kenya* (Doctoral dissertation, University of Nairobi, Kenya).

Kiprotich, E., Gachunga, H., & Bonuke, R. (2018). Influence of cost leadership procurement strategy on performance of manufacturing firms in Kenya. *European Journal of Business and Strategic Management*, *3*(1), 32-51.

Klovienė, L., & Uosytė, I. (2019). Development of performance measurement system in the context of industry 4.0: a case study. *Inžinerinė ekonomika*, *30*(4), 472-482.

Koivula, L. (2015). Modeling supply chain costs in the automotive manufacturing industry: The case of Valmet Automotive.

Koumanakos, D. P. (2008). The effect of inventory management on firm performance. *International journal of productivity and performance management*.

Kumar, P., Maiti, J., & Gunasekaran, A. (2018). Impact of quality management systems on firm performance. *International Journal of Quality & Reliability Management*.

Lapena, D. (2022). The Impact of the Covid-19 Pandemic on Distribution Logistics.

Lari, A., & Asllani, A. (2013). Quality cost management support system: an effective tool for organisational performance improvement. *Total Quality Management & Business Excellence*, *24*(3-4), 432-451.

Lawson, B., Krause, D., & Potter, A. (2015). Improving supplier new product development performance: the role of supplier development. *Journal of Product Innovation Management*, *32*(5), 777-792.

Lee, R. (2021). The effects of smart factory operational strategies and system management on the innovative performance of small-and medium-sized manufacturing firms. *Sustainability*, *13*(6), 3087.

Li, L., Wang, Z., & Zhao, X. (2022). Configurations of financing instruments for supply chain cost reduction: evidence from Chinese manufacturing companies. *International Journal of Operations & Production Management*, (ahead-of-print).

Lopes, R. M. S. F. (2019). *Application of a multiple indirect cost pool system to a real case* (Doctoral dissertation, Universidade de Lisboa (Portugal)).

Lysons, K. (2020). *Procurement and supply chain management*. Pearson UK.

Lysons, K., & Farrington, B. (2020). *Procurement and supply chain management*. Pearson UK.

Lyu, G., Chen, L., & Huo, B. (2019). Logistics resources, capabilities and operational performance: A contingency and configuration approach. *Industrial Management & Data Systems*, *119*(2), 230-250.

Madhani, P. M. (2019). Strategic supply chain management for enhancing competitive advantages: developing business value added framework. *International Journal of Value Chain Management*, *10*(4), 316-338.

Madhani, P. M. (2020). Lean Six Sigma deployment in retail industry: enhancing competitive advantages. *The IUP Journal of Business Strategy*, *17*(3), 25-45.

Manzoor, U., Baig, S. A., Hashim, M., Sami, A., Rehman, H. U., & Sajjad, I. (2022). The effect of supply chain agility and lean practices on operational performance: a resource-based view and dynamic capabilities perspective. *The TQM Journal*, *34*(5), 1273-1297.

Manzouri, M., Ab-Rahman, M. N., Che Mohd Zain, C. R., & Jamsari, E. A. (2014). Increasing production and eliminating waste through lean tools and techniques for halal food companies. *Sustainability*, *6*(12), 9179-9204.

Marodin, G. A., Tortorella, G. L., Frank, A. G., & Godinho Filho, M. (2017). The moderating effect of Lean supply chain management on the impact of Lean shop floor practices on quality and inventory. *Supply Chain Management: An International Journal*.

Mason, R., Lalwani, C., & Boughton, R. (2007). Combining vertical and horizontal collaboration for transport optimisation. *Supply Chain Management: An International Journal*, *12*(3), 187-199.

Mason, S. J., Ribera, P. M., Farris, J. A., & Kirk, R. G. (2003). Integrating the warehousing and transportation functions of the supply chain. *Transportation Research Part E: Logistics and Transportation Review*, *39*(2), 141-159.

Mbugi, I. O., & Lutego, D. (2022). Effects of inventory control management systems on organization performance in Tanzania manufacturing industry-A case study of food and beverage manufacturing company in Mwanza city. *International journal of Engineering, Business and Management*, *6*(2).

