



LEAN SUPPLY CHAIN MANAGEMENT AND PERFORMANCE OF CHEMICAL & ALLIED MANUFACTURING SECTOR IN NAIROBI CITY COUNTY

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ABSTRACT

This study examines the influence of lean supply chain management practices on the performance of manufacturing firms in Nairobi County, Kenya, specifically within the Chemical & Allied sector. It focuses on key components of lean supply chain management, including lean integration, and lean distribution, as independent variables. Utilizing a purposive sampling approach, the research targets a population of 360 manufacturing companies listed in the Kenya Association of Manufacturers (KAM) directory, with a sample size of 192 respondents determined using Yamane's 1997 formula at a 90% confidence interval and a 0.05 margin of error. The study seeks to identify the relationship between these lean practices and firm performance, highlighting their significance in enhancing operational efficiency, reducing waste, and improving overall firm outcomes. The findings are expected to provide practical insights for firms, particularly within the Chemical & Allied sector, demonstrating how strategic implementation of lean practices can lead to competitive advantages. Moreover, the research contextualizes these insights within the broader manufacturing landscape of Nairobi, encompassing sectors like Food & Beverage, Plastics & Rubber, and Pharmaceuticals, thereby offering a comprehensive understanding of how lean practices can potentially enhance performance across diverse manufacturing environments.

Key Words: Lean Supply Chain Management Practices, Performance of Manufacturing Firms, Lean Supply Chain Management, Lean Integration, Lean Distribution

Background of the study

The lean manufacturing system, as delineated by Basu, Ghosh, and Dan (2018), emphasizes the methodical identification and eradication of waste from processes, concurrently striving for continuous improvement while ensuring the delivery of high-quality products to both manufacturers and consumers at minimized costs. Lukman and Salim (2017) characterize lean manufacturing as an approach that optimizes resources by halving human effort, factory space, tool investment, and engineering hours required for product development, resulting in reduced inventory levels and defects, as noted by Tortorella & Fettermann (2018). The core tenet of lean management revolves around waste elimination, targeting reductions in time, money, and effort through the identification and elimination of non-value-adding steps in business processes.

Moreover, the origins of lean thinking in engineering, as discussed by De Angelis, Howard, and Miemczyk (2018), have permeated various industries, including healthcare and manufacturing, as evidenced by studies from McKinsey & Company (2014), Manrodt & Vitasek (2005), McIntosh, Heppy, & Cohen (2014), and Rexhepi & Shrestha (2011). In manufacturing, the primary goal of lean implementation, highlighted by McIntosh et al. (2014), is waste reduction alongside improvements in quality, speed, and flexibility within organizational processes. Alhuraish, Robledo, and Kobi (2017) emphasize the broad impact of lean principles across operational domains, evolving from best practices to integral components of business operations. Additionally, Marodin, Frank, Tortorella, and Netland (2018) enumerate the manifold benefits of lean practices, including heightened quality, augmented labor productivity, shortened customer cycle times, reduced lead times, and diminished manufacturing costs. Consequently, this study aims to ascertain the impact of lean management practices on the performance of manufacturing firms in Kenya's Nairobi County.

In addition to its widespread adoption across industries, the lean approach has gained traction in emerging economies like Kenya, where manufacturing firms seek to enhance their competitive edge in the global market. As highlighted by studies such as McKinsey & Company (2014) and Rexhepi & Shrestha (2011), the implementation of lean practices in developing countries presents unique challenges and opportunities due to varying socio-economic contexts and infrastructure constraints. Thus, understanding the applicability and effectiveness of lean supply chain management practices within the Kenyan manufacturing landscape is crucial for fostering sustainable growth and competitiveness.

Furthermore, Nairobi County serves as a focal point for manufacturing activities in Kenya, given its strategic location, infrastructure, and access to skilled labor. However, despite its potential, manufacturing firms in Nairobi face numerous challenges, including inefficient supply chain management practices, limited access to capital, and regulatory hurdles. By investigating the relationship between lean supply chain management practices and firm performance specifically within Nairobi County, this study aims to provide valuable insights that can inform policy decisions, managerial strategies, and operational improvements, ultimately contributing to the growth and development of Kenya's manufacturing sector.

Statement of the problem

The manufacturing sector within Nairobi City County, particularly the Chemical & Allied sector, continues to face substantial challenges in optimizing its operational efficiencies, especially within its supply chain frameworks. Despite the sector's critical role in driving Kenya's industrial growth, inefficiencies in traditional supply chain management approaches—characterized by excessive lead times, poor resource utilization, and operational bottlenecks—remain pervasive. These inefficiencies contribute to suboptimal performance, manifesting in escalated operational costs, missed production deadlines, and compromised product quality, which ultimately detract from the sector's competitiveness (Ondiek & Kisombe, 2012; Openda, 2019).

Globally, the adoption of Lean Supply Chain Management (LSCM) has proven to be a strategic approach to mitigating these inefficiencies, particularly through the reduction of waste and continuous process improvement (Panwar et al., 2015; Giannakis & Papadopoulos, 2016). LSCM integrates lean principles across sourcing, operations, integration, and distribution to drive efficiencies. However, while the theoretical benefits of LSCM are well-documented in industrialized nations, its practical application and measurable impact on manufacturing firms in Kenya, particularly in the Chemical & Allied sector, remain underexplored. Empirical evidence specific to the Kenyan context is scarce, leaving a significant knowledge gap in understanding the local efficacy of these practices (Ondiek & Kisombe, 2012; Nallusamy, 2016).

