Lean Application and Operational Efficiency of Small and Medium Enterprise's in Rivers State

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***Abstract*—Small and Medium Scale Enterprises (SMEs) play a pivotal role in Nigeria's economic development, contributing significantly to employment generation, industrial diversification, and poverty reduction. However, despite their importance, many SMEs continue to struggle with inefficiencies, wasteful practices, and poor operational performance. This study examined the effect of Lean Application on Operational Efficiency among SMEs in Rivers State, Nigeria. Specifically, it investigated the influence of Just-In-Time (JIT), Waste Elimination, and Value Stream Mapping (VSM) on operational efficiency, with Lean Culture serving as a moderating variable.**

The study adopted a quantitative survey research design, utilizing structured questionnaires administered to 290 SME owners and managers across Port Harcourt, Bonny, and Eleme, from which 220 valid responses were analyzed. Data were processed using descriptive statistics, Pearson's correlation, and multiple regression analysis with the aid of SPSS version 27. The results revealed that JIT, Waste Elimination, and VSM each have significant positive effects on operational efficiency ($p < 0.05$). Among these, Waste Elimination had the strongest influence ($\beta = 0.366$). Furthermore, Lean Culture significantly moderated the relationship between lean application and operational efficiency, indicating that firms with stronger lean-oriented cultures achieved better performance outcomes.

The study concludes that lean application enhances SME productivity, innovation, and competitiveness by reducing waste and optimizing resources. It recommends that SME managers institutionalize lean practices, government agencies promote lean awareness programs, and academia foster industry collaboration to sustain efficiency-driven growth in Nigeria's SME sector.

***Index Terms*—Lean Application, Operational Efficiency, Just-In-Time, Waste Elimination, Value Stream Mapping, Lean Culture, SMEs, Rivers State.**

I. INTRODUCTION

1.1 Background to the Study

Small and Medium Scale Enterprises (SMEs) constitute the backbone of economic growth and development in both developed and developing economies. They are vital for employment generation, poverty alleviation, innovation, and industrial diversification (Agwu & Emeti, 2014; Akingunola, 2022). In Nigeria, SMEs account for over 96% of businesses and contribute nearly 48% to the national Gross Domestic Product (GDP), thereby acting as the driving force for inclusive growth and entrepreneurship (SMEDAN, 2023). Despite this critical role, the performance of SMEs has remained suboptimal due to persistent operational inefficiencies, high production costs, and poor resource management (Bagshaw, 2018).

Operational efficiency defined as the optimal use of resources to achieve productivity and quality has become a crucial determinant of firm competitiveness and survival (Sharma, 2014). In today's globalized and competitive environment, organizations must continuously enhance their operations to meet changing customer demands while minimizing waste. One of the most recognized frameworks for achieving this is the Lean System, which originated from the Toyota Production System (Womack & Jones, 2005). Lean methodology focuses on value creation through waste elimination, process improvement, and employee engagement (Sundar, Balaji, & Kumar, 2014).

Lean application involves several key tools and principles, including Just-In-Time (JIT) production, Waste Elimination, Value Stream Mapping (VSM), and Continuous Improvement (Kaizen). These principles aim to eliminate non-value-adding activities and improve flow and quality (Ohno, 1988). The

application of these tools enhances cost reduction, increases productivity, and improves customer satisfaction. However, most Nigerian SMEs have been slow to adopt lean methods due to lack of awareness, limited financial capacity, and weak managerial expertise (Eze & Okafor, 2021).

In Rivers State, the business environment is characterized by infrastructural challenges, erratic power supply, and high operational costs. These factors compel SMEs to seek sustainable strategies to enhance operational efficiency. Lean application offers a structured approach to achieving this by reducing waste, optimizing processes, and fostering a culture of continuous improvement (Haq, Khan, & Jabeen, 2023). Despite its proven success in developed economies, the adaptation of lean principles to the realities of Nigerian SMEs remains underexplored.

1.2 Statement of the Problem

SMEs in Nigeria face numerous operational inefficiencies that hinder their competitiveness and sustainability. Issues such as overproduction, delays, excessive inventory, poor process flow, and quality defects continue to plague their operations (Bagshaw, 2018). These inefficiencies often result in high costs, poor product quality, and customer dissatisfaction, ultimately leading to the premature collapse of many SMEs within their first five years (Agwu & Emeti, 2014).

