WASTE REDUCTION AND CONTINUOUS IMPROVEMENT CULTURE: DETERMINANTS OF PERFORMANCE IN FOOD AND BEVERAGE MANUFACTURING FIRMS IN SOUTH-SOUTH NIGERIA

Mbagwu, Leo Ezenwoke[1] Agbionu, Clementina Uchenna[2]
[1]*Department of Business Administration, Nnamdi Azikiwe University, Awka Anambra State*
[2]*Department of Entrepreneurship, Nnamdi Azikiwe University, Awka Anambra State*
Emails: *le.mbagwu@stu.unizik.edu.ng[1]; cu.agbionu@unizik.edu.ng[2]*

Abstract
This study investigates the effect of waste reduction and continuous improvement culture, two core components of the Integrated Lean Six Sigma (ILSS) production system on the performance of food and beverage manufacturing firms in South-South Nigeria. Anchored on the Theory of Constraints (TOC), the research examines how waste reduction influences production efficiency and how continuous improvement culture shapes employee productivity and engagement. A descriptive survey design was employed, with data collected from 303 respondents across five multinational food and beverage companies in the region. Data analysis involved descriptive statistics, linear regression, and multivariate analysis of variance (MANOVA). Findings reveal that waste reduction exerts a statistically significant positive effect on production efficiency ($R = 0.784$, $R^2 = 0.615$, $p < .05$), indicating that eliminating non-value-adding activities can improve efficiency by over 61%. Continuous improvement culture was also found to significantly influence both employee productivity ($R^2 = 0.667$) and employee engagement ($R^2 = 0.536$), underscoring the role of cultural transformation in workforce performance. The study concludes that adopting ILSS practices that integrate waste elimination and continuous improvement principles can enhance operational efficiency and workforce output in resource-constrained environments. It recommends that manufacturing firms should institutionalize continuous improvement programs, invest in employee training, and adopt data-driven waste reduction strategies to sustain long-term competitiveness.

Key words: *Lean Six Sigma, waste reduction, continuous improvement culture, production efficiency, employee productivity, Theory of Constraints, Nigeria.*

Introduction

In an era of global competition and rapid technological change, manufacturing firms must achieve operational excellence to remain competitive (Antony et al., 2021; Galli, 2023). This is especially critical in developing economies such as Nigeria, where infrastructural limitations, high operational costs, and fluctuating macroeconomic

conditions impose significant constraints on industrial performance (Akinwale et al., 2020; Adegbite & Ayadi, 2021). Within the Nigerian manufacturing landscape, the food and beverage sector is a vital contributor to gross domestic product (GDP), employment generation, and industrial growth (National Bureau of Statistics [NBS], 2022). However, firms in this sector, particularly in the South-South geopolitical zone, face persistent inefficiencies, resource wastage, and productivity gaps that hinder their competitiveness in both domestic and export markets (Ugoani, 2020). One strategic framework gaining traction globally for addressing these operational challenges is the Integrated Lean Six Sigma (ILSS) production system, which synergizes the waste elimination principles of Lean manufacturing with the variation-reduction and quality improvement focus of Six Sigma (George, 2002; Alhuraish et al., 2022). Among the numerous ILSS practices, waste reduction and continuous improvement culture are two critical levers for enhancing performance. Waste reduction directly impacts production efficiency by eliminating non-value-adding activities, streamlining processes, and improving resource utilization (Womack & Jones, 2014). Continuous improvement culture, on the other hand, influences workforce productivity and engagement by embedding a mindset of ongoing process refinement, employee empowerment, and collaborative problem-solving (Imai, 2012; Liker, 2020).