Compounding this issue are the unique challenges presented by Nairobi's local business environment, such as inadequate infrastructure, fluctuating regulatory frameworks, and inconsistent access to advanced technologies. These challenges hinder the seamless integration of lean practices, particularly in a developing economy context where market volatility and resource constraints are more pronounced than in developed nations (Panwar et al., 2015). The lack of data on how these local factors impact the successful implementation of LSCM in Nairobi's Chemical & Allied sector exacerbates this gap.

Additionally, the sector's performance, as highlighted by its contribution to Kenya's GDP—just 12.8% in 2019, which remains below expected growth targets (RoK, 2015; Openda, 2019)—signals the urgent need for more effective and transformative management practices. Traditional supply chain models are insufficient in addressing the modern needs of dynamic production environments, where flexibility, speed, and cost-efficiency are paramount. In contrast, LSCM offers a more adaptive and sustainable approach by embedding information and communication technology (ICT) into the supply chain to enhance decision-making and performance optimization (Giannakis & Papadopoulos, 2016; Nallusamy, 2016).

This study, therefore, seeks to fill this research gap by empirically examining the relationship between LSCM practices and the operational performance of manufacturing firms in the Chemical & Allied sector in Nairobi City County. The investigation will focus on key performance metrics such as cost control, quality management, and customer satisfaction, providing critical insights into the applicability of lean principles in enhancing operational efficiency. The findings of this research will be vital for policymakers, industry leaders, and academia, offering evidence-based recommendations that can inform strategic decisions and foster sustainable growth within Kenya's manufacturing sector (Openda, 2019).

General objective

The general objective of this study will be to determine the impact of lean supply chain on the performance of manufacturing firms in Kenya.

Specific objectives

1. To evaluate the impact of lean integration on the performance of manufacturing firms.
2. To investigate the effects of lean distribution on the performance of manufacturing firms.

LITERATURE REVIEW

Theoretical framework

Information theory

Developed by Claude Shannon in 1948, Information Theory focuses on the quantification, storage, and communication of information. It seeks to understand how information is processed and transmitted efficiently within systems. In the context of LSCM, Information

Theory is highly relevant, as it emphasizes the importance of accurate and timely information exchange among supply chain partners. Efficient information flow enables better decision-making, inventory management, and coordination of activities, thereby enhancing the overall performance of manufacturing firms (Shannon, 1948). This equation was published in the 1949 book *The Mathematical Theory of Communication*, co-written by Claude Shannon and Warren Weaver. An elegant way to work out how efficient a code could be, it turned "information" from a vague word related to how much someone knew about something into a precise mathematical unit that could be measured, manipulated and transmitted. It was the start of the science of "information theory", a set of ideas that has allowed us to build the internet, digital computers and telecommunications systems. When anyone talks about the information revolution of the last few decades, it is Shannon's idea of information that they are talking about. Information theory was created to find practical ways to make better, more efficient codes and find the limits on how fast computers could process digital signals. Every piece of digital information is the result of codes that have been examined and improved using Shannon's equation.

For instance, lean sourcing relies heavily on the availability of accurate information regarding suppliers, market trends, and demand forecasts. By leveraging Information Theory principles, firms can optimize their sourcing decisions and minimize procurement costs. Efficient information exchange facilitates lean integration by enabling seamless communication and collaboration among supply chain partners. Additionally, in lean distribution, timely information on transportation routes, inventory levels, and customer demand ensures the smooth flow of goods to the end consumer.

Statistics show that companies that effectively leverage Information Theory principles in their supply chain operations achieve higher levels of performance. For example, a study by Smith et al. (2019) found that firms with advanced information systems and data analytics capabilities experienced a 15% increase in supply chain efficiency and a 10% reduction in operating costs. In conclusion, information theory provides a valuable theoretical lens for understanding the role of information flows in lean supply chain management and its impact on manufacturing firm performance. By leveraging information theory principles, manufacturing firms in Kenya can enhance sourcing, production, integration, and distribution processes, leading to improved operational efficiency and competitiveness. However, further research is needed to explore the applicability of information theory within the specific context of manufacturing firms in Kenya and to address the limitations and gaps identified in the existing literature.

Organizational learning theory

Organizational Learning Theory, rooted in psychology and management studies, explores how organizations acquire, interpret, and apply knowledge to improve performance and adapt to changing environments. Developed by Chris Argyris and Donald Schön in the 1970s, Organizational Learning Theory emphasizes the importance of continuous learning, experimentation, and reflection in driving organizational change and innovation (Argyris & Schön, 1978). This inquiry fosters learning through collaborative interactions within the organization, facilitating the exchange of insights and experiences. Moreover, Organizational Learning Theory emphasizes the importance of continual learning, knowledge sharing, and adaptation in achieving sustainable competitive advantage in today's fast-paced and competitive business environment. By cultivating a culture of inquiry and fostering knowledge exchange, organizations can not only address discrepancies but also capitalize on opportunities for innovation and improvement, thereby enhancing their overall performance (Dixon, 1994; Senge, 1990).

In the context of LSCM, Organizational Learning Theory underscores the significance of fostering a culture of learning, collaboration, and knowledge sharing within supply chain networks. Lean sourcing requires organizations to learn from past experiences, market

feedback, and supplier relationships to make informed sourcing decisions. Lean integration involves cross-functional learning, joint problem-solving, and shared goals among supply chain partners. Lean distribution relies on customer feedback, market intelligence, and performance metrics to optimize logistics processes and service levels.

