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Lean Implementation and Organisational Agility: The Mediating Role of Continuous Improvement Culture in Nigerian Manufacturing Firms

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ABSTRACT

This study investigates the relationship between lean implementation (LI) and organisational agility (OA) in Nigerian manufacturing firms, with a focus on the mediating role of continuous improvement culture (CIC). Drawing upon the dynamic capabilities and organization culture perspectives, we argue that lean practices provide process discipline and visibility, while a culture of continuous improvement transforms these practices into adaptive organisational capabilities. Data were collected through a cross-sectional survey of 54 listed manufacturing firms. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to test the proposed model. The findings indicate that LI has a significant positive effect on OA, and CIC mediates this relationship. The study concludes that lean practices enhance agility most effectively when accompanied by strong learning and improvement-oriented cultures. Implications for managers and policy makers are discussed.

Keywords: Lean manufacturing, organisational agility, continuous improvement, dynamic capabilities, Nigeria, PLS-SEM

INTRODUCTION

In the current unstable manufacturing environment, which is characterised by intense global competition, demand variability, supply chain disruptions and technological shifts, manufacturing companies are under increasing pressure to improve their operational efficiency in order to maintain profitability and sustain growth (Agbionu & Mbagwu, 2025). The competitive environment has changed significantly as a result of market globalisation, technological innovation, and volatile socioeconomic conditions, requiring businesses to be more adaptable and agile (Animashaun, Akeke, Imaila, & Yousouph-Adeyi, 2024). These difficulties are compounded for businesses in developing nations like Nigeria by infrastructure limitations, fluctuating exchange rates and inconsistent policies. Manufacturing companies must be agile to survive and thrive, not just efficient, agility is the ability to see, react and quickly adapt to changes in the environment. In this regard, they need tactics that could improve product quality, minimise operational costs and accelerate delivery schedules (Elunem et al., 2023). And to increase productivity and operational excellence, many businesses have applied lean methodologies in their manufacturing operations as indicated in many previous studies (Ajit, Birhane & Moti, 2025).

Bamisaye, Oroye, Farayibi, Adeitan, and Agbo (2023) claim that lean management implementation tools are standard operating systems that are evolved from the Toyota Production System (TPS). The lean philosophy emphasizes waste elimination, continuous flow, employee empowerment, and customer value maximization through methods like Just-in-Time (JIT) production, total quality management, total production maintenance, Poka-yoke, 5S, setup time reduction, value stream mapping, Kanban pull system, Takt time, kaizen (continuous

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

improvement), staff training, teamwork, and value stream mapping (Agbionu & Mbagwu, 2025; Bamisaye, Oroye, Farayibi, Adeitan & Agbo (2023). Ajit et al. (2025) state that waste removal, continuous improvement, respect for people and their components, timely output, adherence to standard procedure, error proofing, and defect discovery are examples of lean management techniques for manufacturing organizations.

Several previous studies have shown how companies use the lean manufacturing method as a strategy to increase productivity and efficiency in their manufacturing processes. Customer satisfaction, productivity, and business effectiveness have all increased with this strategy (Olu-Lawal, Ekemezie & Usiagu, 2024). To get a competitive advantage, businesses today use lean manufacturing practices (Bilal & Urooj, 2023).

Despite its enormous appeal, studies have revealed that many industrial firms struggle to completely apply lean concepts, particularly in developing countries like Nigeria (Ding, Hernandez & Jane, 2023). However, research shows that lean's benefits extend beyond reducing costs and wasteful processes; they also include better inventory management, shorter operational cycle times, and increased flexibility, organizational productivity, and financial performance (Bamisaye et al., 2023). However, lean implementation often fails to provide sustained performance gains when the underlying culture of continuous improvement (CI) is not well implemented in the area of intellectual characteristics of human assets (Lim., Sabil & Othman, 2022). In an increasing amount of study on the connection between lean and culture, Miller, Cadden, Tang, and Humpheys (2018) suggested that businesses that concentrate on creating a suitable organizational culture while implementing lean methods will see better operational performance results. This raises an important question: By encouraging a culture of continuous improvement, can lean implementation increase organizational agility?

In the face of uncertainty, organizational agility is regarded as a key strategy (Mekuri-Ndimele, 2025). The concept refers to the capability to sense, respond, and quickly adapt to changes in the external environment. In Nigeria’s industrial environment, where infrastructure is inadequate, policies are inconsistent and dependency on imports is high, businesses must be extraordinarily agile to thrive and survive (Mbagwu, 2025). However, lean concepts may not be sufficient to provide agility unless they are embedded in a culture that supports continuous learning and development (Cadden et al., 2020; Leksic et al. 2020). While it is successful, studies reveal that many companies find it difficult to implement lean principles especially in developing countries such as Nigeria (Ding, Hernandez & Jane, 2023).

The combination function of lean methods with other elements such as organizational agility and continuous improvement culture, and the assessment of the overall influence of this on the sustainability performance of a firm, are little attended to (Hassan & Pasha, 2023).