The South-South region of Nigeria hosts several multinational food and beverage manufacturers, including Guinness Nigeria Plc (Benin), International Breweries Plc (Port Harcourt), Niger Flour Mills Plc (Calabar), Life Flour Mills (Sapele), and Champion Breweries Plc (Uyo). Despite operating with global production frameworks, these firms face systemic inefficiencies manifested in extended cycle times, high defect rates, and sub-optimal utilization of human capital. Waste in the form of excess inventory, redundant movements, overproduction, and process delays inflate production costs and constrain output (Antony, 2015; Liker, 2020). Simultaneously, the absence of a robust continuous improvement culture often results in low employee engagement, reduced innovation, and stagnant productivity levels (Bessant et al., 2001). While international evidence suggests that waste reduction significantly enhances production efficiency (Galeazzo et al., 2014; Ahmed et al., 2023) and that continuous improvement culture fosters higher workforce performance (Salah et al., 2017; Chiarini & Baccarani, 2021), empirical evidence from Nigerian manufacturing particularly within the South-South region remains sparse. This study addresses this gap by examining how waste reduction influences production efficiency and how continuous improvement culture affects employee productivity and engagement.

Guided by the Theory of Constraints (TOC) (Goldratt, 1990), which posits that every system has at least one limiting factor that constrains its performance, the research focuses on identifying and addressing operational bottlenecks. Waste reduction is expected to address process-related constraints, thereby improving throughput, while

continuous improvement culture aligns with TOC's philosophy of ongoing identification and elimination of constraints, ensuring sustained performance gains over time.

Objectives

This study focuses on two specific objectives:

1. To examine the influence of waste reduction on production efficiency in food and beverage manufacturing firms in South-South Nigeria.
2. To evaluate the influence of continuous improvement culture on employee productivity and engagement in food and beverage manufacturing firms in South-South Nigeria.

Research Questions

1. What influence does waste reduction have on production efficiency in food and beverage manufacturing firms in South-South Nigeria?
2. How does continuous improvement culture influence employee productivity and engagement in food and beverage manufacturing firms in South-South Nigeria?

Research Hypotheses

H_{o1}: Waste reduction has no significant influence on production efficiency in food and beverage manufacturing firms in South-South Nigeria.

H_{o2}: Continuous improvement culture has no significant influence on employee productivity and engagement in food and beverage manufacturing firms in South-South Nigeria.

Literature Review

Waste Reduction and Production Efficiency

Waste reduction is a central pillar of Lean philosophy and one of the most direct pathways to enhancing production efficiency. In manufacturing, waste is broadly defined as any activity or resource use that does not add value to the end customer (Liker, 2020). Lean categorises waste into eight types: defects, overproduction, waiting, non-utilised talent, transportation, inventory, motion, and extra processing. Reducing these waste forms enables organisations to improve process flow, reduce cycle time, and optimise resource utilisation, ultimately leading to higher output with fewer inputs (Womack & Jones, 2014). In the context of food and beverage manufacturing, waste reduction translates into improved production efficiency through multiple channels. Streamlined workflows eliminate bottlenecks, inventory control reduces holding costs, and improved process layouts minimise unnecessary material handling (Galeazzo et al., 2014). Empirical studies in manufacturing sectors globally confirm a positive link

between waste reduction initiatives and operational efficiency (Ahmed et al., 2023; Subramanian et al., 2024).

Waste reduction strategies often employ tools such as Value Stream Mapping (VSM) to identify non-value-adding activities, Kanban systems to align production with demand, and 5S workplace organisation to improve process discipline (Antony, 2015; Kolberg & Zühlke, 2021). These tools not only reduce operational waste but also improve information flow, equipment reliability, and worker productivity, creating cumulative efficiency gains. From a theoretical standpoint, the Theory of Constraints (Goldratt, 1990) provides a framework for understanding waste reduction's contribution to efficiency. By focusing on constraints that limit throughput, waste elimination efforts can remove systemic bottlenecks, allowing the production system to operate closer to its full capacity. In resource-constrained environments such as South-South Nigeria, this approach is especially critical, as it enables firms to maximise output without proportionately increasing costs.