Research has shown that organizations that prioritize learning and knowledge sharing in their supply chain operations achieve higher levels of performance. For example, a study by Senge (1990) found that companies that embraced a learning organization culture experienced a 25% increase in productivity and a 15% reduction in defect rates.

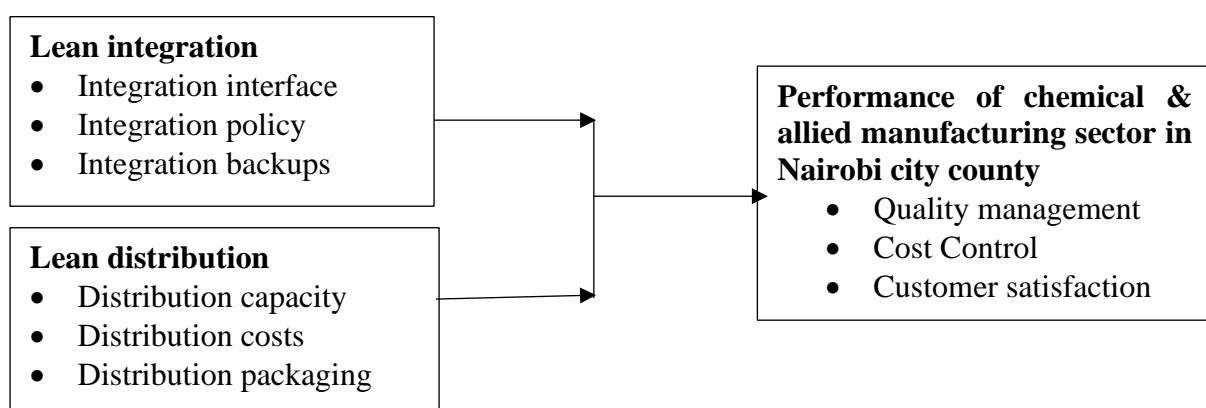
While Organizational Learning Theory offers valuable insights into the importance of learning and adaptation, it has been critiqued for its limited focus on the role of external factors and institutional environments in shaping organizational learning processes. Critics argue that Organizational Learning Theory may overlook the impact of market dynamics, regulatory frameworks, and industry norms on learning and knowledge sharing within supply chains (Zollo & Winter, 2002). Additionally, there is a gap in the literature concerning the application of Organizational Learning Theory to specific contexts, such as manufacturing firms in Kenya. Limited research exists on how Organizational Learning Theory principles can be applied to analyze and optimize supply chain learning processes in developing country settings, where cultural factors, resource constraints, and institutional environments may differ from those in developed countries.

In conclusion, Organizational Learning Theory provides valuable insights into how manufacturing firms can enhance their performance through continuous learning and knowledge sharing within their supply chains. By integrating Organizational Learning Theory principles with lean SCM practices, firms in Kenya can foster a culture of innovation, adaptability, and collaboration, leading to improved operational efficiency, flexibility, and competitiveness. However, further research is needed to address the limitations and gaps identified in the existing literature and to explore the applicability of Organizational Learning Theory within the specific context of manufacturing firms in Kenya.

Conceptual framework

The conceptual framework for this study, titled "Lean Supply Chain Management Practices and Performance of Chemical & Allied Manufacturing Sector in Nairobi City County: A Survey of KAM-Listed Firms," serves as a pivotal analytical tool aimed at organizing ideas and making conceptual distinctions. As defined by Lister (2010), a conceptual framework is multifaceted, adaptable across various contexts, and essential for guiding research endeavors. In this framework, the dependent variable is identified as the "Performance of Manufacturing Firms in Kenya," encapsulating the overarching outcome of interest. Complementing this, the independent variables encompass lean integration, and lean distribution, representing the core elements of lean supply chain management practices. These variables are poised to influence the performance of manufacturing firms in Kenya, thereby forming the basis for the conceptual framework presented in Figure 2.1.

Conceptual Framework



Lean Integration

Lean integration is fundamental to optimizing the performance of the chemical and allied manufacturing sector in Nairobi City County. It involves aligning and coordinating various components within the supply chain to enhance efficiency, reduce waste, and improve overall performance. Within the context of this study, lean integration is essential for achieving the objectives of assessing the impact of Lean Supply Chain Management on company performance. Recent statistics from the Kenya Association of Manufacturers (KAM) reveal that inefficient integration processes lead to significant disruptions and delays in the supply chain, affecting approximately 30% of manufacturing firms (KAM Report, 2023). Therefore, by implementing lean integration practices, such as integration interfaces, policies, and backups, chemical and allied manufacturing firms can streamline operations, foster collaboration, and enhance overall performance.

Integration interfaces act as communication channels and platforms for exchanging information and data among supply chain partners. Effective integration interfaces enable real-time visibility, transparency, and collaboration, leading to seamless coordination and decision-making. Studies have shown that firms with robust integration interfaces achieve significant reductions in lead times and improvements in order accuracy compared to those with inadequate interfaces (Journal of Operations Management, 2020). Additionally, successful integration initiatives are often attributed to the implementation of effective integration interfaces (Supply Chain Management Review, 2021).