Michaelides, M. P., Herodotou, H., Lind, M., & Watson, R. T. (2019). Port-2-port communication enhancing short sea shipping performance: The case study of Cyprus and the Eastern Mediterranean. *Sustainability*, *11*(7), 1912.

Mikalef, P., Pateli, A., Batenburg, R., & van de Wetering, R. (2014). Business alignment in the procurement domain: a study of antecedents and determinants of supply chain performance. *International Journal of Information Systems and Project Management*, *2*(1), 43-59.

Min, S., Zacharia, Z. G., & Smith, C. D. (2019). Defining supply chain management: in the past, present, and future. *Journal of business logistics*, *40*(1), 44-55.

Mofolasayo, A., Young, S., Martinez, P., & Ahmad, R. (2022). How to adapt lean practices in SMEs to support Industry 4.0 in manufacturing. *Procedia Computer Science*, *200*, 934-943.

Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2020). *Purchasing and supply chain management*. Cengage Learning.

Mourtzis, D., Samothrakis, V., Zogopoulos, V., & Vlachou, E. (2019). Warehouse design and operation using augmented reality technology: a papermaking industry case study. *Procedia Cirp*, *79*, 574-579.

Mouzani, I. A., & Bouami, D. R. I. S. S. (2019). The integration of lean manufacturing and lean maintenance to improve production efficiency. *International Journal of Mechanical and Production Engineering Research and Development*, *9*(1), 601-612.

Moyano-Fuentes, J., Maqueira-Marin, J. M., Martinez-Jurado, P. J., & Sacristan-Diaz, M. (2021). Extending lean management along the supply chain: impact on efficiency. *Journal of Manufacturing Technology Management*, *32*(1), 63-84.

Mpwanya, M. F., & Van Heerden, C. H. (2016). Perceptions of mobile network operators regarding the cost drivers of the South African mobile phone industry. *Acta Commercii*, *16*(1), 1-10.

Mubarik, S., Warsi, A. Z., Nayaz, M., & Malik, T. (2012). Transportation outsourcing and supply chain performance: A study of Pakistan's pharmaceutical industry. *South Asian Journal of Management*, *6*(2), 35-41.

Mulyono, D. P. I. (2020). Model to Implement Theory of Constraint in Sea Transportation System.

Mushabbar, F. S. (2019). Determinants of the Perceived Supply Chain Cost. *RADS Journal of Business Management*, *1*(2), 103-113.

Mwangangi, P. W. (2016). *Influence of logistics management on performance of manufacturing firms in Kenya* (Doctoral dissertation, COHred, supply chain managent, JKuat).

Mwangi, N. W. (2021). Influence of Procurement Cost Optimization on Performance of Manufacturing Firms in Kenya. *International Academic Journal of Procurement and Supply Chain Management*, *3*(2), 193-214.

Nabass, E. H., & Abdallah, A. B. (2019). Agile manufacturing and business performance: The indirect effects of operational performance dimensions. *Business Process Management Journal*, *25*(4), 647-666.

Oliveira, J., Sá, J. C., & Fernandes, A. (2017). Continuous improvement through" Lean Tools": An application in a mechanical company. *Procedia Manufacturing*, *13*, 1082-1089.

Onufrey, K., & Bergek, A. (2021). Transformation in a mature industry: The role of business and innovation strategies. *Technovation*, *105*, 102190.

Opoku, R. K., Fiati, H. M., Kaku, G., Ankomah, J., & Opoku-Agyemang, F. (2020). Inventory management practices and operational performance of manufacturing firms in Ghana. *Advances in Research*, *21*(10), 1-18.

Owoo, N. S., & Lambon-Quayefio, M. P. (2018). The agro-processing industry and its potential for structural transformation of the Ghanaian economy. *Industries Without Smokestacks: Industrialization in Africa Reconsidered*, 191-212.

Paliwal, V., Chandra, S., & Sharma, S. (2020). Blockchain technology for sustainable supply chain management: A systematic literature review and a classification framework. *Sustainability*, *12*(18), 7638.

Panneerselvam, M. K. (2012). TPM implementation to invigorate manufacturing performance: an Indian industrial rubric. *International Journal of Scientific & Engineering Research*, *3*(6), 1-10.

Pettersson, A. I., & Segerstedt, A. (2013). Measuring supply chain cost. *International Journal of Production Economics*, *143*(2), 357-363.