While lean methodology has demonstrated effectiveness in improving operational efficiency in large organizations (Chi & Matsui, 2011; Singh, Gupta, & Trehan, 2022), its adoption among SMEs in Nigeria remains minimal. This may be attributed to the perception that lean is resource-intensive and complex, as well as to a lack of empirical studies contextualizing lean within the Nigerian SME environment (Chetty & Govender, 2024). Furthermore, even when lean tools are implemented, their effectiveness is often undermined by weak organizational cultures that resist change (Paro & Gerolamo, 2015).

Given these gaps, there is a pressing need to examine how lean application affects operational efficiency in Nigerian SMEs, especially in Rivers State where industrial activities are high but efficiency remains low. Moreover, understanding the moderating role of Lean Culture—the shared values and behaviors that support lean practices—can help identify conditions under which lean tools yield optimal results.

1.3 Aim and Objectives of the Study

The Aim of this study is to ascertain the relationship between lean application and operational efficiency of Small and Medium Scale Enterprises in Rivers State, Nigeria.

The specific objectives are to:

1. Examine the relationship between Just-In-Time (JIT) and operational efficiency among SMEs in Rivers State.
2. Assess the influence of Waste Elimination on operational efficiency among SMEs.
3. Investigate the impact of Value Stream Mapping (VSM) on operational efficiency among SMEs.
4. Examine the moderating effect of Lean Culture on the relationship between lean application and operational efficiency.

1.4 Research Questions

The following research questions will guide this study:

1. What is the relationship between Just-In-Time (JIT) and operational efficiency in SMEs in Rivers State?
2. How does Waste Elimination influence operational efficiency in SMEs?
3. To what extent does Value Stream Mapping affect operational efficiency?
4. Does Lean Culture significantly moderate the relationship between lean application and operational efficiency?

1.5 Research Hypotheses

To address the research questions, the following null hypotheses (H_0) are formulated:

H_{01}: There is no significant relationship between Just-In-Time (JIT) and operational efficiency in SMEs.

H_{02}: Waste Elimination does not significantly influence operational efficiency in SMEs.

H_{03}: Value Stream Mapping has no significant impact on operational efficiency.

H_{04}: Lean Culture does not significantly moderate the relationship between lean application and operational efficiency.

1.6 Significance of the Study

This study is significant in several respects:

Theoretically, it contributes to the body of knowledge on lean management by contextualizing it within the Nigerian SME sector, which remains understudied in lean research (Pakdil & Leonard, 2014). By integrating Lean Thinking Theory with the Resource-Based View (RBV), this study provides an empirical model that explains how resource optimization and waste elimination enhance competitiveness.

Practically, the study provides insights for SME managers on how to implement lean principles such as JIT, waste elimination, and value stream mapping to enhance efficiency and customer satisfaction. It also emphasizes the importance of building a supportive lean culture that sustains improvement initiatives.

Policy-wise, findings from this research could guide government agencies such as the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and the Bank of Industry (BOI) in developing capacity-building programs and policies that promote lean adoption among SMEs.

Academically, the study provides a robust empirical foundation for future research and postgraduate discourse on lean practices, efficiency, and organizational performance in developing economies.

1.7 Scope of the Study

This study focuses on the application of lean principles; Just-In-Time, Waste Elimination, and Value Stream Mapping and their effects on operational efficiency among SMEs in Rivers State, Nigeria. The study also examines the moderating influence of lean culture. Geographically, the study covers selected SMEs in Port Harcourt, Bonny, and Eleme due to their industrial concentration. Thematically, it emphasizes operational efficiency dimensions such as quality improvement, process optimization, and innovation.

1.8 Operational Definition of Terms

Lean Application: A systematic approach to identifying and eliminating waste through continuous improvement while delivering value to customers.

Just-In-Time (JIT): A lean technique aimed at producing and delivering goods only when needed to reduce inventory and storage costs.

Waste Elimination: The process of identifying and removing non-value-adding activities from production or service processes.

Value Stream Mapping (VSM): A tool used to visualize material and information flows within a process to identify inefficiencies.

Lean Culture: The collective mindset and behaviors that promote teamwork, continuous improvement, and waste reduction.

Operational Efficiency: The ability of an organization to utilize resources optimally to achieve productivity, quality, and cost-effectiveness.

