

Lean Supply Chain Practices and Operational Efficiency of Quoted Industrial Goods Manufacturing Companies in Nigeria

Ifekanandu Chukwudi Christian, Ph.D.*; Tom Charles Miyene, Ph.D.

Department of Marketing, Faculty of Administration and Management, Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria.

*Corresponding Author's Email: chukwudiifekanandu12@gmail.com

Abstract

This study explored the relationship between lean supply chain practices and operational efficiency of quoted industrial goods manufacturing companies in Nigeria. The study adopted the positivism research philosophy and correlational research design. The population comprised 12 quoted industrial goods manufacturing companies in Nigeria, and a census approach was adopted at the company level. The study analyzed data from 64 completed questionnaires returned by managers drawn from the 12 companies. Data were collected using a structured questionnaire and analyzed statistically, while the Pearson Product Moment Correlation Coefficient and SPSS version 25 were used to test the hypotheses. The findings revealed significant relationships between lean procurement and waste reduction, lean procurement and cost reduction, lean manufacturing and waste reduction, and lean manufacturing and cost reduction. The study concludes that lean supply chain practices are significantly associated with operational efficiency among quoted industrial goods manufacturing firms in Nigeria. The study recommends the application of lean principles across supply chain activities to reduce avoidable waste and costs. However, because the data were collected through a single self-report questionnaire at one point in time, the possibility of common method variance should be considered when interpreting the unusually strong correlations.

Keywords: Lean supply chain practices, Lean procurement, Lean manufacturing, Operational efficiency, Waste reduction, and Cost reduction.

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INTRODUCTION

In a resource constrained environment with high level of competitive intensity, companies need to become more strategic in their approach to business and do everything within their capacity to improve their operational efficiency. According to Gill et al. (2018), operational efficiency is the ability of a company to do things in a cost-effective way. It involves fine-tuning and optimizing the business processes to reach the highest level of output with fewer inputs (resources). Operational efficiency focuses on minimizing waste and costs while maintaining or improving organizational productivity (Yuen & Thai, 2017). It measures how well a company can deliver the highest level of output with the least amount of resources. For example, a company can achieve operational efficiency it produces more units of a product per hour with fewer resources (International Business Machine in Habib & Shahwan, 2020). A company that operates efficiently can serve customers better than its competitors, offers products at affordable and competitive prices, and attract more customers to the firm which consequently boost sales and profit margin (Orwa et al, 2025). Industrial goods manufacturing companies need to improve their operational efficiency in order to reap its full benefits. There is no better way of doing this than to adopt lean supply chain strategies.

Lean supply chain is a strategic approach to supply chain management whereby a company minimizes waste and creates superior value to customers throughout the entire process of its supply chain operation (Wainaina & Odari, 2023). It places emphasis on quality control, improved equipment, and creation of better products with zero or fewer defects. Lean supply chain is aimed at streamlining processes, eliminating unnecessary procedures, and improving the quality of products (Nimeh et al, 2018). It focuses on continuous improvement, error prevention or reduction, quality control, superior value creation, and efficient utilization of resources. A company can be said to be practicing lean supply chain if it minimizes defects to avoid costly recalls, optimizes its bill of materials, and improve its equipment to achieve zero-defect production. By delivering defect-free products, lean supply chain reduces costs, improve product quality, and strengthen brand value (Garcia-Buendia et al, 2021). Lean supply chain strategy is more suitable for manufacturing companies with complex products and manufacturing process because it helps to save costs and create a more efficient manufacturing system (Alvim & Oliveira, 2020).