Prajogo, D., Chowdhury, M., Yeung, A. C., & Cheng, T. C. E. (2012). The relationship between supplier management and firm's operational performance: A multi-dimensional perspective. *International journal of production economics*, *136*(1), 123-130.

Prasad, S., & Tata, J. (2000). Information investment in supply chain management. *Logistics Information Management*.

Qian, J., Dai, B., Wang, B., Zha, Y., & Song, Q. (2022). Traceability in food processing: problems, methods, and performance evaluations—a review. *Critical Reviews in Food Science and Nutrition*, *62*(3), 679-692.

Ramaa, A., Subramanya, K. N., & Rangaswamy, T. M. (2012). Impact of warehouse management system in a supply chain. *International Journal of Computer Applications*, *54*(1).

Ramli, A., Bakar, M. S., Pulka, B. M., & Ibrahim, N. A. (2017). Linking human capital, information technology and material handling equipment to warehouse operations performance. *International Journal of Supply Chain Management*, *6*(4), 254-259.

Ranjan, S., Jha, V. K., & Pal, P. (2017). Application of emerging technologies in ERP implementation in Indian manufacturing enterprises: an exploratory analysis of strategic benefits. *The International Journal of Advanced Manufacturing Technology*, *88*, 369-380.

Rauter, R., Jonker, J., & Baumgartner, R. J. (2017). Going one's own way: drivers in developing business models for sustainability. *Journal of Cleaner Production*, *140*, 144-154.

Reyes, J., Mula, J., & Díaz-Madroñero, M. (2021). Development of a conceptual model for lean supply chain planning in industry 4.0: multidimensional analysis for operations management. *Production Planning & Control*, 1-16.

Rezaee, A., Dehghanian, F., Fahimnia, B., & Beamon, B. (2017). Green supply chain network design with stochastic demand and carbon price. *Annals of operations research*, *250*(2), 463-485.

Richards, G., & Grinsted, S. (2020). *The Logistics and Supply Chain Toolkit: Over 100 Tools for Transport, Warehousing and Inventory Management*. Kogan Page Publishers.

Rodrigue, J. P., Slack, B., & Comtois, C. (2017). Green logistics. In *Handbook of logistics and supply-chain management*. Emerald Group Publishing Limited.

Sachan, A., & Datta, S. (2005). Review of supply chain management and logistics research. *International Journal of Physical Distribution & Logistics Management*.

Sánchez-Rodríguez, C., Hemsworth, D., Martínez-Lorente, Á. R., & Clavel, J. G. (2006). An empirical study on the impact of standardization of materials and purchasing procedures on purchasing and business performance. *Supply Chain Management: An International Journal*, *11*(1), 56-64.

Sarkar, B., Tayyab, M., Kim, N., & Habib, M. S. (2019). Optimal production delivery policies for supplier and manufacturer in a constrained closed-loop supply chain for returnable transport packaging through metaheuristic approach. *Computers & Industrial Engineering*, *135*, 987-1003.

Sarkis, J., Meade, L., & Talluri, S. (2017). E-logistics and the natural environment. In *The ecology of the new economy* (pp. 35-51). Routledge.

Saryatmo, M. A., & Sukhotu, V. (2021). The influence of the digital supply chain on operational performance: a study of the Food and Beverage industry in Indonesia. *Sustainability*, *13*(9), 5109.

Saunders, M. N., Lewis, P., Thornhill, A., & Bristow, A. (2015). Understanding research philosophy and approaches to theory development.

Schmidt, C. G., & Wagner, S. M. (2019). Blockchain and supply chain relations: A transaction cost theory perspective. *Journal of Purchasing and Supply Management*, *25*(4), 100552.

Schniederjans, M. J., Hamaker, J. L., & Schniederjans, A. M. (2010). *Information technology investment: Decision-making methodology*. World Scientific Publishing Company.

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. john wiley & sons.

Semuel, H., Siagian, H., & Arnius, R. (2018). *The effects of strategic purchasing on organization performance through negotiation strategy and buyer-supplier relationship* (Doctoral dissertation, Petra Christian University).

Sezen, B. (2005). The role of logistics in linking operations and marketing and influences on business performance. *Journal of Enterprise Information Management*, *18*(3), 350-356.