II. LITERATURE REVIEW

2.1 Conceptual Framework

Based on the reviewed literature, the conceptual model for this study illustrates the relationships among the independent variables (JIT, Waste Elimination, and VSM), the dependent variable (Operational Efficiency), and the moderating variable (Lean Culture).

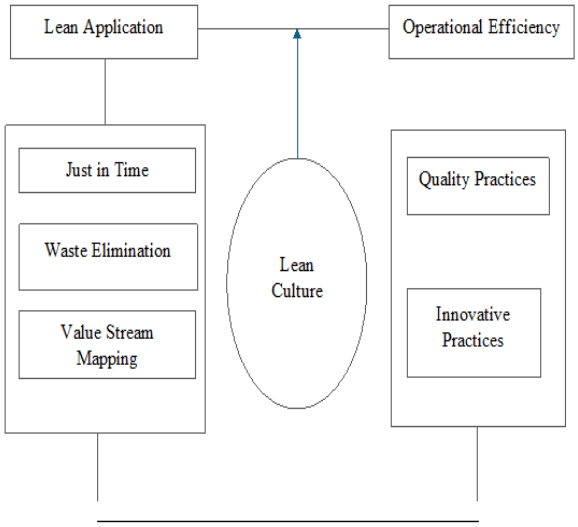

Fig 1.0: The relationship between Lean Application and Operational Efficiency of Small and Medium Scale Enterprises in Rivers State.

The independent variable was adopted from the work of Willian Uwa and Okurebia (2023); Babalola, Ibem, and Ezema (2019) Gaikwad and Suunapwa (2021); Schwantz, Klein and Simonetto (2023). The dependent variable was adopted from the works of Chetty and Govender (2024).

This framework posits that lean application directly enhances operational efficiency and that this relationship is strengthened when a robust lean culture exists within the organization.

2.1.1 Concept of Lean Application

Lean application refers to a systematic and holistic approach to identifying and eliminating waste through continuous improvement and the empowerment of people. The concept originated from the Toyota Production System (TPS), developed by Taiichi Ohno in the 1950s, which emphasized the efficient use of resources to create value for the customer (Ohno, 1988). Lean is built upon five core principles:

- Identifying Value – Understanding what customers perceive as value.
- Mapping the Value Stream – Analyzing all steps in the production or service process to identify waste.
- Creating Flow – Ensuring smooth and continuous operations without interruptions.
- Establishing Pull – Producing only what is needed when it is needed.
- Pursuing Perfection – Continuously improving every aspect of operations (Womack & Jones, 2005).

According to Sundar, Balaji, and Kumar (2014), lean application extends beyond manufacturing and has been successfully adopted in service industries, healthcare, education, and SMEs. It provides a disciplined framework for improving productivity, reducing operational costs, and enhancing customer satisfaction. For SMEs, lean principles are particularly valuable because they promote efficient use of limited resources and improve competitiveness in turbulent markets (Pakdil & Leonard, 2014).

2.1.2 Just-In-Time (JIT)

The Just-In-Time (JIT) system aims to produce and deliver products precisely when they are needed in the right quantity and quality. It eliminates waste related to overproduction, inventory, and waiting time (Chi & Matsui, 2011). JIT enhances production flexibility, reduces inventory costs, and increases responsiveness to customer demand. In SMEs, adopting JIT can be challenging due to unreliable supply chains, yet when effectively implemented, it significantly improves operational efficiency and cost control (Eze & Okafor, 2021).

2.1.3 Waste Elimination

Waste elimination also referred to as Muda is a cornerstone of lean philosophy. Ohno (1988) identified seven forms of waste: overproduction, waiting, transportation, inappropriate processing, unnecessary inventory, motion, and defects. In modern lean practice, an eighth waste—underutilization of human potential has been added. Waste elimination aims to maximize value by streamlining operations and improving workflow (Sundar et al., 2014).

For SMEs, waste reduction directly impacts profitability and customer satisfaction. Rasit, Satar, and Ramli (2018) assert that waste elimination leads to improved throughput and reduced operational downtime. When combined with a supportive organizational culture, waste elimination fosters innovation and long-term sustainability (Paro & Gerolamo, 2015).

2.1.4 Value Stream Mapping (VSM)

Value Stream Mapping (VSM) is a visual tool used to depict the flow of materials and information through a process. It helps organizations identify non-value-adding activities and develop strategies for process improvement (Rother & Shook, 1999). Singh, Gupta, and Trehan (2022) found that VSM improves transparency, reduces cycle time, and enhances coordination across value chains. In SMEs, where resource constraints often limit efficiency, VSM provides a structured method for optimizing workflows.