The gap between lean adoption and organizational performance outcomes has led to researchers exploring the underlying processes through which lean initiatives translate into sustainable agility and performance advantages (Mbaagwu, 2025). A suggested component of this relationship is the continuous improvement culture that drives learning, experimentation and process improvement at all levels of the organization (Lim, Sabil, & Othman, 2022). Continuous improvement methods are associated with an organizational culture that embraces a variety of improvement activities that lead to success and lower failure rates. (Whalen, 2020)

With an emphasis on the mediating function of continuous improvement culture, this study examines the relationship between lean implementation and organizational agility in Nigerian manufacturing organizations. It suggests that while lean methods offer the structural basis for efficiency, they can only result in long-term organizational agility when combined with a widespread culture of continual improvement.

Statement of the Problem

Lean implementation has been recognized worldwide as an enabler of efficiency and waste reduction however, its direct impact on organizational agility is still unascertained, especially in the context of emerging economies. Previous work has yielded conflicting results. There are studies that show the positive relation of lean and agility (Mbagwu, 2025), but there are also those that reveal the existence of implementation barriers, lack of fit in the organizational culture and human development policies that impede the translation of lean into strategic responsiveness (Austin & Adebayo, 2021).

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

Manufacturing companies in Nigeria have been seen to apply lean tools like 5S, Kaizen, Just-in-Time (JIT), Total Productive Maintenance (TPM) individually and not as a system (Agbionu & Mbagwu, 2025). In an organization where there is no culture of continuous improvement, employees are often in resistant and results are short-lived. This leaves many businesses operationally sound but strategically rigid, unable to adapt to supply chain disruptions, market volatility, and technology advancements.

By highlighting particular important predictors that may have been omitted, neglected, or overlooked in earlier research conducted in Lean implementations, this study sought to provide some clarity. Thus, the goal of this research was to determine how continuous improvement culture influences the relationship between organizational agility and lean deployment in manufacturing companies. By empirically investigating how continuous improvement culture mediates the relationship between lean adoption and organizational agility in Nigerian manufacturing organizations, the study fills in these gaps. Developing an integrative model for attaining both operational excellence and strategic flexibility in the industrial context requires an understanding of this mediation effect.

Research Objectives

This study's primary goal is to examine whether the presence of a continuous improvement culture mediates the relationship between lean implementation and organisational agility in Nigerian manufacturing companies.

The specific objectives are to:

1. Investigate the direct effect of lean implementation on organisational agility.

2. Examine the influence of lean implementation on continuous improvement culture.

3. Evaluate the impact of continuous improvement culture on organisational agility.

Research Questions

The following questions will be addressed by the study in order to fulfill its stated objectives:

1. What is the relationship between lean implementation and organisational agility in Nigerian manufacturing firms?
2. How does lean implementation influence the development of continuous improvement culture?
3. In what ways does continuous improvement culture affect organisational agility?
4. Does the culture of continuous improvement mediate the relationship between organizational agility and lean implementation?

Scope of the Study

The study's population consists of all Nigerian manufacturing firms. However, the study concentrated on listed manufacturing companies on the Nigerian Exchange Group (NGX) due to the impracticability of examining every manufacturing company. These companies represent a number of industry subsectors, such as consumer goods, industrial products, cement, and food and beverage. The sample's representativeness is enhanced by concentrating on listed manufacturing companies because these businesses are well-known for their lean adoption initiatives, have solid financial records, and are major participants in their respective industries. Lean implementation (measured by just-in-time (JIT)), total quality management (TQM, 5s, kaizen), organizational agility (strategic responsiveness, flexibility, and adaptability), and continuous improvement culture (employee involvement, learning orientation, and openness to change) are the variables of interest.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

LITERATURE REVIEW

According to a survey of relevant literature, the majority of research studies have shown connections between organizational agility, lean implementation, and continuous improvement culture from various angles. Nevertheless, it was discovered that the connections between organizational agility, lean implementation, and continuous improvement culture have not been fully investigated. Furthermore, not much research has been done on how continuous improvement mediates the relationship between organizational agility and lean implementation in Nigerian manufacturing organizations. Academics from a variety of disciplines are becoming more interested in this field of study. This research, therefore, recognized the necessity to empirically determine the variables for sustainability of lean implementation.

Conceptualization and Hypotheses Proposition

Research Model

Figure 1 was developed by the author to demonstrate the assumed connection among the three constructs in this study namely; lean implementation; organisational agility; and continuous improvement. In figure 1, organisational agility is a dependent variable, while lean implementation and continuous improvement are independent variables. Lean implementation and continuous improvement culture are expected to be significantly related, both are also assumed to significantly influence organisational agility.