Lean supply chain is capable of improving operational efficiency of manufacturing firms. According to Jasti and Kurra (2017), lean supply chain strategy helps manufacturing firms to reduce defects goods to zero, minimize waste and increase their operational efficiency. This strategy helps companies to reduce the number of product returns by customers and avoid unnecessary costs associated with repairs. By manufacturing products that are less prone to defects, companies can improve their efficiency and brand reputation. Ariadi et al. (2021), opined that lean supply chain strategy reduces costs, minimize waste, and ensure efficient utilization of resources across their entire supply chain. By fostering a culture of continuous improvement and ensuring that all employees are committed to the pursuit of efficiency, lean supply chain improves product quality, minimize costs, reduce waste, and improve operational efficiency. It is against this backdrop that this study explores the relationship between lean supply chain practices and operational efficiency of quoted industrial goods manufacturing companies in Nigeria.

Statement Of The Problem

One of the major challenges confronting manufacturing companies in Nigeria is how to improve operational efficiency by reducing waste and costs under persistent macroeconomic

and infrastructural constraints. The sector operates within an environment characterized by inadequate and unstable energy supply, weak infrastructure, high production costs, and logistics inefficiencies. Port and cargo bottlenecks can delay the movement of imported inputs and increase inventory and transaction costs, while unreliable electricity can disrupt production schedules and compel firms to maintain costly alternative power arrangements. These realities make waste and cost reduction a contextual necessity rather than merely a managerial preference. Consequently, lean procurement, just-in-time coordination, process optimization, quality control, and continuous improvement may be particularly valuable because they can reduce avoidable process waste and improve the use of scarce resources.

Many manufacturing companies continue to experience avoidable material, time, inventory, and process losses, while the cost of coping with infrastructural and supply-chain disruptions can further erode efficiency. Yet the Nigerian environment also creates a practical tension for lean implementation: firms may hold precautionary inventory to protect production from power interruptions, import delays, and supplier unreliability. The key problem is therefore not simply whether lean practices are generally associated with efficiency, but whether and how lean procurement and lean manufacturing can improve operational efficiency in a context where firms must balance the elimination of non-value-adding waste with operational resilience. Previous studies have examined lean supply chain practices in relation to performance, productivity, and sustainability, but limited attention has been given to their relationship with the specific dimensions of waste reduction and cost reduction among quoted industrial goods manufacturing companies in Nigeria. This study addresses that contextual gap by examining the relationship between lean supply chain practices and operational efficiency within the constraints of the Nigerian manufacturing environment.

Conceptual Framework

The conceptual framework of lean supply chain practices and operational efficiency is shown in figure 1 below:

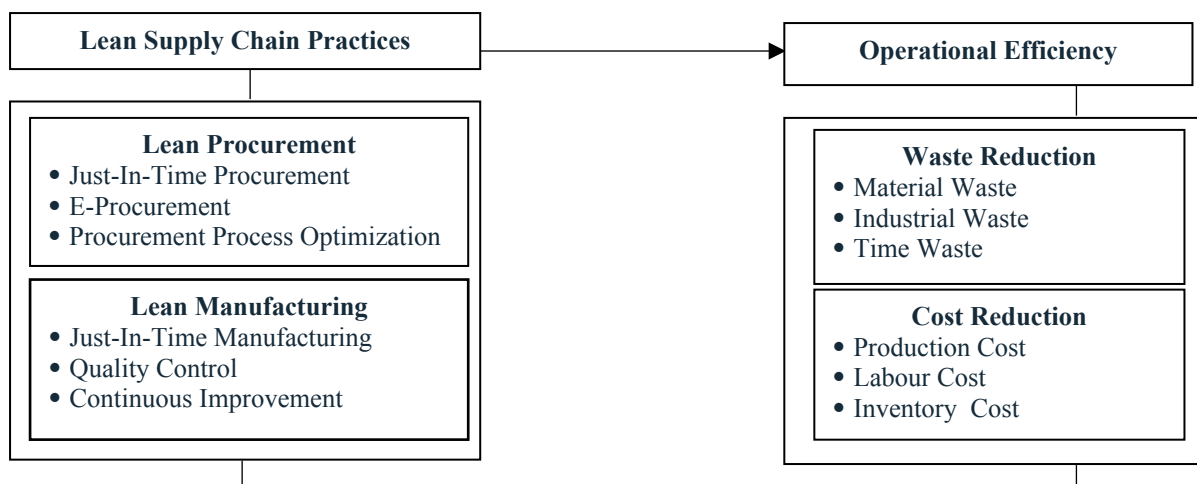


Figure 1: Conceptual framework of lean supply chain practices and operational efficiency of quoted industrial goods manufacturing companies in Nigeria