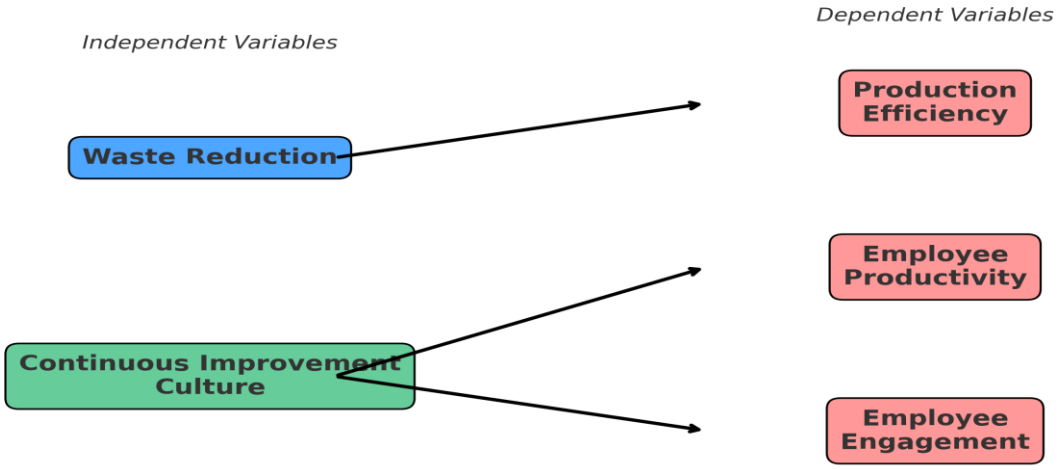
Continuous Improvement Culture and Employee Productivity

Continuous improvement culture (CIC) refers to an organisational environment that systematically encourages incremental and ongoing enhancements in processes, products, and services. Originating from the Japanese concept of *Kaizen*, CIC involves all employees, from top management to shop floor workers in problem-solving and innovation (Imai, 2012). The underlying assumption is that empowering employees to identify inefficiencies and propose solutions fosters ownership, motivation, and higher performance. Employee productivity is closely tied to the presence of a robust continuous improvement culture. In manufacturing, productivity gains arise from enhanced problem-solving skills, better cross-functional collaboration, and a proactive approach to operational challenges (Bessant et al., 2001). CIC also strengthens employee engagement, defined as the emotional and cognitive connection employees have with their work, which has been shown to improve discretionary effort and reduce turnover (Chiarini & Baccarani, 2021).

Empirical studies indicate that CIC has a dual impact: it improves employee productivity directly by providing tools and training for more effective work and indirectly by increasing job satisfaction and organisational commitment (Salah et al., 2017; Singh et al., 2023). Moreover, in Lean Six Sigma environments, CIC complements statistical process control and waste reduction by embedding the mindset necessary to sustain process improvements (Antony et al., 2021). From the perspective of the Theory of Constraints, continuous improvement culture supports the iterative identification and elevation of constraints. As constraints shift over time due to market changes, process modifications, or resource reallocations, a culture that normalises ongoing assessment ensures that performance improvements are sustained rather than

eroded. In this sense, CIC is not a one-off initiative but a structural capability that enables adaptive, long-term competitiveness.

Conceptual Framework



Source: Authur, (2025)

Synthesis and Gap in Literature

While there is substantial global evidence linking waste reduction to production efficiency and CIC to employee productivity, research in Nigeria's manufacturing sector remains limited. Studies have largely focused on general Lean adoption (Ugoani, 2020) or quality management practices (Akinwale et al., 2020), with few empirical works isolating the effects of specific ILSS components on discrete performance metrics. The present study addresses this gap by empirically testing these relationships in five multinational food and beverage manufacturing firms in South-South Nigeria, contributing context-specific evidence to the broader Lean Six Sigma literature.