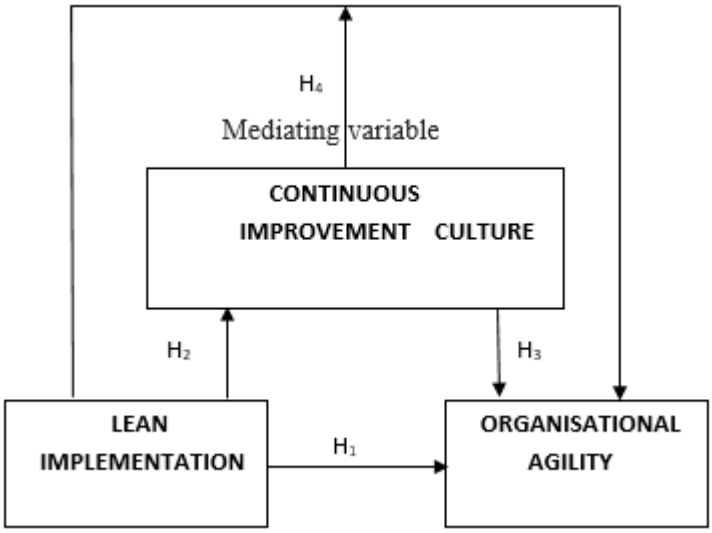

Figure 1: Hypothesised Model of Lean Implementation and Organisational Agility: A Mediating Role of Continuous Improvement Culture in Nigerian Manufacturing Firms

Lean Implementation and Organisational Agility

Lean manufacturing, according to Olu-Lawal, Ekemezie, and Usiagu (2024), is a set of methods and concepts intended to lessen uncertainty, get rid of waste, and guarantee efficient process flow. The literature claims that in order to increase the company's manufacturing capacity, reduce waste, and improve its financial performance, a number of manufacturing tools, techniques, and methodologies were developed, assessed, and suggested. Just-in-time (JIT), Poka-yoke, kaban, total quality management (TQM), employee involvement, visual management, and supplier integration are some of the lean manufacturing strategies that have been shown to have a significant manufacturing influence on business performance (Hassan & Pasha, 2023). By reducing process bottlenecks and improving information flow, lean systems can enable faster problem detection and resolution, leading to enhanced agility (Mbagwu, 2025).

Organizational agility originated in the manufacturing sector, as the literature analysis revealed. According to Zitkiene and Deksyns (2018), it was described as a manufacturing system that can quickly switch between

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

products in real time to fulfill the demands of a changing marketplace. Agile manufacturing is thought to be the next development in production methodology, following Lean manufacturing. According to ElBadaway, Amr, Farouk, Talaat, Walid, and AbdelRaheem (2024), agile manufacturing is an approach to manufacturing that focuses on satisfying customer wants while upholding high standards of quality and controlling the total costs associated in the manufacture of a certain product. This strategy is intended for businesses operating in fiercely competitive markets where minor differences in product delivery and performance can have a significant impact on a company's long-term survival and customer reputation (Mbagwu, 2025). According to Agbionu and Mbagwu (2025), agility is a comprehensive strategy aimed at thriving in an unpredictable and rapidly changing environment.

According to Narkhede, Raut, Roy, Yadav & Gardas (2020) and Ding, Hernandex, and Jane (2023), many manufacturing companies integrate both lean and agile systems into their manufacturing processes in order to reduce waste, shorten customer lead times, and boost productivity. The hybrid Lean-Agile framework, according to Serrador & Pinto, 2023, combines Agile techniques with Lean Manufacturing concepts to produce an all-encompassing strategy for process optimization and operational effectiveness. According to Helmalatha, Sankaranarayanasamy & Durairaaj (2021), lean and agile manufacturing are essential for improving the production process in order to compete in a digital and dynamic world.

Organizational agility has become the essential mindset for success in today's quickly changing business environment. Businesses must embrace agility as a key component of their strategy in order to guarantee long-term success. The underline hypothesis was developed as a result of this study's findings:

H1: Lean implementation has a positive effect on organisational agility.

Lean Implementation and Continuous Improvement Culture

Lean is about developing and enhancing reliable, predictable systems and procedures to provide clients with high-quality goods or services on schedule by including all members of the company. Furthermore, companies must foster an atmosphere that encourages employee participation and ongoing education (Protzman, Whiton & Kerpcher, 2022). A continuous improvement culture, according to Kaizen Institute, motivates staff members to actively look for ways to improve procedures, goods, and services. Organizations can leverage the combined thoughts and creativity of their staff to achieve sustained growth and success by encouraging cooperation and open communication. The emphasis on continuous improvement, which is frequently operationalized in the context of Kaizen and entails improving performance in numerous small, incremental steps involving everyone in a company, is a fundamental aspect of lean philosophy (Nwatu, 2024).

According to Nganga & Nyaga (2022), managers' and employees' participation in continuous improvement initiatives can be a strategic instrument for enhancing and preserving competitive advantage by leveraging their expertise and involvement to raise an organization's overall performance level. Therefore, the implementation of continuous improvement has enormous and noteworthy advantages since it doesn't take a lot of capital, making it easy to use employees' skills (Nganga & Nyaga, 2022). Continuous improvement is essentially the widespread participation of workers in improvement procedures.