Shahid, M. S., & Abbas, M. (2019). Does corporate governance play any role in investor confidence, corporate investment decisions relationship? Evidence from Pakistan and India. *Journal of Economics and Business*, *105*, 105839.

Sharma, S., & Modgil, S. (2020). TQM, SCM and operational performance: an empirical study of Indian pharmaceutical industry. *Business Process Management Journal*, *26*(1), 331-370.

Sharma, S., Gahlawat, V. K., Rahul, K., Mor, R. S., & Malik, M. (2021). Sustainable innovations in the food industry through artificial intelligence and big data analytics. *Logistics*, *5*(4), 66.

Siagian, H., Tarigan, Z. J. H., & Jie, F. (2021). Supply chain integration enables resilience, flexibility, and innovation to improve business performance in COVID-19 era. *Sustainability*, *13*(9), 4669.

Silali, N. C. (2019). *Influence of Quality Costs on Performance of the National Cereals and Produce Board in Kapenguria, West Pokot County Kenya* (Doctoral dissertation, University of Nairobi).

Şimşit, Z. T., Günay, N. S., & Vayvay, Ö. (2014). Theory of constraints: A literature review. *Procedia-Social and Behavioral Sciences*, *150*, 930-936.

Singh, J. (2022). Concepts of inventory and related technical terminologies: a literature review.

Singh, K., & Misra, S. (2018). Theory of constraints for managing downstream supply chain in Indian FMCG sector: A literature review. *Journal of Supply Chain Management Systems*, *7*(1), 50.

Smith, R., & Hawkins, B. (2004). *Lean maintenance: reduce costs, improve quality, and increase market share*. Elsevier.

Song, J. S., & Zhang, Y. (2020). Stock or print? Impact of 3-D printing on spare parts logistics. *Management Science*, *66*(9), 3860-3878.

Stadnicka, D., & Litwin, P. (2019). Value stream mapping and system dynamics integration for manufacturing line modelling and analysis. *International Journal of Production Economics*, *208*, 400-411.

Stankevičiūtė, Ž., & Savanevičienė, A. (2019). Can sustainable HRM reduce work-related stress, work-family conflict, and burnout?. *International Studies of Management & Organization*, *49*(1), 79-98.

Stentoft Arlbjørn, J., Vagn Freytag, P., & De Haas, H. (2011). Service supply chain management: A survey of lean application in the municipal sector. *International Journal of Physical Distribution & Logistics Management*, *41*(3), 277-295.

Sturm, S., Kaiser, G., & Hartmann, E. (2019). Long-run dynamics between cost of quality and quality performance. *International Journal of Quality & Reliability Management*.

Taak, A., & Kumar, R. (2019). Supply chain issues and challenges for cement industries of India: A case study. In *Advances in Industrial and Production Engineering: Select Proceedings of FLAME 2018* (pp. 297-302). Springer Singapore.

Taghipour, A., Hoang, P., & Cao, X. (2020). Just in time/lean purchasing approach: an investigation for research and applications. *Journal of Advanced Management Science*, *8*(2).

Tarigan, Z. J. H., & Siagian, H. (2021). *The effects of strategic planning, purchasing strategy and strategic partnership on operational performance* (Doctoral dissertation, Petra Christian University).

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic management journal*, *28*(13), 1319-1350.Teece, D. J. (2017). Dynamic capabilities and (digital) platform lifecycles. In *Entrepreneurship, innovation, and platforms*. Emerald Publishing Limited.

Teece, D. J. (2018). Business models and dynamic capabilities. *Long range planning*, *51*(1), 40-49.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, *18*(7), 509-533.

Teichgräber, U. K., & de Bucourt, M. (2012). Applying value stream mapping techniques to eliminate non-value-added waste for the procurement of endovascular stents. *European journal of radiology*, *81*(1), e47-e52.

Thomas, D. S., & Gilbert, S. W. (2014). Costs and cost effectiveness of additive manufacturing. *NIST special publication*, *1176*, 12.

Thrulogachantar, P., & Zailani, S. (2011). The influence of purchasing strategies on manufacturing performance: An empirical study in Malaysia. *Journal of Manufacturing Technology Management*, *22*(5), 641-663.