Aim and Objectives of the Study

The aim of this study is to examine the relationship between lean supply chain practices and operational efficiency of quoted industrial goods manufacturing companies in Nigeria.

Specifically, the study intends to:

1. determine the relationship between lean procurement and waste reduction of quoted industrial goods manufacturing companies in Nigeria;
2. ascertain the relationship between lean procurement and cost reduction of quoted industrial goods manufacturing companies in Nigeria;
3. examine the relationship between lean manufacturing and waste reduction of quoted industrial goods manufacturing companies in Nigeria;
4. determine the relationship between lean manufacturing and cost reduction of quoted industrial goods manufacturing companies in Nigeria.

Research Questions

The following research questions were developed to address the objectives of the study:

1. What is the relationship between lean procurement and waste reduction of quoted industrial goods manufacturing companies in Nigeria?
2. To what extent does procurement lean procurement relate to cost reduction of quoted industrial goods manufacturing companies in Nigeria?
3. What is the relationship between lean manufacturing and waste reduction of quoted industrial goods manufacturing companies in Nigeria?
4. To what extent does lean manufacturing relate to cost reduction of quoted industrial goods manufacturing companies in Nigeria?

Research Hypotheses

The following hypotheses were formulated to guide this study:

- H₀₁:** There is no significant relationship between lean procurement and waste reduction of quoted industrial goods manufacturing companies in Nigeria.
- H₀₂:** There is no significant relationship between lean procurement and cost reduction of quoted industrial goods manufacturing companies in Nigeria.
- H₀₃:** There is no significant relationship between lean manufacturing and waste reduction of quoted industrial goods manufacturing companies in Nigeria.
- H₀₄:** There is no significant relationship between lean manufacturing and cost reduction of quoted industrial goods manufacturing companies in Nigeria.

REVIEW OF RELATED LITERATURE

Concept of Lean Supply Chain

Lean supply chain is the application of lean principles across all stages of the supply chain from procurement, manufacturing, distribution, to end-customer. It involves the flow of goods, service and technology from supplier to customer without waste (Lamming, in Pokuaa-Duah & Nadarajah, 2021). The idea of lean originated from a Japanese automobile company named Toyota. Toyota implemented the concept in its production operation tagged “Toyota Production System” in the 1990s and since then, the lean philosophy has gained much popularity (Mathiyazhagan et al., 2021). The extension of lean principles to supply chain network can be traced to the book published by Womack and Jones in 1996 which was titled

“Lean Thinking.” The integration of lean thinking into supply chain provides a direct link between upstream and downstream supply chain, and ensure a smooth flow of products, services, information, technology, and funds in collaborative manner to minimize waste and costs by producing products based on customer request or order (Nimeh et al., 2018). The main target of lean supply chain strategy is to reduce waste, minimize errors (defects) and improve information flow along the supply chain (McManus, in Kimari & Muli, 2022). Lean supply chain makes use of techniques that have the capability of producing zero inventories, zero delays, zero downtimes, and zero defects in the process of production (Kimari & Muli, 2022). This type of supply chain requires companies to develop a culture of continuous improvement in quality, design, cost, and delivery (Khorasani et al., 2020). According to Ionel (2025), continuous improvement efforts are made to reduce waste across the supply chain.

Dimensions of Lean Supply Chain Practices

Lean principles are applied across the supply chain network, from procurement, manufacturing, distribution, to customers. However, the dimensions of lean supply chain practices considered in this study are lean procurement and lean manufacturing.