2.1.5 Lean Culture

Lean culture represents the set of shared beliefs, norms, and behaviors that sustain continuous improvement and respect for people (Mann, 2003). It emphasizes teamwork, problem-solving, and long-term commitment to eliminating waste. According to Paro and Gerolamo (2015), technical tools alone are insufficient to achieve sustainable lean transformation without a supportive culture. A strong lean culture ensures that employees are empowered to identify inefficiencies and contribute to improvement efforts.

2.1.6 Operational Efficiency

Operational efficiency is the ability of an organization to convert inputs (resources) into outputs (goods or services) with minimal waste and maximum productivity (Sharma, 2014). It reflects how effectively an organization manages its operations to achieve profitability, quality, and innovation. For SMEs, operational efficiency is vital for

competitiveness and sustainability in volatile markets. Balamurugan and Yogeswari (2024) describe operational efficiency as a composite measure involving process effectiveness, resource utilization, innovation, and service quality.

2.2 Theoretical Framework

2.2.1 Resource-Based View (RBV) Theory

The Resource-Based View (RBV), developed by Barney (1991), posits that a firm's sustained competitive advantage is derived from its unique resources and capabilities that are valuable, rare, inimitable, and non-substitutable (VRIN). In the context of this study, lean practices represent internal capabilities that enhance process efficiency and customer satisfaction. SMEs that effectively develop and deploy lean capabilities gain superior performance and operational advantage.

Lean principles, such as JIT and waste elimination, align with RBV because they optimize internal resources and enhance value creation. When SMEs strategically adopt lean tools, they strengthen their internal processes and create a resource-based advantage that competitors find difficult to replicate.

2.2.2 Lean Thinking Theory

The Lean Thinking Theory, popularized by Womack and Jones (2005), emphasizes continuous improvement, customer focus, and value creation. It argues that organizations can achieve operational excellence by systematically removing waste and empowering employees to contribute to process improvement.

Lean Thinking Theory provides the philosophical foundation for this study by linking process improvement with organizational performance. It also underscores the moderating role of culture, as sustained lean success depends on employee commitment and managerial leadership (Mann, 2003). In SMEs, adopting lean thinking translates to flexible operations, enhanced productivity, and reduced cost inefficiencies.

2.3 Empirical Review

Several empirical studies have investigated the relationship between lean application and operational efficiency across various sectors and economies.

Ahmad, Schroeder, and Mallick (2004) found a significant positive correlation between JIT implementation and operational performance among Malaysian manufacturers. Firms practicing JIT reported improved quality and responsiveness.

Nowak, Kafel, and Walecka (2017) examined lean implementation in Polish SMEs and reported that VSM improved information flow, cycle time, and process reliability.

Singh, Gupta, and Trehan (2022) discovered that VSM adoption enhanced transparency, quality, and overall efficiency in Indian SMEs.

Haq, Khan, and Jabeen (2023) analyzed lean practices among Asian manufacturing firms and found that waste elimination had the strongest positive influence on operational performance.

Bagshaw (2018), in a study of Nigerian SMEs, observed that lean tools improved product quality and reduced operational cost, though limited by poor infrastructure and management commitment.

Eze and Okafor (2021), examining SMEs in Lagos, found that JIT practices significantly improved innovation and customer responsiveness.

Chetty and Govender (2024), using South African SMEs as a case study, confirmed that lean adoption leads to enhanced operational efficiency and resource utilization, reinforcing lean's applicability to developing economies.

Collectively, these studies reveal that lean application enhances operational efficiency through waste elimination, improved quality, and reduced process variation. However, the degree of success often depends on the organizational culture, managerial commitment, and resource availability—factors that are particularly relevant to Nigerian SMEs.

2.4 Summary of the Literature Review

The literature review underscores the importance of lean principles in enhancing operational efficiency. Lean application—through JIT, Waste Elimination, and VSM—improves process flow, reduces cost, and fosters innovation. Theoretical perspectives from RBV and Lean Thinking provide strong justification for linking resource optimization with organizational performance. Empirical evidence from both developed and developing countries confirms the relevance of lean tools to SMEs. However, successful lean transformation depends on cultivating a culture that supports continuous improvement and employee empowerment.