Methodology

This study adopted a descriptive survey research design to examine the influence of waste reduction on production efficiency and the influence of continuous improvement culture on employee productivity and engagement in food and beverage manufacturing firms located in South-South Nigeria. The design was considered appropriate because it enables the collection of quantitative data from a defined population to test hypothesised relationships between variables (Creswell & Creswell, 2018). The population comprised employees of five multinational food and beverage

manufacturing companies operating in South-South Nigeria: Guinness Nigeria Plc (Benin, Edo State), International Breweries Plc (Port Harcourt, Rivers State), Niger Flour Mills Plc (Calabar, Cross River State), Life Flour Mills (Sapele, Delta State), and Champion Breweries Plc (Uyo, Akwa Ibom State). These firms were selected due to their scale, structured production systems, and documented engagement with operational excellence initiatives.

The target population included personnel from production, quality control, engineering/maintenance, and operations departments, as these functions are directly impacted by Lean Six Sigma practices. The total population was 410 employees. The sample size of 303 respondents was determined using the Yamane (1967) sample size formula with a 5% margin of error and proportionate stratified random sampling to ensure representation across departments and firms. Data were collected using a structured questionnaire developed from established measurement scales in Lean Six Sigma and organisational performance literature. The questionnaire was divided into three sections: demographic information, items measuring waste reduction (adapted from Antony et al., 2015), and items measuring continuous improvement culture (adapted from Imai, 2012; Bessant et al., 2001), along with performance indicators for production efficiency, employee productivity, and engagement. A five-point Likert scale ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree" was employed.

Content validity was ensured through expert review by three academics with expertise in operations management and Lean Six Sigma, who assessed the clarity, relevance, and alignment of items with the study objectives. Construct validity was examined using exploratory factor analysis to confirm that items loaded appropriately on their respective constructs. Reliability was assessed through Cronbach's alpha, yielding coefficients of 0.872 for waste reduction, 0.864 for continuous improvement culture, 0.879 for production efficiency, and 0.886 for employee productivity/engagement, exceeding the 0.70 benchmark recommended by Nunnally and Bernstein (1994). Data were analysed using descriptive statistics to summarise demographic characteristics and variable means. Inferential analyses included linear regression to examine the relationship between waste reduction and production efficiency, and multivariate analysis of variance (MANOVA) to assess the effect of continuous improvement culture on employee productivity and engagement simultaneously. Statistical significance was evaluated at the 0.05 level.

For Objective 1, the regression model was specified as:

$$PE = \beta 0 + \beta 1\text{WR} + \varepsilon$$

Where:

PE = Production Efficiency

WR = Waste Reduction

β_0 = Constant term
β_1 = Coefficient for waste reduction
ε= Error term

For Objective 2, the MANOVA model assessed the joint effect of continuous improvement culture (CIC) on the two dependent variables: employee productivity (EP) and employee engagement (EE) as:
EP=β0+β1CIC+ε1
EE=β0+β1CIC+ε2

This analytical approach aligns with previous empirical studies assessing ILSS impacts in manufacturing environments (Salah et al., 2017; Chiarini & Baccarani, 2021).

Analysis and Results

Descriptive Statistics

Table 1 presents the descriptive statistics for the main study variables relevant to the two objectives. Respondents reported relatively high mean scores for both waste reduction (M = 4.21, SD = 0.54) and continuous improvement culture (M = 4.17, SD = 0.57), indicating widespread agreement that these practices are present in their organisations. Similarly, production efficiency (M = 4.19, SD = 0.51) and employee productivity/engagement (M = 4.12, SD = 0.53) were also rated positively.

Table 1
Descriptive Statistics of Study Variables

Variable	Mean	SD	N
Waste Reduction (WR)	4.21	0.54	303
Continuous Improvement Culture (CIC)	4.17	0.57	303
Production Efficiency (PE)	4.19	0.51	303
Employee Productivity (EP)	4.15	0.52	303
Employee Engagement (EE)	4.09	0.54	303

Source: SPSS Output

Objective 1: Influence of Waste Reduction on Production Efficiency

A simple linear regression was conducted to examine the influence of waste reduction on production efficiency. Results (Table 2) show that waste reduction had a statistically significant positive effect on production efficiency ($R = 0.784$, $R^2 = 0.615$, $F(1, 301) = 481.26$, $p < 0.001$). This indicates that 61.5% of the variance in production efficiency is explained by waste reduction practices.