Lean Procurement

Lean procurement is the application of lean principles in the procurement activities of an organization with the aim of reducing waste and balancing necessary waste with the principle of maverick spending (Alkhawaldah et al., 2023). Lean principle essentially lies in waste reduction and its application in procurement activities of a firm is facilitated by optimizing the procurement processes (Tortorella et al., 2018). By integrating lean principles into procurement operations, companies tend to identify value-adding components within their manufacturing system and eliminate every other thing (Belekoukias et al., 2014). Lean procurement focuses on achieving greater efficiency with fewer resources. It requires companies to use innovative web technologies and solutions to streamline their procurement processes, cut down costs, and become more efficient. Ariadi et al. (2021) posited that the use of procurement technologies and the automation of procurement processes help companies to minimize manual errors while providing real-time process visibility. By applying lean principles in procurement activities, companies tend to reduce process waste, minimize costs, and achieve greater efficiency (Musyoka, 2015).

Lean Manufacturing

Lean manufacturing is a modern approach to production which emphasizes the need to eradicate overproduction, excess inventory, and improve quality control to reduce waste and costs (Lawal, 2025). Unlike the traditional manufacturing which focuses on mass production and excess inventory, lean manufacturing emphasizes production based on customer order, minimize inventory, and reduce waste (Shah & Ganji, 2017). Womack and Jones in Lawal (2025) described lean manufacturing as a systematic approach to manufacturing which aimed at reducing waste without compromising on quality, productivity, or efficiency. Lean manufacturing was introduced as a strategy to address the problem of overproduction, excess inventory, and defects (Belekoukias et al., 2014). Lean manufacturing requires companies to adopt just-in-time strategy, Six Sigma, and Total Quality Management (TQM) as measures to reduce inventory, minimize waste, and achieve operational efficiency (Cox & Ulmer, 2015). Mathiyazhagan et al. (2021) posited that lean manufacturing helps companies to reduce inventory, minimize storage costs, and reduce waste, thereby enhancing supply chain efficiency.

Concept of Operational Efficiency

Operational efficiency refers to how well an organization utilizes its resources (time, money, materials, labour, and technology) to achieve the desired result (Azad et al., 2018). It indicates the extent to which an organization produces the expected output without wasting resources. Khan (2022) simply defined operational efficiency as accomplishing more with lesser resources and efforts. When an organization accomplishes more with fewer resources, such organization can be said to be efficient (Orwa et al., 2025). Operational efficiency indicates zero waste, zero defects, zero error, and quality output (Lawal, 2025). Habib and Shahwan (2020) opined that operational efficiency enables a company to compete favourably in its industry by producing quality products with minimal costs. When an organization operates efficiently, its financial stability is guaranteed. Therefore, companies need to operate efficiently in order to gain competitive advantage and survive in its industry. To operate efficiently, companies must ensure that their machines and technologies are in good condition, workers are well trained, materials are available when needed, and work processes are streamlined to reduce costs and waste (Gill et al., 2018).

Measures of Operational Efficiency

There are various indices used to measure operational efficiency in literature. However, this study measures operational efficiency using waste reduction and cost reduction.

Waste Reduction

Waste reduction refers to the minimization of the quantity of wastes generated during production, packaging, and other industrial and commercial activities of a firm (International Finance Corporation, 2014). It involves minimizing the amount of raw material waste, industrial waste, time waste, and labour waste in the course of carrying out business activities. Waste reduction can be achieved by applying innovative or alternative procedures to procurement, production, and distribution activities (Zafar, 2020). Waste can also be reduced by reusing second-hand products, repairing broken items instead of buying new ones, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using disposable products, removing any food/liquid remains from cans and packaging and designing products that use less material to achieve the same purpose (for example, light weighting of beverage cans) (Rajendran & Murphy, 2019). Manufacturing firms generate huge amount of waste which end up in the landfills. These wastes can be reduced by adopting lean approach to business, streamline processes, apply JIT technique, and employ the use of modern technologies in production operations (Shah & Ganji, 2017).