III. RESEARCH METHODOLOGY

3.1 Research Design

This study adopted a quantitative survey research design, which involves the use of structured questionnaires to obtain data from a sample of respondents. The quantitative design was chosen because it enables statistical analysis of relationships between variables such as lean application and operational efficiency. According to Creswell (2014), quantitative design provides measurable evidence that can establish cause-and-effect relationships between independent and dependent variables.

This design is suitable for this study because it allows the collection of numerical data from SME managers and owners in Rivers State and enables empirical testing of the formulated hypotheses through statistical methods such as correlation and regression analysis.

3.2 Population of the Study

The target population of this study comprised registered Small and Medium Scale Enterprises (SMEs) operating within three major industrial hubs in Rivers State — Port Harcourt, Bonny, and Eleme. Data obtained from the Rivers State Ministry of Commerce and Industry (2024) revealed that approximately 1,050 SMEs were officially registered in these regions across manufacturing, hospitality, service, and trading sectors.

The population was chosen because these areas represent the most active centers of commercial and industrial activity in the state, thereby providing a comprehensive view of SME operational practices and challenges.

3.3 Sample Size Determination

A sample size of 220 SMEs was selected from the total population of 1,050 using Yamane's (1967) formula for finite populations:

$$n = \frac{n}{1 + N(e)^2}$$

Where,

n = Sample Size,

N = Population Size (1,050)

e = level of Significance (0.05)

$$\text{The sample size (n)} = \frac{1050}{1 + 1050\ (0.05)^2}$$

$$= \frac{1050}{3.625}$$

$$= 289.6$$

For practical purposes, 290 questionnaires were distributed, but only 220 valid responses were retrieved and used for analysis, representing a response rate of 76%, which is considered adequate for survey research (Sekaran & Bougie, 2016).

3.4 Sampling Technique

The study employed a stratified random sampling technique. The population was divided into strata based on the industrial sector (manufacturing, hospitality, and services). Respondents were then randomly selected from each stratum to ensure fair representation and minimize sampling bias.

This method was appropriate because SMEs in different sectors may exhibit variations in lean adoption and operational efficiency (Chetty & Govender, 2024). The stratified approach allowed the researcher to capture these differences effectively.

3.5 Sources of Data

Both primary and secondary data were used in this study.

Primary Data: Collected through structured questionnaires administered to SME managers and owners.

Secondary Data: Obtained from journals, textbooks, government publications, SME reports, and previous empirical studies relevant to lean application and operational efficiency (e.g., Womack & Jones, 2005; Haq et al., 2023).

3.6 Method of Data Collection

Questionnaires were the main instrument for data collection. The instrument was divided into three sections:

1. Section A: Demographic information of respondents (age, gender, education, business type, years of operation).
2. Section B: Items measuring Lean Application (JIT, Waste Elimination, VSM).
3. Section C: Items measuring Operational Efficiency and Lean Culture.

A five-point Likert scale was used to measure responses ranging from 1 = Strongly Disagree to 5 = Strongly Agree. Questionnaires were distributed

physically and electronically to enhance response rates.

3.7 Instrument Validation

To ensure the validity of the research instrument, the questionnaire underwent both content validity and construct validity assessments.

Content validity was ensured by submitting the questionnaire to three experts in management science and operations research for review.

Construct validity was established through factor analysis, confirming that items loaded appropriately under each construct (Hair et al., 2019).

3.8 Reliability of Instrument

Reliability refers to the consistency of the instrument in measuring what it intends to measure. The reliability of the questionnaire items was tested using Cronbach's Alpha. According to Nunnally (1978), a Cronbach's alpha value of 0.70 and above is considered acceptable for internal consistency.

Table 3.1: Reliability Statistics

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Just-In-Time (JIT)	0.82	0.85	0.61
Waste Elimination	0.79	0.83	0.58
Value Stream Mapping	0.84	0.87	0.63
Operational Efficiency	0.86	0.89	0.65
Lean Culture	0.81	0.84	0.60

Source: Researcher's computation (2025)

The results indicate that all constructs achieved a Cronbach's alpha above 0.79, confirming a high level of internal reliability and consistency among items.

3.9 Method of Data Analysis

Data collected were analyzed using descriptive and inferential statistical tools. Descriptive statistics such as frequencies, percentages, mean, and standard deviation were used to summarize demographic characteristics. Inferential statistics including Pearson's correlation and multiple regression analysis were used to test the hypotheses at a 0.05 level of significance.