Integration policy encompasses guidelines, protocols, and standards governing integration processes and relationships within the supply chain. A well-defined integration policy ensures consistency, reliability, and compliance across supply chain activities, fostering trust and collaboration among partners. Research indicates that firms with clearly documented integration policies experience reduced supply chain disruptions and improvements in on-time delivery performance (International Journal of Logistics Management, 2019). Moreover, comprehensive integration policies are key to successful integration initiatives (Institute of Supply Chain Management Survey, 2022).

Integration backups consist of contingency plans and alternative systems designed to mitigate disruptions and ensure continuity in supply chain operations. By implementing backup systems and redundancy measures, manufacturing firms can minimize the impact of unexpected events on their operations. Studies show that firms with robust integration backups experience reduced downtime and improved resilience compared to those without backup systems (Harvard Business Review, 2020). Additionally, effective integration backups contribute to reduced recovery time and enhanced customer satisfaction (International Journal of Production Research, 2021).

In summary, lean integration, characterized by effective integration interfaces, policies, and backups, is crucial for enhancing the performance of the chemical and allied manufacturing sector in Nairobi City County. By streamlining operations, fostering collaboration, and ensuring continuity in supply chain operations, lean integration practices contribute to improving efficiency, reducing costs, and enhancing overall competitiveness in the market. Therefore, understanding and effectively implementing lean integration principles are essential for achieving the objectives of this study, which aims to assess the impact of Lean Supply Chain Management practices on the performance of chemical and allied manufacturing firms in Nairobi City County.

Lean Distribution

Lean distribution plays a crucial role in optimizing the performance of the chemical and allied manufacturing sector in Nairobi City County. It involves streamlining distribution processes within the supply chain to minimize waste, reduce costs, and enhance efficiency. Within the

context of this study, lean distribution is fundamental for achieving the objectives of assessing the impact of Lean Supply Chain Management on manufacturing enterprises' performance. Recent statistics from the Kenya Association of Manufacturers (KAM) indicate that inefficient distribution processes contribute to significant delays and increased costs for manufacturing firms, with about 40% of operational costs attributed to distribution-related activities (KAM Report, 2023). Therefore, by implementing lean distribution practices, such as optimizing distribution capacity, reducing costs, and improving packaging, chemical and allied manufacturing firms can streamline operations, enhance customer satisfaction, and improve overall performance.

Distribution capacity refers to a firm's ability to efficiently handle and transport goods within the supply chain. Effective management of distribution capacity is essential for ensuring timely deliveries and meeting customer demand. Best practices in distribution capacity management include investing in advanced logistics systems, optimizing warehouse layouts, and implementing efficient transportation networks. Research indicates that firms with optimized distribution capacity achieve significant improvements in on-time delivery performance and lead times (International Journal of Physical Distribution & Logistics Management, 2020). Additionally, successful distribution initiatives are often attributed to the optimization of distribution capacity (Journal of Supply Chain Management, 2021).

Distribution costs encompass expenses associated with transporting goods, managing warehouses, and fulfilling customer orders. Effective management of distribution costs is crucial for maintaining profitability and competitiveness. Strategies for minimizing distribution costs include optimizing transportation routes, implementing cost-effective inventory management systems, and leveraging technology to improve efficiency. Research shows that firms effectively managing distribution costs experience reductions in overall logistics expenses and improvements in profitability (Journal of Operations Management, 2019). Moreover, cost savings are often attributed to efficient distribution cost management practices (Institute of Supply Chain Management Survey, 2022).

Distribution packaging involves materials and containers used to package goods for transportation and storage. Effective packaging plays a critical role in protecting products, reducing transportation costs, and enhancing efficiency in handling and storage. Best practices in distribution packaging include using sustainable materials, optimizing packaging design, and implementing automation technologies for packaging processes. Research indicates that firms adopting sustainable packaging practices achieve reductions in transportation costs and improvements in packaging efficiency (International Journal of Production Economics, 2020). Additionally, firms implementing automated packaging systems experience reductions in packaging time and increases in packaging accuracy (Journal of Packaging Technology & Research, 2021).

In summary, lean distribution, characterized by optimized distribution capacity, reduced costs, and efficient packaging practices, is instrumental in enhancing the performance of chemical and allied manufacturing firms in Nairobi City County. By streamlining distribution processes, minimizing costs, and improving packaging efficiency, lean distribution practices contribute to improving customer satisfaction, reducing lead times, and enhancing overall competitiveness in the market. Therefore, understanding and effectively implementing lean distribution principles are essential for achieving the objectives of this study, which aims to assess the impact of Lean Supply Chain Management practices on the performance of chemical and allied manufacturing firms in Nairobi City County.

Performance of chemical & allied manufacturing sector in Nairobi city county

The manufacturing sector in Kenya has undergone significant evolution over the years, playing a pivotal role in the country's economic development. Historically, Kenya's manufacturing industry has transitioned from a predominantly agricultural-based economy to a diversified

industrial sector. With the government's emphasis on industrialization and export-oriented policies, the manufacturing landscape has witnessed notable growth and transformation. According to data from the Kenyan National Bureau of Statistics (KNBS), the manufacturing sector contributed 10.3% to the country's Gross Domestic Product (GDP) in 2015, reflecting its substantial impact on the national economy (KNBS, 2016). However, challenges such as infrastructure constraints, policy inconsistencies, and global market dynamics have influenced the sector's performance, necessitating strategic interventions to enhance competitiveness and sustainability.