Cost Reduction

Cost reduction is a deliberate measure taken by an organization to cut down its operating costs to the barest minimum to achieve efficiency (Cox & Ulmer, 2015). Operating costs include production cost, material costs, labour costs, administrative costs, transportation costs, distribution costs, purchasing costs, and inventory holding costs (Habib & Shahwan, 2020). The reduction of these costs is vital for organizations to operate profitably and achieve financial stability (Habib & Shahwan, 2020). Cost reduction is a crucial metric for measuring operational efficiency of a firm. It indicates how efficient an organization is in achieving the desired results with minimal costs. Khan (2022), posited that cost reduction helps a company to become more competitive in its industry by producing top quality products at a reduced costs and attracting

more customers which boosts sales and profitability. Shah and Ganji (2017), opined that a company that reduces its operational cost to its minimum without compromising on quality will stand out among the crowd in a highly competitive market. It is for this reason that companies are taking steps to reduce their operational costs so that they can reap the full benefit of cost reduction.

Theoretical Review

Lean Theory

This study is anchored on Lean Theory, particularly the lean thinking framework developed by Womack and Jones (1996). Lean Theory emphasizes the systematic identification of customer value, mapping of the value stream, creation of continuous flow, use of pull-based production, and the pursuit of perfection through continuous improvement. Central to the theory is the elimination of non-value-adding activities and the reduction of waste (*muda*) throughout the entire value chain rather than concentrating primarily on a single system bottleneck. The theory is appropriate for this study because lean procurement and lean manufacturing are direct manifestations of lean thinking. Lean procurement seeks to remove non-value-adding steps, delays, errors, and excess costs from sourcing and purchasing processes, while lean manufacturing seeks to reduce overproduction, excess inventory, defects, unnecessary processing, and other forms of waste. The expected outcomes of these practices, namely waste reduction and cost reduction, are therefore theoretically consistent with the central propositions of Lean Theory.

Although the Theory of Constraints may complement lean practice in some operational settings, the two approaches are conceptually distinct. TOC focuses on identifying and managing the system constraint that limits overall throughput, whereas Lean Theory adopts a broader system-wide orientation toward waste elimination, flow, pull, and continuous improvement. Since the present study measures lean practices and evaluates their relationship with waste and cost reduction across supply chain activities, Lean Theory provides the more coherent anchor theory for the study. The theory of constraints is relevant to this study as it explains the reason behind the practice of lean supply chain by firms and how such practice improves operational efficiency. The TOC identifies overproduction, excessive inventory and high inventory holding costs as constraints to achieving operational efficiency and support the idea of lean supply chain as a method of addressing these constraints and achieve operational efficiency. According to TOC, lean supply chain requires companies to produce products based on customer order, reduce inventories, minimize waste, and reduce costs, thereby enhancing operational efficiency.

Empirical Review

Some related studies have been conducted on lean supply chain practices and operational efficiency of firms. For instance, Chaturvedi et al. (2021), examined the impact of lean supply chain management strategy on supply chain performance and organizational productivity. The study employed the survey research design where a structured questionnaire was used to collect data from 200 managers drawn from manufacturing firms in India. The data collected were analyzed using mean score while the hypotheses were tested using correlation and regression analysis. The findings revealed that lean supply chain management strategy (inventory costs reduction, waste elimination, quality improvement, production costs reduction, timely delivery, purchase cost reduction, collaborative supplier relationship and lower forecasting dependency)

has positive and significant relationship with supply chain performance and organizational productivity (increased sales and revenue) of manufacturing firms.