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 27. The decision rule was:

Reject the null hypothesis (H_0) if p-value < 0.05

Accept the null hypothesis (H_0) if p-value ≥ 0.05

3.10 Model Specification

To test the effect of lean application on operational efficiency, the following linear regression model was formulated:

$$OE = \beta_0 + \beta_1 JIT + \beta_2 WE + \beta_3 VSM + \mu$$

Where:

OE = Operational Efficiency

JIT = Just-In-Time

WE = Waste Elimination

VSM = Value Stream Mapping

β_0 = Constant

β_1, β_2, β_3 = Coefficients of independent variables

μ = Error term

To test for moderation by Lean Culture, an interaction term was introduced:

$$OE=\beta_0 +\beta_1 JIT+\beta_2 WE+\beta_3 VSM+\beta_4 LC+\beta_5 (JIT*LC) +\beta_6 (WE*LC) +\beta_7 (VSM*LC)+\mu$$

This model enables examination of how Lean Culture strengthens or weakens the relationship between lean practices and operational efficiency.

3.11 Ethical Considerations

Ethical guidelines were strictly adhered to throughout the research process. Participation was voluntary, and respondents were informed about the study's purpose and assured of confidentiality. No identifying information was collected, and all responses were used strictly for academic purposes. The researcher also obtained approval from the University of Port Harcourt Business School, prior to data collection.

IV. DATA PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter presents, analyzes, and discusses the data collected from SME managers and owners in Rivers State. The analysis was carried out in line with the research objectives and hypotheses formulated in

Chapter One. The data were analyzed using descriptive statistics (frequencies, means, and standard deviations) and inferential statistics (correlation and multiple regression analyses) to determine the relationship between lean application and operational efficiency.

Out of 290 copies of the questionnaire distributed, 220 were retrieved and found valid for analysis, representing a 76% response rate. This response rate is acceptable for survey-based studies (Sekaran & Bougie, 2016).

4.2 Demographic Characteristics of Respondents

Table 4.1: Respondents' Demographic Profile

Variable	Category	Frequency	Percentage (%)
Gender	Male	134	60.9
Female	86	39.1	
Age	21–30 years	48	21.8
31–40 years	86	39.1	
41–50 years	60	27.3	
51 years and above	26	11.8	
Education Level	SSCE/ND	34	15.5
HND/B.Sc	120	54.5	
M.Sc/MBA	66	30.0	
Business Type	Manufacturing	88	40.0
Service	72	32.7	
Hospitality	60	27.3	
Years in Operation	1–5 years	42	19.1
6–10 years	104	47.3	
Above 10 years	74	33.6	

Source: Field Survey (2025)

Interpretation:

The table reveals that 60.9% of respondents were male, and the dominant age group was between 31–40 years (39.1%), showing that SME operations are mostly managed by young and middle-aged entrepreneurs. Most respondents (54.5%) held an HND/B.Sc degree, indicating a moderate level of managerial education. The majority (47.3%) of businesses had been in operation between 6 and 10 years, suggesting that the respondents had sufficient experience to provide valid insights.

4.3 Descriptive Statistics of Key Variables

Table 4.2: Descriptive Statistics of Study Variables

Variables	N	Mean	Std. Deviation	Interpretation
Just-In-Time (JIT)	220	3.96	0.74	High
Waste Elimination (WE)	220	4.12	0.66	High
Value Stream Mapping (VSM)	220	3.87	0.72	High
Lean Culture (LC)	220	3.91	0.68	High
Operational Efficiency (OE)	220	4.05	0.63	High

Source: SPSS Output (2025)

Interpretation:

All the mean values range between 3.87 and 4.12, indicating that respondents agreed to a high extent that their firms practiced lean principles and experienced operational efficiency. Waste elimination recorded the highest mean (4.12), suggesting that SMEs place greater emphasis on minimizing production waste, while VSM had the lowest (3.87), indicating it is less commonly applied.

4.4 Correlation Analysis

To determine the strength and direction of relationships among the study variables, Pearson's correlation coefficient (r) was computed.