A culture of continuous improvement that emphasizes learning, experimentation, and group problem solving is fostered by effective lean implementation. The organizational performance of Nigerian manufacturing companies has been demonstrated to be impacted by continuous improvement approaches, according to Animashaun et al. (2024). Consequently, the following hypothesis was developed for testing.

H2: Lean implementation has a positive effect on continuous improvement culture.

Continuous Improvement Culture and Organisational Agility

The capacity of an organization to quickly adjust and change in response to shifts in the market, technology, and client needs is known as organizational agility. It involves utilizing a variety of adaptable tactics, structures, procedures, and a continual development culture to move swiftly and effortlessly (Anderson, 2024). Conversely,

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

continuous improvement is the process of continuously looking for methods to improve operations, processes, services, and goods. It's about producing tiny, gradual improvements that add up to big breakthroughs (Agilemania, 2025). A company's capacity to adjust to changes in the environment is improved by a culture that encourages ongoing learning, experimentation, and knowledge exchange. Sensing agility (via feedback systems), decision agility (through empowerment and cooperation), and execution agility (through iterative learning and quick reconfiguration) are all facilitated by a culture of continuous development.

In today's fast-paced business climate, integrating agile approaches into organizational culture has become important for promoting innovation, adaptation, and continuous development. But establishing a set of tools or procedures is not enough to achieve long-term success with agile methodologies; the firm as a whole must undergo a profound culture shift. Teams must be encouraged to collaborate, take ownership of their processes, and be adaptable in the face of new knowledge or challenges in order to foster an agile mentality (Adebayo, 2022). Therefore, an organization's capacity to connect its cultural values with the concepts of agility is crucial to the success of agile adoption. Lean systems can facilitate quicker problem identification and resolution, resulting in increased agility, by lowering process bottlenecks and enhancing information flow. As a result, the following hypothesis was created:

H3: Continuous improvement culture has a positive effect on organisational agility.

Mediating Role of Continuous Improvement Culture

According to Kolocha and Anugwu (2022), lean manufacturing is a methodical approach to identifying and eliminating waste in operations through continuous improvement to do everything more efficiently, lower operating system costs, and satisfy customers' desire for maximum value at the lowest price. Lean implementation offers discipline and structure, but these practices become ingrained and self-sustaining through a culture of continuous improvement. We propose that the relationship between lean implementation and organizational agility is mediated by continuous improvement culture. This is because when people internalize improvement as part of their everyday work, the organization develops agility by continuously modifying processes to changing conditions.

According to Novkov (2020), developing the capacity for ongoing improvement is essential to guaranteeing that teams have an agile experience. You must make a commitment to ongoing development if you claim to be genuinely agile. To guarantee long-term benefits, manufacturing companies using true lean thinking must take waste reduction and long-term value generation into account. Additionally, since prior research has demonstrated the connection between organizational agility and lean implementation, successful continuous improvement initiatives eventually result in positive Lean implementations (Tan, Lim, Ong, Goh & Choi, 2019). As a result, continuous improvement enables the maintenance of organizational agility. It makes sense that in manufacturing companies, the relationship between lean adoption and organizational agility is mediated via continuous improvement. These results reinforced the idea that a culture of continuous improvement is crucial in mediating the relationship between lean implementation and organizational agility. As a result, the following hypothesis was developed for testing:

H4: Continuous improvement culture mediates the relationship between lean implementation and organisational agility.

THEORETICAL FRAMEWORK

This study makes use of the dynamic capabilities view (DCV) as the theoretical framework underpinning this study.

Theory of Dynamic Capabilities (DCT)

The dynamic capabilities view is a strategic management theory that contends that a company's ability to adapt and respond to a changing environment is crucial to obtaining a long-term competitive advantage (Cavusgil and

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

Daeligonul, 2024). This thesis states that for businesses to remain competitive, they must be able to grow, restructure, and adapt (Hutchison, 2024).

Understanding dynamic capabilities is crucial to comprehending the nature of organisational agility since the dimensions of organisational agility encompass a range of dynamic capabilities. Hutchison (2024) claims that the theory identifies three interrelated capabilities: the capacity to swiftly discover new strategic assets within the company and the capacity to modify existing assets to satisfy evolving needs. According to Baskarada & Koronios (2018), these abilities are essential for businesses to thrive in the face of change because they promote responsiveness and agility.

Lean management and dynamic capabilities (DC) are two strategy frameworks that companies use to increase their competitiveness and adaptability in a fast-paced, increasingly complicated business environment (Uwa, 2024). An organization's "dynamic capabilities" include its ability to identify opportunities and threats, seize those possibilities, and realign resources and procedures to maintain a competitive edge (Uwa, 2024). On the other hand, lean management emphasises continual improvement, streamlines operations, and reduces waste in order to maximise value to the client. Lean management and dynamic capabilities are very relevant since they both emphasise the importance of flexibility and change management. In addition to allowing businesses to achieve and sustain operational excellence through continuous innovation and evolution, this combination guarantees long-term competitiveness and resilience (Nganga & Nyaga, 2022).