Wainaina and Odari (2023), explored the relationship between lean supply chain practices and performance of Kassmatt Supermarkets Limited in Kenya. The researchers employed the descriptive survey research and used a questionnaire to collect data from 12 employees drawn from Kassmatt Supermarkets Limited. The data collected were analyzed using the percentage and frequency tables, mean and standard deviation while the hypotheses were tested using multiple regression analysis and SPSS version 28. The findings revealed that lean supply chain practices (demand management, process standardization, lean transport, and lean customer practice) have significant relationship with performance of Kassmatt Supermarkets Limited.

Kimari and Muli (2022), carried out a study to determine the influence of lean supply chain management practices on the performance of manufacturing firms in Kenya. The researchers adopted the descriptive survey research design where open and closed ended questionnaire was used to collect data from 80 employees in Unilever Kenya Ltd. The data collected were analyzed using descriptive statistics while the hypotheses were tested using regression analysis and SPSS version 21. The finding revealed that six sigma dimension of lean supply chain management has a significant positive influence on performance of manufacturing firms, while just-in-time procurement and total quality management dimensions of lean supply chain management have an insignificant negative influence on performance of manufacturing firms.

Ionel (2025), examined lean supply chain management and its impact on supply chain performance of firms. Their study adopted the survey research design and the qualitative research approach where interview was used to collect data from key stakeholders such as procurement managers, production managers and lean practitioners in the automotive manufacturing industry. The data collected were analyzed using thematic analysis, and the findings revealed that lean supply chain practices build a culture of continuous improvement and collaboration among supply chain partners, thereby enhancing supply chain responsiveness and agility. The study also revealed that the integration of lean principles in supply chain management drives operational excellence, increase customer satisfaction level and firm competitiveness.

Istimaroh et al. (2023) conducted a study to determine the impact of lean and agile supply chain strategy on environmental performance of manufacturing industries in Malaysia. The study adopted the survey research design and the quantitative research approach where data were collected from 231 manufacturing firms in Malaysia using structured questionnaire. The data collected were analyzed statically while the hypotheses were tested using Partial Least Square-Structural Equation Modeling (PLS-SEM) method. The findings revealed that lean supply chain strategy (just-in-time manufacturing, cost management, waste management, inventory management, customer involvement practices and supplier involvement practices) has significant relationship with environmental performance of manufacturing industries in Malaysia.

Adama et al. (2024) examined the influence of lean supply chain management strategies on organizational sustainability of manufacturing firms in Rivers State, Nigeria. Their study employed a cross-sectional survey research design and used a structured questionnaire to collect data from 86 managers drawn from 32 manufacturing firms in Rivers State. The data collected were analyzed using mean and standard deviation, while the hypotheses were tested using Pearson correlation and SPSS. The findings revealed that lean supply chain management

strategies, including just-in-time practices, were significantly associated with the organizational sustainability of the manufacturing firms studied in Rivers State.

Gap in Literature

The literature reveals both an empirical and a contextual gap. Empirically, prior studies have examined lean supply chain practices in relation to supply chain performance, firm performance, productivity, environmental performance, and organizational sustainability. However, limited evidence directly examines the relationships of lean procurement and lean manufacturing with the specific operational efficiency dimensions of waste reduction and cost reduction among quoted industrial goods manufacturing companies in Nigeria.

More importantly, the Nigerian manufacturing environment creates a contextual gap that cannot be explained by geography alone. Manufacturing firms operate amid infrastructural deficits, unstable electricity supply, high operating costs, logistics and port-related delays, and uncertainty in the supply of inputs. These conditions can intensify waste and costs while also encouraging firms to maintain protective inventory and other buffers that appear inconsistent with conventional lean ideals. Consequently, the effectiveness of lean practices may depend on how firms adapt lean principles to maintain flow and reduce non-value-adding activities without exposing production to avoidable disruption. This study therefore contributes by examining lean supply chain practices within a difficult operating environment in which efficiency improvements may have greater strategic significance and different implementation challenges than in more stable manufacturing systems.