Table 4.3: Correlation Matrix

Variables	JIT	WE	VSM	LC	OE
JIT	1				
WE	.631**	1			
VSM	.582**	.604**	1		
LC	.487**	.523**	.496**	1	
OE	.674**	.721**	.662**	.608**	1

Note: Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output (2025)

Interpretation:
The correlation results show positive and statistically significant relationships between all independent variables (JIT, WE, VSM) and operational efficiency (OE). The strongest correlation was between Waste Elimination and Operational Efficiency ($r = .721$, $p < .01$), while the weakest was between Lean Culture and Operational Efficiency ($r = .608$, $p < .01$). This implies that waste elimination contributes more to improving SME performance compared to other lean tools.

4.5 Regression Analysis
To evaluate the predictive power of the independent variables on operational efficiency, multiple regression analysis was conducted.

Table 4.4: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	.834	.695	.682	0.298

Source: SPSS Output (2025)

Interpretation:
The R-value of .834 indicates a strong positive relationship between lean application and operational efficiency. The R^2 value of .695 implies that approximately 69.5% of the variation in operational efficiency is explained by the combined effect of JIT, Waste Elimination, and VSM, while the remaining 30.5% is attributed to other factors not captured in the model.

Table 4.5: ANOVA Results

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	22.58	3	7.53	83.76	.000
Residual	9.91	216	0.046		
Total	32.49	219			

Source: SPSS Output (2025)

Interpretation:
The F-value (83.76) with a significance level of 0.000 ($p < 0.05$) confirms that the regression model is statistically significant. This indicates that lean application (JIT, WE, VSM) jointly predicts operational efficiency among SMEs in Rivers State.

Table 4.6: Coefficients of Regression

Predictor	Unstandardized Coefficients (B)	Std. Error	Beta (β)	t-Value	Sig.
Constant	0.654	0.122		5.36	.000
Just-In-Time (JIT)	0.241	0.067	0.238	3.60	.001
Waste Elimination (WE)	0.331	0.062	0.366	5.34	.000
Value Stream Mapping (VSM)	0.187	0.058	0.211	3.22	.002

Dependent Variable: Operational Efficiency
Source: SPSS Output (2025)

Interpretation:
The coefficients table shows that all independent variables - JIT, Waste Elimination, and VSM, have positive and statistically significant effects on operational efficiency ($p < 0.05$). Waste Elimination has the highest standardized beta value ($\beta = 0.366$), indicating it contributes most significantly to operational efficiency. This supports findings from previous studies (Haq et al., 2023; Singh et al., 2022). The estimated regression equation is therefore:
$OE = 0.654 + 0.241(JIT) + 0.331(WE) + 0.187(VSM) + \mu$

4.6 Moderation Analysis: Effect of Lean Culture
A moderation test was conducted to determine whether Lean Culture (LC) influences the relationship between lean application and operational efficiency.

Table 4.7: Moderation Regression Results

Predictor	Beta (β)	t-Value	Sig.	Interpretation
Lean Application	0.623	9.84	.000	Significant
Lean Culture	0.272	5.06	.000	Significant
Lean Application * Lean Culture	0.193	3.72	.001	Significant

Source: SPSS Output (2025)

Interpretation:
The interaction term (Lean Application * Lean Culture) has a beta coefficient of 0.193 and a significance value of .001 ($p < 0.05$), implying that Lean Culture significantly moderates the relationship

between lean application and operational efficiency. This means that the positive effect of lean practices on SME efficiency is stronger when firms possess a supportive lean culture emphasizing teamwork and continuous improvement (Mann, 2003; Paro & Gerolamo, 2015).

4.7 Discussion of Findings

The results of this study provide empirical support for the proposition that lean application significantly improves operational efficiency among SMEs in Rivers State.

Just-In-Time (JIT): The positive and significant relationship between JIT and operational efficiency aligns with Ahmad, Schroeder, and Mallick (2004), who found that JIT implementation enhances quality and responsiveness. In the Rivers State SME context, timely production and reduced inventory costs directly boost productivity.

Waste Elimination: Waste elimination emerged as the most influential predictor of operational efficiency. This finding corroborates Haq et al. (2023) and Rasit et al. (2018), who emphasized that removing non-value-adding activities enhances productivity and cost-effectiveness. SMEs that actively identify and reduce waste experience better process flow and profitability.

Value Stream Mapping (VSM): The positive influence of VSM on efficiency supports the work of Singh, Gupta, and Trehan (2022), who observed that VSM improves transparency and coordination across processes. In this study, SMEs applying VSM recorded faster cycle times and fewer operational bottlenecks.