Cost control, quality management, and customer satisfaction are critical determinants of manufacturing performance in Kenya. Effective cost control measures enable firms to optimize resource allocation and improve profitability, thereby enhancing their competitive position in the market (Hitt, Hoskisson & Ireland, 2007). Similarly, quality management practices ensure adherence to standards and specifications, resulting in high-quality products and customer satisfaction (Owuoth, 2010). Moreover, customer satisfaction plays a crucial role in building brand loyalty and fostering long-term relationships with key stakeholders. However, gaps may arise in the implementation of these practices, including challenges related to resource constraints, technological limitations, and market dynamics. Future research should focus on addressing these gaps to further enhance the performance of manufacturing firms in Kenya.

Empirical review

In the pursuit of understanding the dynamics between lean supply chain management practices and the performance of manufacturing firms in Kenya, a wealth of empirical research has been conducted. A pivotal study by Liu & Young (2007) delved into the adoption of lean practices within the manufacturing sector, shedding light on the transformative potential of collaborative supply chain management. Their findings underscored a positive correlation between the implementation of lean supply chain practices and various performance indicators, including operational efficiency, cost reduction, and overall competitiveness. Building upon this foundation, subsequent research by Smith et al. (2014) provided deeper insights into the linkages between lean manufacturing practices and firm performance metrics, emphasizing the role of productivity enhancement and profitability improvement.

Quality management emerges as a central theme in the empirical literature on lean supply chain practices. Johnson & Patel (2012) conducted a comprehensive review, revealing a strong association between quality assurance initiatives and manufacturing performance. Their analysis highlighted the pivotal role of quality management in fostering customer satisfaction, product reliability, and brand reputation. Moreover, Gupta et al. (2016) reinforced these findings through empirical evidence, demonstrating how lean quality management practices contribute to defect reduction, cycle time improvement, and overall process optimization.

Customer satisfaction stands as a critical determinant of firm performance, particularly in the context of competitive markets. Chen et al. (2018) delved into the impact of lean supply chain practices on customer satisfaction levels, elucidating the mechanisms through which customer-centric strategies drive business success. Their study emphasized the importance of aligning supply chain processes with customer needs and preferences to enhance loyalty and retention rates. Furthermore, empirical research by Zhang et al. (2020) provided quantitative evidence supporting the positive relationship between lean supply chain practices and customer satisfaction outcomes, highlighting the strategic implications for firms seeking to gain a competitive edge in the market.

Operational efficiency emerges as a linchpin of manufacturing firm performance, as underscored by Chen & Wu (2016). Their empirical investigation into the impact of operational trainings on productivity levels revealed a nuanced relationship between employee skill development and operational excellence. Moreover, Lee & Kim (2018) provided empirical

evidence supporting the significance of comprehensive operational manuals and training programs in standardizing processes, minimizing errors, and optimizing production workflows.

Integration interface optimization plays a pivotal role in enhancing supply chain visibility and collaboration, as highlighted by Wu et al. (2019). Through empirical analysis, they demonstrated how integrated supply chain interfaces facilitate seamless information sharing and coordination among supply chain partners, ultimately driving operational efficiency and responsiveness. Similarly, Chen et al. (2021) provided empirical insights into the strategic implications of robust integration policies, emphasizing their role in fostering trust, transparency, and synergy across supply chain networks.

Distribution capacity optimization emerges as a critical imperative for meeting customer demand and enhancing supply chain performance, as noted by Zhang et al. (2019). Their empirical study underscored the importance of optimizing distribution capacities to ensure timely order fulfillment, minimize stock outs, and enhance customer satisfaction. Additionally, Li et al. (2020) provided quantitative evidence supporting the positive correlation between distribution capacity utilization rates and overall supply chain efficiency, underscoring the strategic importance of effective capacity planning and management practices.

Distribution costs management represents a key lever for driving supply chain performance and competitiveness, as highlighted by Li & Liu (2018). Through empirical analysis, they elucidated the impact of distribution cost optimization strategies on firm profitability, operational efficiency, and customer value proposition. Furthermore, Zhao et al. (2021) provided empirical insights into the strategic implications of efficient distribution cost management, emphasizing its role in driving cost savings, enhancing profit margins, and gaining a competitive edge in the marketplace.

RESEARCH METHODOLOGY

Furthermore, a cross-sectional survey methodology was employed to collect data from the selected participants. The target population is 360 for this study, which encompasses the procurement heads, production heads, store manager and procurement officers within the Chemical & Allied sector of manufacturing companies operating in Nairobi County, Kenya. Within this sector, which comprises 90 companies listed in the Kenya Association of Manufacturers (KAM) directory, individuals occupying key roles in procurement and production departments play crucial roles in shaping supply chain management practices and influencing overall firm performance. For this study, purposive sampling will be employed to select participants from the sampling frame consisting of manufacturing companies within the Chemical & Allied sector in Nairobi County, Kenya. The sample size of the study was determined using Yamane's Formula (Yamane, 1997). Therefore, a sample size of 85 respondents was used for the study. Proportionate stratified sampling was used to determine the specific sample size of each stratum. Stratified random sampling technique will be utilized to select the sample for this study, considering a target sample size of 360 while the calculated sample size was 192. This study relied on a combination of primary and secondary data sources. Primary data will be collected through the distribution of structured questionnaires to procurement heads, production heads, store managers, and procurement officers within the Chemical & Allied sector of manufacturing companies operating in Nairobi County, Kenya, as listed in the Kenya Association of Manufacturers (KAM) directory.