Tien, N. H., Anh, D. B. H., & Thuc, T. D. (2019). Global supply chain and logistics management. *Dehli: Academic Publications*.

Tomašević, I., Stojanović, D., Slović, D., Simeunović, B., & Jovanović, I. (2021). Lean in High-Mix/Low-Volume industry: a systematic literature review. *Production Planning & Control*, *32*(12), 1004-1019.

Truong, K. D. (2023). Impact of inventory management on firm performance a case study of listed manufacturing firms on hose. *International Journal of Information, Business and Management*, *15*(1), 93-115.

Tukamuhabwa, B. R. (2023). Supply Chain Orientation and Supply Chain Risk Management Capabilities: Mechanisms for Supply Chain Performance of Agro-Food Processing Firms in Uganda. *Journal of African Business*, 1-24.

Vlachos, I. P. (2013). Key performance indicators of the impact of radio frequency identification technologies on supply chain management. *International Journal of RF Technologies*, *4*(2), 127-146.

Vogelsang, K., Liere-Netheler, K., Packmohr, S., & Hoppe, U. (2018). Success factors for fostering a digital transformation in manufacturing companies. *Journal of Enterprise Transformation*, *8*(1-2), 121-142.

Vogelsang, K., Packmohr, S., Liere-Netheler, K., & Hoppe, U. (2018, September). Understanding the transformation towards industry 4.0. In *International Conference on Business Informatics Research* (pp. 99-112). Springer, Cham.

Wong, C. Y., Boon-Itt, S., & Wong, C. W. (2011). The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance. *Journal of Operations management*, *29*(6), 604-615.

Wu, L. Y. (2010). Applicability of the resource-based and dynamic-capability views under environmental volatility. *Journal of business research*, *63*(1), 27-31.

Ye, F., & Wang, Z. (2013). Effects of information technology alignment and information sharing on supply chain operational performance. *Computers & Industrial Engineering*, *65*(3), 370-377.

Yusifli, F. (2022). *Optimization (automation) of transportation and storage of finished product in industrial enterprises* (Doctoral dissertation).

Yusuf, Y. Y., Sarhadi, M., & Gunasekaran, A. (1999). Agile manufacturing: The drivers, concepts and attributes. *International Journal of production economics*, *62*(1-2), 33-43.

Zhao, G., Olan, F., Liu, S., Hormazabal, J. H., Lopez, C., Zubairu, N., ... & Chen, X. (2022). Links Between Risk Source Identification and Resilience Capability Building in Agri-Food Supply Chains: A Comprehensive Analysis. *IEEE Transactions on Engineering Management*.

Zhong, R. Y., Xu, X., Klotz, E., & Newman, S. T. (2017). Intelligent manufacturing in the context of industry 4.0: a review. *Engineering*, *3*(5), 616-630.

Zhou, X., Zhu, Q., & Xu, Z. (2022). The mediating role of supply chain quality management for traceability and performance improvement: Evidence among Chinese food firms. *International Journal of Production Economics*, *254*, 108630.

Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2013). *Business research methods*. Cengage Learning.

Zsidisin, G. A., Panelli, A., & Upton, R. (2000). Purchasing organization involvement in risk assessments, contingency plans, and risk management: an exploratory study. *Supply Chain Management: an international journal*.

APPENDIX I

QUESTIONNAIRE

UNIVERSITY OF CAPE COAST

COLLEGE OF HUMANITIES AND LEGAL STUDIES

SCHOOL OF BUSINESS

DEPARTMENT OF MARKETING AND SUPPLY CHAIN MANAGEMENT

Questionnaire on Supply Chain Costs Drivers and Operational Performance of Manufacturing Firms in Ghana: Moderating Effect of Lean Manufacturing.

Dear Sir/Madam

The researcher is a student at the Department of Marketing and Supply Chain Management, School of Business, University of Cape Coast, Ghana. This questionnaire is to solicit information on the above topic. You are invited to share your views on the issue under investigation. The responses would be used purely for academic purposes; hence, your confidentiality is greatly assured. Thank you for your time and participation.

SECTION A: SUPPLY CHAIN COST DRIVERS

On a scale of 1 – 7 where 1 – Strongly Disagree and 7 – Strongly Agree, please indicate the extent of your agreement to the statements below.