In conclusion, lean management techniques and the concepts of Dynamic Capabilities Theory are strongly related. Lean management helps businesses prosper in a changing business environment by encouraging flexibility, ongoing learning, resource optimisation, strategic alignment, resilience, customer focus, and teamwork (Uwa, 2024).

Empirical Review

Uchenna & Ezenwoke (2025) examined the effects of a hybrid lean-agile framework on operational efficiency in manufacturing companies, concentrating on Cadbury Nigeria Plc in Lagos. The study employed a mixed-method approach, combining quantitative data from official surveys with qualitative material from 260 employees' semi-structured interviews. Descriptive analysis, regression, and correlation were used. The study's conclusions indicate that the Hybrid Lean-Agile Framework significantly improves operational effectiveness and offers a practical paradigm for companies functioning in unpredictable and resource-constrained environments.

Similarly, Uwa (2024) carried out an empirical study in Akwa Ibom that examined the competitive advantage of businesses and lean management techniques. This study used a survey research approach to explore the association between lean practices and firms' competitive advantage in a subset of firms in Akwa Ibom State. Based on the data gathered, hypotheses were assessed using the analysis's ordinal regression tool. The findings demonstrated a strong relationship between the Lean Management dimension (employee involvement, Just-in-Time) and the competitive advantage of enterprises in Akwa Ibom State. Just-in-time and employee involvement are relational characteristics that could improve firms' competitive edge and organisational performance in Akwa Ibom State.

Njoroge & Nyaga (2022) investigated the relationship between the performance of Nairobi Bottlers Limited and measures for continuous improvement. The analysis of the study made use of inferential statistics and multiple regression. The study has shown that continuous improvements have an impact on the organisational performance of industrial businesses. According to the study's findings, manufacturing companies should strive to successfully add value for their customers while enabling their employees to contribute and realise their full potential.

In their study "Lean Manufacturing Approach and Operational Efficiency of Nigerian Pharmaceutical Companies in Anambra State," Okolocha & Anugwu (2022) validated lean business strategy as a management technique that could help Nigerian manufacturing companies reposition their business processes in order to optimize resources, reduce operational costs, become responsive, flexible, and customer-focused. The study used

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

a descriptive survey research approach, and SPSS version 20.0 was used to analyze the data using the T-test statistical tool at the 5% significant level.

Austin & Adebayo (2021) investigated how people and the duality of lean impact lean deployment in businesses using Irish food processing manufacturing companies as a case study. Using data from 340 surveys from Irish food processing industries, the study employed structural equation modelling (PLS-SEM). Lean adoption may be hampered by inadequate organisational communication techniques, organisational culture, organisational knowledge, managerial support, and human development policies, according to the study. The study concludes that there is no one-size-fits-all method for applying lean; rather, the presence or lack of the aforementioned components can either facilitate or impede the use of lean, especially in Irish food processing manufacturing businesses.

Last but not least, attempts for continuous improvement frequently have a high failure rate. However, research often focuses on success factors rather than directly addressing failures. McLeana, Antonya, and Dahlgaard (2016) looked at the failure of continuous improvement projects in manufacturing environments. The study's objective was to provide a thorough summary of the literature outlining the reasons why Continuous Improvement initiatives might not be successful in manufacturing settings. The findings highlight the challenges of implementing Continuous Improvement inside a company.

RESEARCH METHODOLOGY

Research Design and Sample

The study examined how the culture of continuous improvement mediates the relationship between organisational agility and lean implementation in Nigerian manufacturing companies using a quantitative research methodology and a survey design approach to enable the generalisation of the results to the entire population of the study. Manufacturing companies listed with the Nigerian Exchange Group (NGX) made up the population. Both primary and secondary sources were used to generate the data. The chosen companies within the listed manufacturing firms provided primary data.

The study's target population consisted of 270 workers from 54 listed manufacturing companies on the Nigeria Stock Exchange (NSE), including managers of operations, production, quality, and two supervisors. Operations, production, and quality managers as well as two supervisors from each division of the participating companies were given a standardised questionnaire. Supervisors were asked to complete the questionnaires in situations where it was difficult to get in touch with the company's managers because they are directly involved in the operating system and also keep an eye on production activities.

The sample size was 161 respondents calculated using Taro Yammane (1967) statistical formula.

$$n = \frac{N}{(1 + Ne^2)} = \frac{270}{1 + 270(0.05)^2} = \frac{270}{1 + 270(0.0025)} = \frac{270}{1.675} = 161$$

Stratified and convenience sampling methods were used for sample selection. The firms were grouped under different industrial sector and selection was made based on the willingness of the firm to participate.