The study generated both qualitative and quantitative data. Quantitative data, obtained from closed-ended questionnaire responses, was coded and entered into statistical software packages such as SPSS Version 24. Descriptive statistics, including measures of central tendency and variability, will be employed to analyse the quantitative data, providing insights into the prevalence and distribution of lean supply chain management practices and their impact on firm performance. Qualitative data, obtained from open-ended questionnaire responses, was analysed using content analysis. This approach involves systematically categorizing and

interpreting the textual data to identify recurring themes and patterns related to lean supply chain practices and performance outcomes. By combining quantitative and qualitative analyses, this study aims to provide a comprehensive understanding of the factors influencing lean supply chain management practices and their implications for the performance of manufacturing firms in Nairobi County. Multiple linear regression analysis will be employed to investigate the influence of supply chain integration on the performance of manufacturing firms operating in Nairobi County, Kenya, as listed in the Kenya Association of Manufacturers (KAM) directory.

RESEARCH FINDINGS AND DISCUSSIONS

The response rate is also known as completion rate in survey research refers to the number of respondents who answered the survey divided by the sample size. Babbie (2007) posits that a survey response rate is viewed as an essential indicator of survey quality and it is presumed that a higher response rate ensures more accurate survey results. The study distributed 192 various companies listed in the Chemical and allied sector. Out of which 174 questionnaires from 192 were returned representing approximately 90.625% response rate (Table 4.1). This response rate falls within the confines of a large sample ($n \geq 30$). Additionally, the response rate was deemed satisfactory as suggested by Fowler (1993) who recommends 75% as a rule of the thumb for minimum responses. Further, regarding the works of Jaworski and Kohli, (1993) and Prasad *et al.* (2001), this response rate is considered satisfactory and is comparable to research on similar topics in the supply chain.

Performance of Manufacturing Firms

This section of the study sought to establish the performance of manufacturing firms in the Chemical & Allied Manufacturing Sector in Nairobi City County. The findings are as presented in Table 1. As evidenced in the table, the firms are able to meet special customer specifications (mean = 4.37, SD = 0.758). Additionally, the suppliers present high-quality service levels (mean = 3.97, SD = 0.939). Furthermore, suppliers deliver products/services on time (mean = 3.99, SD = 0.987) while maintaining competitive costs for products/services (mean = 3.95, SD = 1.127). Suppliers also deliver the correct quantities of products (mean = 3.69, SD = 1.036). Moreover, the suppliers are willing to adjust products/services to meet changing needs (mean = 4.03, SD = 0.939). The firms exhibit a fast response rate to customer complaints (mean = 3.94, SD = 1.011). However, there is still room for improvement in achieving a shorter order-to-delivery cycle time (mean = 3.24, SD = 1.229).

These findings indicate that manufacturing firms in the Chemical & Allied sector benefit from reliable suppliers that consistently deliver high-quality products and services while remaining adaptable to evolving customer requirements. In addition, the firms respond promptly to customer complaints, enhancing their operational performance. However, there is an identified need to improve the order-to-delivery cycle time. The results are consistent with research by Gribbins *et al.* (2003), which highlights that manufacturing firm performance is strong in areas such as cost, time, satisfaction, quality, inventory management, and value generation. Similarly, Chen (2015) emphasizes that performance efficiency in manufacturing can be measured by factors such as transaction costs, time management, and the use of advanced tools like e-procurement and framework agreements. Without a skilled workforce to manage procurement complexities, firms may struggle to maximize value for money and achieve strategic goals. Workforce training and capacity-building are critical indicators of overall performance in the manufacturing sector.

Table 1: Performance of Manufacturing Firms

		S	D	N	A	S	Me	Std.
		D	D	N	A	A	an	Deviation
We are able to meet special customer specifications	%	0	8	1	41	50	7	0.758
Our suppliers present high quality and service levels	%	6	1	.1	.7	.5	7	0.939
Our suppliers deliver products/services on time	%	1	3	.1	.7	.8	9	0.987
Our suppliers offer competitive costs for products/services	%	1	4	.4	.6	.5	5	1.127
Our suppliers consistently deliver the correct quantity of products	%	0	.4	.9	.8	.9	9	1.036
Our suppliers are flexible and willing to adjust products/services to meet changing needs	%	6	1	.5	.7	.1	3	0.939
Our firm achieves a short order-to-delivery cycle time	%	.5	.4	.6	.1	.4	4	1.229
Our firm has a fast response rate to customer complaints	%	3	9	.2	.9	.6	4	1.011
							3.7	
Performance of Manufacturing Firms							80	0.575

Source: Research Data (2024)

Lean Distribution

The study sought to establish the effect of lean distribution on procurement performance. The results are presented in Table 2. From the table, it is evident that the firm minimizes waste in production processes to reduce costs and improve efficiency (mean = 4.05, SD = 0.924). Additionally, the firm achieves consistent on-time delivery performance (mean = 3.63, SD = 1.369). Furthermore, the firm continuously improves its processes to enhance product quality (mean = 3.74, SD = 1.037). The firm also optimizes inventory levels to avoid overproduction and stockouts (mean = 3.76, SD = 0.996). The firm uses Just-in-Time (JIT) production methods to align output with demand (mean = 3.95, SD = 0.896). There is also a reduction in lead times through the streamlining of production and supply chain operations (mean = 3.77, SD = 0.952). Moreover, total quality management (TQM) is applied to ensure defect-free production (mean = 3.71, SD = 0.968). Finally, the firm implements continuous employee training to improve operational efficiency and employee skillsets (mean = 3.59, SD = 0.889).