Table 2

Regression Analysis: Waste Reduction and Production Efficiency

Model	**R**	**R^2**	**Adjusted R^2**	**F**	**p-value**
1 (WR → PE)	0.784	0.615	0.614	481.26	0.000

Coefficients:

Predictor	**B**	**SE**	**Beta**	**t**	**p-value**
Constant	0.842	0.112	—	7.52	0.000
Waste Reduction	0.801	0.036	0.784	21.93	0.000

Source: SPSS Output, (2025)

The results suggest that a one-unit increase in waste reduction scores is associated with a 0.801-unit increase in production efficiency scores, holding other factors constant.

Objective 2: Influence of Continuous Improvement Culture on Employee Productivity and Engagement

A multivariate analysis of variance (MANOVA) was performed to determine the effect of continuous improvement culture on employee productivity and engagement. The multivariate test using Wilks' Lambda indicated a statistically significant effect of CIC on the combined dependent variables, $\Lambda = 0.333$, $F(2, 300) = 150.06$, $p < 0.001$, partial $\eta^2 = 0.667$. Follow-up univariate ANOVAs (Table 3) revealed that CIC had a significant effect on both employee productivity ($F(1, 301) = 602.11$, $p < 0.001$, partial $\eta^2 = 0.667$) and employee engagement ($F(1, 301) = 346.67$, $p < 0.001$, partial $\eta^2 = 0.536$).

Table 3

MANOVA Results: Continuous Improvement Culture and Workforce Performance

Dependent Variable	***Sum of Squares***	***df***	***Mean Square***	***F***	***p-value***	***Partial η^2***
Employee Productivity	75.42	1	75.42	602.11	0.000	0.667
Employee Engagement	62.12	1	62.12	346.67	0.000	0.536

Source: SPSS Output, (2025)

These findings indicate that continuous improvement culture accounts for 66.7% of the variance in employee productivity and 53.6% of the variance in employee engagement.

Hypotheses Testing

Rule- If p-value ≤ 0.05: Reject the null hypothesis (**H_0**) and accept the alternative hypothesis (**Ha**)

Objective 1: the regression analysis yields a p-value less than 0.05, then waste reduction significantly improves production efficiency, and Ha is accepted, and Ho is rejected.

Objective 2: MANOVA outputs show p-values less than 0.05, then continuous improvement culture significantly influences employee productivity and engagement, leading to acceptance of Ha and the null hypothesis Ho is rejected.

Discussion of Findings

The results of this study provide empirical evidence that both waste reduction and continuous improvement culture play significant roles in enhancing operational performance in food and beverage manufacturing firms in South-South Nigeria. The findings align with the propositions of the Theory of Constraints (TOC), which emphasises identifying and eliminating operational bottlenecks to improve system throughput (Goldratt, 1990).

The regression analysis for Objective 1 revealed that waste reduction explains 61.5% of the variance in production efficiency, with a strong positive coefficient ($\beta = 0.801$, $p < 0.001$). This indicates that the more organisations focus on eliminating non-value-adding activities such as excess inventory, rework, and unnecessary material movement, the more efficient their production processes become. These results are consistent with previous studies by Galeazzo et al. (2014) and Ahmed et al. (2023), which found that Lean-based waste elimination significantly improves throughput and reduces lead times. In resource-constrained environments like Nigeria, this effect is particularly relevant, as waste reduction directly mitigates the impact of limited infrastructure and high operational costs.

From the TOC perspective, waste often manifests as hidden constraints that restrict output without being immediately obvious. By systematically identifying and removing waste, organisations elevate the capacity of their existing resources, thus increasing efficiency without additional capital investment. The findings of this study affirm that Nigerian manufacturing firms can achieve competitive efficiency gains through disciplined waste elimination strategies, even within challenging economic contexts.