3.2 Data Collection

Data collection was via 5-point Likert scale questionnaires that were administered to 5 key personnel in each of these organizations that participated. Of the 161 questionnaires distributed, 153 valid responses were received (66.4% response rate). Respondents represented various sectors: Consumer goods (28%), Industrial goods (26%), Healthcare (18%), and others (28%).

3.3 Measures

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

All constructs were measured using validated scales on a 5-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). Items were adapted from prior studies (Lim, Sabi and Othman (2022).

Lean Implementation (LI):

Measured as a second-order reflective construct with dimensions; Just-in-time (JIT), Workplace organization (WPO), and management commitment (TQM)

Continuous Improvement Culture (CI):

This measured with items capturing learning orientation, problem-solving routines, leadership support for improvement, and psychological safety.

Organisational Agility (OA):

A second-order reflective construct measured through three dimensions; sensing capability, responding capability, and transforming capability.

Data Analysis

Measurement Model

Data were analysed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4. The choice of PLS-SEM was due to its suitability for complex models and prediction-oriented research. The measurement model was evaluated to establish the reliability and validity of the latent constructs prior to examining the structural relationships. This is a necessary exercise in structural equation modeling in order to ensure that the indicators accurately and consistently represent their underlying constructs. In this study, the measurement model was assessed through internal consistency reliability, convergent validity, and discriminant validity using established criteria.

Internal consistency reliability was examined using Cronbach's alpha and composite reliability measures (ρA and ρC). As shown in Table 1, Lean Implementation (LI) recorded a Cronbach's alpha value of 0.959, with composite reliability values of 0.960 (ρA) and 0.964 (ρC), indicating a very high level of internal consistency among its indicators. Similarly, Continuous Improvement Culture (CIC) demonstrated strong reliability, with a Cronbach's alpha of 0.959 and composite reliability values of 0.959 (ρA) and 0.964 (ρC). Organisational Agility (OA) also exhibited excellent internal consistency reliability, with a Cronbach's alpha of 0.963, composite reliability (ρA) of 0.964, and composite reliability (ρC) of 0.967. All reported values substantially exceed the recommended minimum threshold of 0.70, thereby confirming the stability and reliability of the measurement scales used in this study.

Convergent validity was assessed using the Average Variance Extracted (AVE). As indicated in Table 1, Lean Implementation (LI) achieved an AVE value of 0.710, indicating that 71.0% of the variance in its indicators is explained by the construct.

Continuous Improvement Culture (CIC) recorded an AVE of 0.730, demonstrating that 73.0% of the variance in its indicators is captured by the construct. Similarly, Organisational Agility (OA) exhibited an AVE value of 0.712, confirming that 71.2% of the variance in its indicators is explained by the latent construct. All AVE values exceed the recommended minimum threshold of 0.50. This means that there is strong empirical evidence of convergent validity, confirming that the indicators converge adequately on their respective constructs.

Table 1: Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability (ρA)	Composite Reliability (ρC)	AVE
CIC	0.959	0.959	0.964	0.730

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

LI	0.959	0.960	0.964	0.710
OA	0.963	0.964	0.967	0.712

Discriminant validity was examined using the indicator cross-loadings, the Heterotrait-Monotrait ratio (HTMT), and the Fornell-Larcker criterion, in line with recommended best practices for PLS-SEM. The cross-loading results indicate that each indicator loads more strongly on its respective construct than on any other construct. This pattern confirms that the indicators are appropriately specified and measure their intended latent variables without substantial overlap.

Table 2: Discriminant Validity Assessment Using Cross-Loadings

Indicator	**CIC**	**LI**	**OA**
CIC1	0.871	0.575	0.599
CIC10	0.842	0.579	0.631
CIC2	0.851	0.573	0.661
CIC3	0.868	0.595	0.653
CIC4	0.825	0.609	0.628
CIC5	0.852	0.615	0.647
CIC6	0.840	0.606	0.637
CIC7	0.866	0.613	0.689
CIC8	0.873	0.550	0.596
CIC9	0.852	0.600	0.656
JIT1	0.548	0.837	0.567
JIT2	0.640	0.836	0.616
JIT3	0.584	0.833	0.544
RC1	0.658	0.569	0.796
RC2	0.630	0.563	0.790
RC3	0.611	0.558	0.788
SC1	0.648	0.578	0.854
SC2	0.587	0.539	0.815
SC3	0.536	0.507	0.800
TC1	0.656	0.602	0.896
TC2	0.660	0.591	0.874
TC3	0.685	0.618	0.867
TC4	0.648	0.618	0.874
TC5	0.629	0.579	0.888
TC6	0.625	0.596	0.870

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

TQM1	0.574	0.860	0.592
TQM2	0.553	0.858	0.541
TQM3	0.589	0.842	0.584
TQM4	0.599	0.892	0.628
TQM5	0.584	0.863	0.599
WPO1	0.583	0.802	0.541
WPO2	0.554	0.832	0.579
WPO3	0.611	0.810	0.551

In the same vein, as indicated in table 3, HTMT values for all construct pairs are found to be below the conservative threshold of 0.85, indicating adequate discriminant validity and confirming that the constructs do not exhibit problematic levels of similarity.