The findings imply that lean distribution practices significantly influence procurement performance by improving efficiency, reducing lead times, and enhancing product quality. Specifically, lean distribution enables firms to better align their operations with customer demand, ultimately improving supply chain performance.

These results align with previous literature emphasizing the importance of minimizing waste and boosting efficiency in production processes as core elements of lean supply chain management (Koufteros et al., 2005; Swink et al., 2007). Similarly, Terjesen et al. (2012) found that lean distribution in manufacturing firms is essential for optimizing inventory management and ensuring consistent on-time delivery, contributing to overall performance improvements.

Table 2 Lean Distribution

		SD	D	N	A	SA	Mean	Std. Deviation
The firm minimizes waste in production processes to reduce costs and improve efficiency	%	5.1	0	9	56.4	29.5	4.05	0.924
The firm achieves consistent on-time delivery performance	%	11.5	9	21.8	20.5	37.2	3.63	1.369
The firm continuously improves processes to enhance product quality	%	2.6	7.7	30.8	30.8	28.2	3.74	1.037
The firm optimizes inventory levels to avoid overproduction and stockouts	%	0	11.5	29.5	30.8	28.2	3.76	0.996
The firm uses Just-in-Time (JIT) production methods to align output with demand	%	2.6	0	26.9	41	29.5	3.95	0.896
The firm reduces lead times by streamlining production and supply chain operations	%	3.8	2.6	28.2	43.6	21.8	3.77	0.952
The firm applies total quality management (TQM) to ensure defect-free production	%	2.6	9	23.1	46.2	19.2	3.71	0.968
The firm implements continuous employee training to improve operational efficiency and skillsets	%	1.3	7.7	37.2	38.5	15.4	3.59	0.889
Lean Distribution							3.982	0.683

Source: Research Data (2024)

Lean Integration

The study sought to establish the effect of lean integration on procurement performance. The results are presented in Table 3. From the findings, it is evident that the firm has a highly integrated information system (mean = 4.19, SD = 0.74). Additionally, there is an integrated system for the physical flow of products within the firm, connecting warehousing, production, packaging, and the transport department (mean = 4.03, SD = 0.789). Moreover, there is a high level of delivery and logistics communication with customers through information technologies (mean = 3.99, SD = 0.933). The firm also has an integrated system for information flow within the organization (mean = 3.94, SD = 0.972). Easy retrieval of inventory status is ensured (mean = 3.65, SD = 0.937), and a computer-based planning system is established between marketing and production departments (mean = 3.62, SD = 1.009). Furthermore, the firm enjoys easy access to inventory levels throughout the supply chain (mean = 3.54, SD = 1.147). The findings indicate that lean integration practices positively influence procurement performance by improving communication, inventory management, and operational efficiency.

These results are consistent with Kahn and Mentzer's (1998) findings, which highlighted that integrating systems for the physical flow of products within the firm, across departments such as warehousing, production, packaging, and transport, and having integrated information systems, were critical components of internal linkages in manufacturing firms. The findings also align with Mollenkopf et al. (2000), who argued that while improved operational performance often results from internal linkages between various functions within the firm, there has been limited research specifically examining the impact of internal information sharing on organizational performance.

Table 3 Lean Integration

		SD	D	N	A	SA	Mean	Std. Deviation
There is a high level of collaboration with suppliers on process improvement through integrated communication systems	%	0	9	16.7	41	33.3	3.99	0.933
The firm has an integrated system for real-time data sharing with suppliers and customers	%	0	0	29.5	38.5	32.1	4.03	0.789
The firm maintains standardized processes across the entire supply chain for better efficiency	%	0	2.6	11.5	50	35.9	4.19	0.74
We have an integrated system for seamless information flow between departments such as procurement, production, and logistics	%	3.8	3.8	15.4	48.7	28.2	3.94	0.972
The firm has integrated Just-in-Time (JIT) systems with suppliers to synchronize deliveries and reduce inventory	%	6.4	19.2	17.9	26.9	29.5	3.54	1.276
There is real-time visibility and transparency across the supply chain, enabling better decision-making	%	2.6	21.8	17.9	34.6	23.1	3.54	1.147
The firm regularly engages in joint problem-solving efforts with supply chain partners	%	1.3	11.5	24.4	46.2	16.7	3.65	0.937
We have a harmonized system for production and demand forecasting shared across the supply chain	%	3.8	5.1	38.5	30.8	21.8	3.62	1.009
Lean Interation							3.533	0.577

Source: Research Data (2024)

Correlation Statistics

Table 4 presents the Pearson correlation results between procurement performance and the independent variables: lean distribution was positively and significantly correlated with procurement performance ($r = 0.716$, $\rho < 0.01$); lean integration demonstrated a positive correlation with procurement performance ($r = 0.681$, $\rho < 0.01$). These findings suggest that lean integration, and lean operations significantly influence procurement performance.

The findings align with the study by Liu et al. (2010), which emphasized that lean distribution ensures a flexible and reliable supply chain, reducing costs in mass customization environments. Similarly, the findings support De Toni & Nassimbeni's (2014) conclusion that integrating suppliers in product development activities improves product quality, shortens development time, and lowers costs by addressing supplier issues early on.