The MANOVA results for Objective 2 showed that continuous improvement culture accounts for 66.7% of the variance in employee productivity and 53.6% in employee engagement, both with high statistical significance ($p < 0.001$). This reinforces the argument by Bessant et al. (2001) and Chiarini and Baccarani (2021) that fostering a workplace environment where employees are encouraged and empowered to contribute

to process improvements leads to sustained productivity and higher engagement levels. When employees feel that their insights are valued and that they have a stake in shaping operational processes, they are more motivated to perform at their best and less likely to disengage from their work.

Theoretically, these findings support the TOC principle that performance improvement is not a one-time intervention but an ongoing process of constraint identification and resolution. Continuous improvement culture institutionalises this philosophy, ensuring that as soon as one constraint is addressed, the organisation proactively seeks the next. In manufacturing contexts, this means that improvements in employee skills, communication channels, and decision-making processes continually contribute to operational gains.

Practically, the evidence from this study suggests that Nigerian manufacturing managers should consider waste reduction and continuous improvement culture not as separate initiatives but as mutually reinforcing strategies within an Integrated Lean Six Sigma (ILSS) framework. Waste reduction removes structural inefficiencies, while continuous improvement culture sustains these gains by embedding the mindset and capabilities necessary to identify future inefficiencies.

The combined influence of these two practices offers a powerful approach to overcoming the persistent operational challenges in Nigeria's manufacturing sector. The high levels of explained variance in both production efficiency and workforce performance metrics underscore their potential for significant, measurable impact. This is particularly important in the South-South region, where competition among multinational firms is high, and operational efficiency can be a key differentiator in market performance.

Conclusion and Recommendations

This study set out to investigate the influence of waste reduction on production efficiency and the effect of continuous improvement culture on employee productivity and engagement in food and beverage manufacturing firms in South-South Nigeria. Guided by the Theory of Constraints (TOC), the analysis confirmed that waste reduction and continuous improvement culture are both significant drivers of operational performance in the manufacturing sector. The regression results demonstrated that waste reduction explains 61.5% of the variance in production efficiency, with a strong positive relationship. This indicates that systematic elimination of non-value-adding activities directly enhances process flow, reduces cycle time, and optimises resource utilisation. The MANOVA results further revealed that continuous improvement culture accounts for 66.7% of the variance in employee productivity and 53.6% in employee engagement, affirming its role in creating an empowered, motivated, and high-performing workforce.

From a theoretical standpoint, these findings reinforce the TOC proposition that organisational performance is constrained by specific bottlenecks, which can be addressed through targeted interventions. Waste reduction removes operational constraints, while continuous improvement culture ensures that the process of identifying and overcoming new constraints is sustained over time. Together, they form a complementary system capable of delivering both immediate and long-term performance gains.

Practical Recommendations:

1. **Institutionalise Waste Reduction Practices:** Manufacturing managers should adopt systematic tools such as Value Stream Mapping (VSM), 5S workplace organisation, and Kanban systems to identify and eliminate waste. This should be reinforced by setting measurable targets for waste elimination linked to production efficiency goals.
2. **Foster a Strong Continuous Improvement Culture:** Organisations should create structures for employee involvement in problem-solving, such as regular Kaizen events and suggestion schemes. Training programmes should focus on equipping staff at all levels with the skills to identify inefficiencies and propose viable solutions.
3. **Integrate Waste Reduction and Continuous Improvement in ILSS Frameworks:** Rather than treating these practices as separate initiatives, they should be integrated into a broader operational excellence strategy. Waste elimination efforts should feed directly into continuous improvement cycles to ensure sustainability of gains.
4. **Leverage Data-Driven Decision Making:** Use performance metrics and analytics to monitor both waste reduction and continuous improvement initiatives. This ensures that improvements are evidence-based and can be adapted in response to changing operational contexts.
5. **Adapt TOC Principles to Local Challenges:** Given the infrastructural and economic constraints in Nigeria, manufacturing firms should adapt TOC by prioritising interventions that yield the highest impact at the lowest cost, focusing on constraints with the greatest influence on throughput.

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