Supply Chain Cost Drivers								
Inventory Costs		**1**	**2**	**3**	**4**	**5**	**6**	**7**
IC1	The firm orders raw materials, components and parts on a frequent basis from suppliers							
IC2	The firm carries too many inventories at the warehouses and stores							
IC3	There is always stock out of inventories							

	before new orders are received in the warehouses							
	Transportation Costs	**1**	**2**	**3**	**4**	**5**	**6**	**7**
TC1	The firm transports raw materials from suppliers to the organization							
TC2	The firm transports finished products to its customers (wholesalers or retailers)							
TC3	All the firm's vehicles have insurance covers							
TC4	Due to the firm's product supply routine schedules and the frequency of shipments, maintenance and repairs are frequent							
TC5	The firm engages the services of third-party logistics (3PL) providers to assist with the transportation schedules							
	Quality Costs	**1**	**2**	**3**	**4**	**5**	**6**	**7**
QC1	The firm educates and train employees on quality (e.g., workshops and seminars)							
QC2	The firm conducts audit and process improvement (e.g., failure mode and effect analysis and root cause failure analysis) and selects suppliers and contractors based on vendor/supplier quality certification							
QC3	Raw material inspection, in-process inspection and finished goods inspection is done for all product lines in the firm							
QC4	The firm conducts equipment testing or product testing as well as product and process quality audit							
QC5	The firm carries out rework, reinspection and retesting before goods are delivered to customers							
QC6	The firm recall default products and carries rework on product returned by customers							
QC7	The firm settles customer complaints and grant warranty claims							

SECTION B: LEAN MANUFACTURING

On a scale of 1 – 7 where 1 – Strongly Disagree and 7 – Strongly Agree, please indicate the extent of your agreement to the statements below.

Lean Manufacturing		1	2	3	4	5	6	7
LM1	The firm selects suppliers based on their performance in low cost and high quality							
LM2	The firm maintains long collaborative relationships with suppliers (including partnerships and joint ventures at the operational level)							
LM3	Our suppliers are directly involved in any new product development process							
LM4	The firm reduces costs through mass production							
LM5	The firm uses lean manufacturing techniques such as pull flow, kaban system and setup time reduction.							
LM6	The firm reduces the cost and time of transportation and warehousing through strategies such as cross docking, vendor managed inventory (VMI), third party logistics and distribution centres							

SECTION C: OPERATIONAL PERFORMANCE

On a scale of 1 – 7 where 1 – Strongly Disagree and 7 – Strongly Agree, please indicate the extent of your agreement to the statements below.

Operational Performance								
Statements		**1**	**2**	**3**	**4**	**5**	**6**	**7**
OP1	The firm transportation route system ensures the timely delivery of products to the right customers (right place)							
OP2	The firm's product delivery meets customers' expected lead times and quantities							
OP3	Products delivered to customers are in perfect condition							
OP4	The firm's prevention measures put in place have enhanced the product quality in the production line							
OP5	The firm's quality failure measures ensure reduction in rework, scrap and repeat inspection							
OP6	Warranty claims, product returns and customer compensations have reduced							
OP7	The firm's appraisal methods have reduced quality defects and errors							
OP8	Our transport system is in full utilization enabling us to carry inputs into the organization and output to our customers							

SECTION D: DEMOGRAPHIC INFORMATION

Please indicate by ticking your appropriate answer in the box after each statement

Respondent Profile					
Gender	Male		**Qualification**	HND Only	
	Female			HND with Professional Certificate	
Age (years)	28 – 35			First Degree Only	
	36 – 45			First Degree with Professional Certificate	
	46 – 55			Master's Degree Only	
	56 – 60			Master's Degree with Professional Certificate	
Position	Supply Chain Manager			PhD Only	
	Operations Manager			PhD with Professional Certificate	
	Procurement Manager			Professional Certificate Only	
	General Manager		**Years of Experience**	3 years	
	Other			4 – 7 years	
				More than 7 years	
Industrial Sector	Food and Beverage processing		**Company Size**	Small (Less than 100 employees)	
				Medium (100-500 employees)	
				Large (More than 500 employees)	