Table 3. Discriminant Validity Assessment Using HTMT

	CIC	**LI**	**OA**
CIC	—		
LI	0.721	—	
OA	0.778	0.711	—

The Fornell–Larcker criterion further supports discriminant validity. As shown in Table 4, the square root of the AVE for each construct (diagonal values) is greater than the correlations between that construct and the other constructs in the model.

Table 4: Discriminant Validity Assessment Using the Fornell–Larcker Criterion

	CIC	**LI**	**OA**
CIC	0.854		
LI	0.693	0.843	
OA	0.750	0.685	0.844

Across the cross-loadings, HTMT, and the Fornell–Larcker criterion, discriminant validity is consistently supported. Each construct is empirically distinct, and the measurement model satisfies all recommended discriminant validity requirements.

RESULTS

Structural Model

Following the establishment of a satisfactory measurement model, the structural model was assessed to examine the hypothesised relationships among Lean Implementation, Continuous Improvement Culture, and Organisational Agility. The evaluation focused on the magnitude, direction, and statistical significance of the structural path coefficients, as well as the mediating role of Continuous Improvement Culture.

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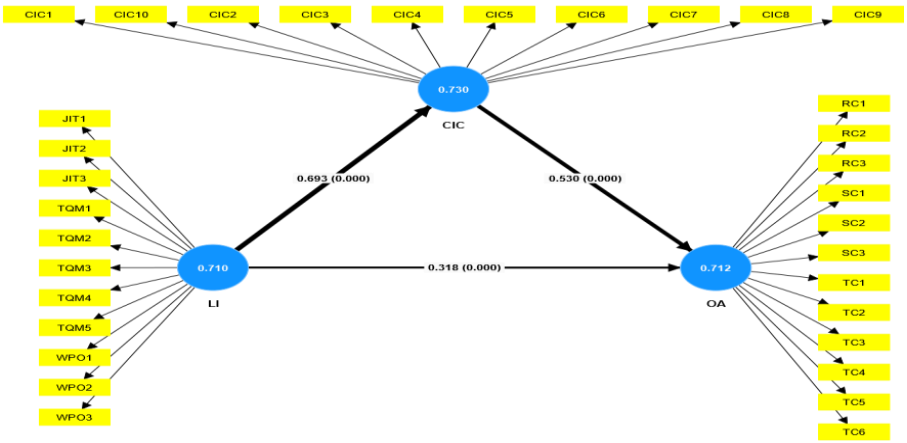

Figure 2: PLS-SEM Structural Model with Path Coefficients and Significance Levels

As shown in figure 2, the results of the direct relationships indicate that Lean Implementation has a strong and statistically significant positive effect on Continuous Improvement Culture. The path coefficient for LI → CIC is substantial (β = 0.693) and highly significant (t = 19.893, p < 0.001), suggesting that the adoption of lean practices strongly fosters a culture of continuous improvement within Nigerian manufacturing firms. Continuous Improvement Culture also exerts a significant positive influence on Organisational Agility (β = 0.530, t = 9.127, p < 0.001), indicating that organisations with stronger continuous improvement cultures are better able to sense, respond to, and transform in dynamic environments. In addition, Lean Implementation demonstrates a direct and statistically significant effect on Organisational Agility (β = 0.318, t = 4.890, p < 0.001), implying that lean practices enhance organisational agility beyond their indirect influence through culture.

Table 5: Structural Model Path Coefficients

Path	Original Sample (β)	Sample Mean	STDEV	T Statistic	p-value
LI → CIC	0.693	0.695	0.035	19.893	0.000
CIC → OA	0.530	0.530	0.058	9.127	0.000
LI → OA	0.318	0.319	0.065	4.890	0.000

The mediating role of Continuous Improvement Culture was assessed through the specific indirect effect of Lean Implementation on Organisational Agility via Continuous Improvement Culture. The results, presented in Table 6, show that the indirect effect is positive and statistically significant (β = 0.367, t = 7.988, p < 0.001). This indicates that Continuous Improvement Culture plays a substantive role in transmitting the effect of Lean Implementation to Organisational Agility.

Table 6: Specific Indirect Effect (Mediation Analysis)

Indirect Path	Original Sample (β)	Sample Mean	STDEV	T Statistic	p-value
LI → CIC → OA	0.367	0.368	0.046	7.988	0.000

Given that both the direct effect of Lean Implementation on Organisational Agility (β = 0.318, p < 0.001) and the indirect effect via Continuous Improvement Culture (β = 0.367, p < 0.001) are statistically significant, the findings indicate the presence of partial mediation. This implies that Lean Implementation enhances organisational agility both directly and indirectly through the establishment of a continuous improvement culture. Notably, the magnitude of the indirect effect exceeds that of the direct effect, suggesting that a considerable proportion of the influence of lean implementation on organisational agility is transmitted through continuous improvement culture, while the direct pathway remains substantively meaningful.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