METHODOLOGY

The positivism research philosophy and the correlational research design were adopted in this study. The study population comprised all the twelve (12) quoted industrial goods manufacturing companies in Nigeria (Nigerian Stock Exchange Factbook, 2025 Edition). Since the population is small and manageable, the census sampling technique was adopted. By adopting this sampling technique, it means that all the members of the population were studied. The sampling unit consisted of managers of the quoted industrial goods manufacturing companies in Nigeria. The managers include strategic managers, operational managers, procurement managers, production managers, supply chain managers, and logistics managers of the companies. A sample size of 72 managers was drawn from the 12 quoted industrial goods manufacturing firms in Nigeria on the basis of 6 managers per company. The instrument used in collecting data from the respondents was a questionnaire which was structured using the modified 4 point Likert scale, ranging from Strongly Agree, Agree, Disagree, to Strongly Disagree. The instrument was validated via face and content analysis while its reliability was determined using Cronbach Alpha method. A total copy of 72 questionnaires was distributed to the respondents via e-mail and 64 copies were completed and returned by the respondents. The data collected were tabulated and analyzed statistically while the hypotheses were tested using Pearson Correlation Coefficient (r). Data processing was done with SPSS version 25 and the results were presented and interpreted accordingly. Because the measures were obtained from the same respondents through a self-report questionnaire at a single point in time, common method variance (CMV) cannot be completely ruled out. This is particularly relevant given the strength of the observed correlations. Accordingly, the findings should be interpreted with appropriate caution, and future studies should consider multiple data sources, temporal separation of measurements, or marker-variable approaches.

RESULTS AND DISCUSSION

The correlation analysis examined the relationships among lean procurement, lean manufacturing, waste reduction, and cost reduction. The results are presented in a consolidated correlation matrix below.

Table 1: Correlation Matrix of Lean Supply Chain Practices and Operational Efficiency

Variable	Lean Procurement	Lean Manufacturing	Waste Reduction	Cost Reduction
Lean Procurement	1.000			
Lean Manufacturing	—	1.000		
Waste Reduction	.885**	.837**	1.000	
Cost Reduction	.806**	.817**	—	1.000
N	64	64	64	64

*Note: ** Correlation is significant at the 0.01 level (2-tailed). Source: SPSS-generated output.*

The correlation matrix shows that all four hypothesized relationships are positive, very strong, and statistically significant at the 0.01 level. Lean procurement is strongly associated with waste reduction and cost reduction, while lean manufacturing is strongly associated with both waste reduction and cost reduction. On this basis, the four null hypotheses are rejected. Overall, the results indicate that stronger adoption of lean procurement and lean manufacturing practices is associated with improved operational efficiency among the quoted industrial goods manufacturing companies studied.

DISCUSSION OF FINDINGS

The finding that lean procurement is associated with waste reduction is particularly meaningful in the Nigerian manufacturing environment. Where firms face unreliable infrastructure, logistics delays, and costly process interruptions, poorly coordinated procurement can generate excess handling, duplicated activities, emergency purchases, obsolete materials, and time losses. Lean procurement can improve process visibility, standardize purchasing activities, and strengthen coordination with suppliers, thereby helping firms distinguish unavoidable environmental constraints from internal activities that do not create value. The finding therefore suggests that lean procurement may help manufacturers use scarce materials, time, and managerial resources more deliberately. This interpretation is consistent with the lean emphasis on value-stream improvement and waste elimination and aligns with earlier studies that reported efficiency benefits from lean procurement practices (Mathiyazhagan et al., 2021; Jasti & Kurra, 2017).

The positive association between lean procurement and cost reduction also has strong contextual relevance. Nigerian manufacturers often face elevated input, energy, transport, and transaction costs. Although lean procurement cannot eliminate macroeconomic costs such as power shortages or port-related charges, it can reduce the avoidable costs that accumulate

within the procurement process, including excessive processing, purchasing errors, unnecessary approvals, duplicated transactions, and poorly controlled inventory. In a high-cost environment, even incremental reductions in these internally generated costs can materially improve operational efficiency. The result is therefore consistent with previous evidence on lean procurement and cost performance, but its importance is amplified where external operating conditions already place significant pressure on manufacturing margins (Tortorella et al., 2018; Ariadi et al., 2021).