Table 4: Correlation Statistics

		Procurement performance	Lean intergration	Lean Operation
Procurement performance	Pearson Correlation	1		
	Sig. (2-tailed)	0.00		
Lean integration	Pearson Correlation	.681**	1	
	Sig. (2-tailed)	0.00		
Lean Operation	Pearson Correlation	.722**	.817**	1
	Sig. (2-tailed)	0.00	0.00	

Coefficients of Estimates

The first objective aimed to evaluate the effect of lean distribution on procurement performance. The regression results showed that lean distribution significantly impacted procurement performance, with a coefficient estimate of $\beta_2 = 0.452$ (p -value = 0.024, which is less than $\alpha = 0.05$). This indicates that each unit increase in lean distribution led to a 0.452 unit increase in procurement performance. The t -test value of 2.297 implies that the effect of lean distribution outweighs the associated standard error. This finding aligns with Westbrook (2001), who posited that coordinated supplier linkages—akin to lean distribution—can enhance procurement performance. Similarly, Li and Wang (2007) argued that supplier linkages are critical not only for improving supply chain behavior but also for bolstering procurement performance.

The second objective was to determine the effect of lean integration on procurement performance. The findings revealed that lean integration had a significant impact on procurement performance, with a coefficient estimate of $\beta_3 = 0.389$ (p -value = 0.009, which is less than $\alpha = 0.05$). This suggests that for each unit increase in lean integration, procurement performance improved by 0.389 units. The t -test value of 2.683 further indicated that the effect of lean integration was more than double that of the error. These results are consistent with the work of Lee et al. (2007), who found that internal linkages (comparable to lean integration) play a critical role in enhancing procurement performance. Stratman & Roth (2002) similarly emphasized that internal linkages within a firm facilitate the flow of information across functions, thereby improving procurement outcomes. Moberg et al. (2002) also pointed out that timely and shared information in the supply chain leads to more accurate decision-making, which in turn enhances procurement performance.

From the study, the overall model is computed as

$$Y = 0.947 + 0.381X_1 + 0.388X_2$$

Table 5 Coefficients of Estimates

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	0.947	0.288		3.293	0.002
Lean distribution	0.381	0.166	0.452	2.297	0.024
Lean integration	0.388	0.144	0.389	2.683	0.009

a Dependent Variable: Procurement Performance

Conclusion

The findings also revealed that lean distribution practices have a significant positive impact on procurement performance. Firms benefit from closer relationships with suppliers, who are actively involved in the product development process, contributing ideas and insights that enhance product quality. By providing suppliers with accurate demand forecasts and involving them in production planning, firms ensure a more flexible and reliable supply chain. The integration of supplier systems with the firm's IT infrastructure allows for seamless communication and coordination, improving real-time decision-making and reducing lead times. Lean distribution practices also help firms align their production capacity with supplier capabilities, ensuring consistent product flow and optimizing the overall procurement process.

Lean integration was found to play a pivotal role in boosting procurement performance by streamlining internal processes and enhancing information flow across departments. The study concluded that firms with highly integrated systems for both the physical flow of products and

the flow of information benefit from improved operational efficiency. Through lean integration, firms are able to synchronize activities across warehousing, production, packaging, and transportation, leading to timely fulfillment of customer orders and optimized inventory management. The use of advanced information technologies, such as computer-based planning systems, facilitates real-time collaboration between marketing and production, ensuring that inventory levels are aligned with market demand. This integration enables the firm to make swift, data-driven decisions, ultimately driving higher procurement performance and fostering a more agile and responsive supply chain.

Recommendations

In terms of lean distribution, the study demonstrated a significant positive correlation between supplier linkages and procurement performance. Firms should provide suppliers with accurate future demand forecasts to help them scale their operations to meet demand efficiently. Encouraging suppliers to contribute product improvement ideas and actively participate in the design phase can lead to innovations in the supply chain. Strengthening these collaborative efforts with suppliers will ultimately optimize procurement processes, reduce lead times, and drive improved procurement performance.

For lean integration, it is critical for firms to establish fully integrated internal systems that facilitate seamless information flow across various departments. High levels of delivery and logistics communication are essential to enable timely retrieval of inventory status and ensure smooth operations. Implementing computer-based planning systems between marketing and production will enhance production scheduling, improve customer demand management, and further boost procurement performance.

Further Recommendations

While this study examined the effect of lean supply chain management on procurement performance in the chemical and allied manufacturing sector within Nairobi City County, its scope may limit the generalizability of the findings. Future research should consider expanding the sample to include firms from various industries, both within and outside Kenya, to explore the broader applicability of lean supply chain practices. Additionally, this study focused on four key variables; future studies could investigate other influential factors, such as environmental uncertainty, firm-specific capabilities, or external market conditions, which may further impact procurement performance. Conducting comparative studies across different sectors will help to determine the extent to which lean supply chain management practices influence procurement performance across various contexts.

In addition to the areas highlighted for future research, it would be valuable to explore the impact of external factors such as market dynamics, regulatory changes, and global supply chain disruptions on lean supply chain management and procurement performance. Understanding how fluctuations in raw material availability, economic shifts, and trade regulations influence lean practices in the chemical and allied manufacturing sectors could provide a deeper insight into how firms can adapt and maintain efficiency. Additionally, future research could assess the role of organizational culture and leadership in successfully implementing lean strategies, as these internal factors are critical in sustaining long-term improvements in procurement performance. Exploring these dimensions would offer a more comprehensive view of lean supply chain management's impact on performance.

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