SUMMARY OF RESULTS

Hypothesis	Path	Path coefficient (original sample β)	T -Statistic	p-Value	Result	Decision
H1	LI → OA	0.318	4.890	0.000	Significant	Accepted
H2	LI → CIC	0.693	19.893	0.000	Significant	Accepted
H3	CIC → OA	0.530	9.127	0.000	Significant	Accepted
H4	LI → CIC → OA	0.367	7.988	0.000	Significant (Partial mediation)	Accepted

DISCUSSION

The primary aim of this study was to look at the mediating role of continuous improvement culture in the relationship between lean implementation and organisational agility in the Nigerian manufacturing firms. The analysis further addressed whether lean implementation and continuous improvement culture directly impact organisational agility in manufacturing firms.

H_1: The result indicates that Lean Implementation has a strong and statistically significant positive effect on Organisational Agility ($\beta = 0.318$, $t = 4.890$, $p < 0.001$. This also implies that lean practices enhance organisational agility in manufacturing firms, and shows a direct positive relationship. The results are consistent with Grace, Praise, and Dave (2025); Togun, Sobowale, and Udom (2024), that lean operations significantly improves agility through waste reduction, process standardization, and continuous improvement. Findings indicate that firms that successfully adopt lean principles experience higher responsiveness, improved process efficiency, and enhanced strategic flexibility.

H_2: The direct relationship indicates that Lean Implementation has a strong and statistically significant positive effect on Continuous Improvement Culture. The path coefficient for LI → CIC is substantial ($\beta = 0.693$) and highly significant ($t = 19.893$, $p < 0.001$), suggesting that the adoption of lean practices strongly fosters a culture of continuous improvement within Nigerian manufacturing firms. In Ghazali et al. (2025), the findings enhance lean theory by situating implementation within cultural frameworks and provide pragmatic assistance for managers aiming to harmonize lean strategies with local cultural characteristics in emerging nations. It becomes clear that lean manufacturing increases quality and productivity in companies and enables the establishment of a continuous improvement work methodology that invites the constant review of processes and consequently the culture of change and quality within companies (Solis-Quinteros, Zayas-Marques, Avila-Lopez & Carillo-Gutirrez, 2021).

H_3: Continuous Improvement Culture also exerts a significant positive influence on Organisational Agility ($\beta = 0.530$, $t = 9.127$, $p < 0.001$), indicating that organisations with stronger continuous improvement cultures are better able to sense, respond to, and transform in dynamic environments**.** A robust Continuous improvement culture enhances sensing and adaptation capabilities, confirming the argument of Felipe et al. (2017). The findings may help managers to understand the importance of adapting their firm's corporate culture to the aspiration of becoming more effective and agile. According to Temitope (2022), the success of agile implementation largely depends on the organisation's ability to align its existing cultural values with the principles of agility.

H_4: The results of the hypothesis testing supported that Continuous Improvement Culture significantly mediated the relationship between Lean Implementation and Organisational Agility within Lean manufacturing firms in Nigeria ($\beta = 0.367, 7.988$, $p < 0.001$). The mediation results align with Cadden et al. (2020) and Lim et al. (2022), showing that continuous improvement culture is a vital link converting lean efficiency into strategic responsiveness.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue V, May 2026

Theoretical Implications

The findings support the notion that lean manufacturing extends beyond efficiency gains to enable strategic agility. The study contributes to dynamic capabilities theory by empirically validating continuous improvement culture as a mediating organisational mechanism. The results align with prior research (**Teece, 2007; Netland, 2016),** affirming that agility emerges not merely from process tools but from the learning routines that sustain adaptation.

Managerial Implications

1. Invest in People, Not Just Tools: Managers should complement lean tool deployment (e.g., JIT, 5S, Kanban) with structured problem-solving training and leadership behaviours that encourage experimentation.

2. Develop Routine Learning Mechanisms: Regular Kaizen events, cross-functional meetings, and Gemba walks institutionalize continuous improvement and embed adaptability.

3. Balance Standardisation and Flexibility: Visual management and standard work should be designed to reveal problems quickly, not suppress deviation.

4. Foster Supplier Collaboration: Strengthening supplier integration enhances responsiveness to market changes.

5. Leadership Commitment: Agility requires leaders who champion learning, reward experimentation, and model continuous improvement behaviours.

Policy Implications

Government agencies and industry associations e.g., Manufacturing Association of Nigeria (MAN), Bank of Industry (BOI) can promote agility by supporting SME-focused lean and continuous improvement capability building programs, integrating improvement routines into national industrial development policies.

CONCLUSION

This study provides empirical evidence that lean implementation enhances organisational agility among Nigerian manufacturing firms and that this effect is partially mediated by a continuous improvement culture. The findings underscore that lean success depends not merely on adopting tools but on embedding a learning-oriented culture. In resource-constrained environments, continuous improvement routines serve as adaptive mechanisms that enable firms to respond swiftly to change.

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