Lean Culture: The moderation analysis indicates that a strong lean culture enhances the effectiveness of lean tools. This aligns with Paro and Gerolamo (2015) and Mann (2003), who assert that without an organizational culture promoting teamwork and problem-solving, lean practices fail to achieve sustainable results.

Overall, the findings affirm that SMEs in Rivers State adopting lean practices experience higher operational efficiency, particularly when management fosters a culture of continuous improvement.

4.8 Summary of Findings

There is a significant positive relationship between JIT and operational efficiency.

Waste Elimination significantly improves operational efficiency and is the strongest predictor among the lean variables.

Value Stream Mapping positively influences operational efficiency by streamlining information and material flow.

Lean Culture significantly moderates the relationship between lean practices and operational efficiency, strengthening the impact of lean tools in SMEs.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Study

This study investigated the effect of Lean Application on Operational Efficiency among Small and Medium Scale Enterprises (SMEs) in Rivers State, Nigeria. The research was motivated by the increasing inefficiencies and wasteful practices that have limited the performance and sustainability of SMEs. Lean application—rooted in the Toyota Production System—was examined through its three core components: Just-In-Time (JIT), Waste Elimination, and Value Stream Mapping (VSM), while Lean Culture was considered as a moderating variable.

The specific objectives were to: (1) examine the relationship between JIT and operational efficiency; (2) assess the influence of Waste Elimination on operational efficiency; (3) determine the effect of VSM on operational efficiency; and (4) evaluate the moderating effect of Lean Culture on the relationship between lean application and operational efficiency.

A quantitative survey research design was employed. A total of 290 questionnaires were distributed to managers and owners of SMEs in Port Harcourt, Bonny, and Eleme, of which 220 valid responses were analyzed. The study used descriptive statistics (mean, percentage, and standard deviation) and inferential statistics (correlation and regression analyses) to test the hypotheses using SPSS version 27.

Findings revealed that all dimensions of lean application—JIT, Waste Elimination, and VSM—had significant positive effects on operational efficiency. Among these, Waste Elimination had the highest influence, demonstrating that minimizing non-value-adding activities is the most critical factor for improving SME performance. Additionally, Lean Culture was found to significantly moderate the relationship between lean practices and operational

efficiency, suggesting that a culture of teamwork and continuous improvement enhances the success of lean initiatives.

In summary, the study concludes that adopting lean principles leads to improved process flow, reduced waste, lower costs, and enhanced quality and innovation among SMEs in Rivers State.

5.2 Conclusion

This study concludes that Lean Application serves as a strategic tool for enhancing operational efficiency in SMEs. The empirical evidence demonstrated that SMEs practicing lean principles achieve superior performance outcomes compared to those that do not. Specifically, Just-In-Time (JIT) contributes to improved inventory management, timely delivery, and responsiveness to customer needs. Waste Elimination fosters cost reduction, quality improvement, and process optimization, while Value Stream Mapping (VSM) enhances visibility and coordination within operations. Moreover, the moderating role of Lean Culture underscores that sustainable operational excellence cannot be achieved through technical tools alone but requires a mindset of continuous improvement and employee empowerment.

Therefore, SMEs in Rivers State and Nigeria at large must integrate lean philosophy not as a one-time project but as an organizational culture embedded in all business processes. In an environment characterized by economic volatility and infrastructural challenges, lean application provides a pathway to resilience, competitiveness, and long-term growth.

5.3 Recommendations

Based on the findings, the following recommendations are proposed:

1. Institutionalize Lean Practices in SMEs:

SME managers should systematically integrate JIT, waste elimination, and VSM into their daily operations. This can be achieved by training employees on lean tools, mapping value streams, and setting performance benchmarks.

2. Promote Lean Culture and Employee Engagement:

The leadership of SMEs should foster a workplace culture that values teamwork, communication, and shared responsibility for improvement. Recognition systems and continuous learning opportunities can sustain lean culture.

3. Government and Policy Support:

The Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and other regulatory bodies should organize capacity-building programs on lean practices. Financial incentives and grants should be provided to SMEs that demonstrate commitment to operational improvement.

4. Academic–Industry Collaboration:

Universities and technical institutes should partner with SMEs to provide consultancy and training in lean management. This will bridge the gap between theoretical knowledge and practical implementation.

5. Adoption of Technology for Lean Implementation:

SMEs should adopt affordable digital tools to enhance data visibility, inventory tracking, and process control. Technology can complement lean principles and drive real-time decision-making.

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