The relationship between lean manufacturing and waste reduction indicates that production-side lean practices remain valuable even under difficult operating conditions. Quality control, continuous improvement, and pull-oriented production can reduce defects, rework, unnecessary movement, overproduction, and avoidable inventory accumulation. This is especially important in Nigeria, where unstable power and supply uncertainty can magnify the consequences of inefficient production: defects consume already expensive inputs, while excess inventory can tie up scarce working capital and increase storage risk. The finding suggests that lean manufacturing improves efficiency not merely by lowering visible physical waste, but by creating more disciplined processes that make deviations, defects, and non-value-adding activities easier to detect and address. This interpretation is consistent with Belekoukias et al. (2014) and Nimeh et al. (2018).

Finally, the relationship between lean manufacturing and cost reduction suggests that the cost advantages of lean extend beyond cutting expenditure. In the Nigerian context, lean manufacturing can improve the conversion of costly inputs into usable output by reducing defects, rework, downtime-related losses, unnecessary processing, and excess inventory. However, the contextual reality also means that firms should not apply lean mechanically. Extremely low inventory levels may increase vulnerability where power supply, imported inputs, transport, or port operations are uncertain. Effective lean implementation should therefore combine the elimination of non-value-adding inventory with carefully justified resilience buffers. This nuance explains why Lean Theory is a more suitable anchor for the study: the objective is to improve end-to-end flow and eliminate waste while adapting implementation to the operating environment. The finding broadly aligns with Shah and Ganji (2017) and Lawal (2025), while providing a context-sensitive interpretation of why lean practices matter for Nigerian manufacturers.

CONCLUSION

This study explored the relationship between lean supply chain practices and operational efficiency of quoted industrial goods manufacturing companies in Nigeria. The findings indicate that lean procurement and lean manufacturing are positively and significantly associated with waste reduction and cost reduction. The study therefore concludes that lean supply chain practices are important drivers of operational efficiency among the firms studied. Their relevance is heightened in the Nigerian manufacturing environment, where infrastructural deficits, unstable power supply, logistics inefficiencies, and high operating costs can magnify the effects of avoidable waste. At the same time, the findings should be interpreted with caution because the strong correlations were derived from cross-sectional self-report data collected from the same respondents, making common method variance a possible limitation. The results demonstrate association rather than definitive causation, and future research should use multiple data sources, longitudinal designs, or additional statistical controls to strengthen causal inference.

RECOMMENDATIONS

Based on the findings and conclusion, the following recommendations are made:

1. Industrial goods manufacturing companies in Nigeria especially those that are experiencing operational inefficiency should apply lean principles across all stages of their supply chain network as it would lead to operational efficiency.
2. Industrial goods manufacturing companies in Nigeria particularly those that are wasting too much time and money in procurement activities should revisit their procurement processes and streamline the processes in line with lean principles as it would reduce time waste, minimize costs, and improve their efficiency.
3. Industrial goods manufacturing companies in Nigeria particularly those with excess inventory arising from overproduction should adopt lean manufacturing strategy where products are produced based on customer order (JIT manufacturing approach) as it would reduce their inventory and inventory holding costs to the barest minimum.
4. Industrial goods manufacturing companies in Nigeria should apply lean principles in the manufacturing operations by practicing quality control and continuous process improvement as it would enable them reduce waste and achieve operational efficiency.
5. Finally, it is recommended that industrial goods manufacturing companies in Nigeria should adopt innovative technologies in their procurement and manufacturing operations in line with lean principles as it would go a long way in reducing operational costs and improving their overall efficiency.

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