INTERNATIONAL JOURNAL OF BUSINESS AND MANAGEMENT RESEARCH
P-ISSN: 1118-4256, E-ISSN:3034-4327
Vol. 6| No. 2 | July 2025
Page No.: 44 - 68

HYBRID LEAN-AGILE FRAMEWORK AND OPERATIONAL EFFICIENCY IN MANUFACTURING FIRMS IN LAGOS, NIGERIA: A FOCUS ON CADBURY NIG PLC.

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Abstract

This study examines the effect of a Hybrid Lean-Agile Framework on operational efficiency in manufacturing firms, with a specific focus on Cadbury Nigeria Plc in Lagos. Manufacturing firms in Nigeria face persistent challenges such as high production costs, extended lead times, and significant operational waste, which traditional process improvement models have struggled to resolve. By integrating Lean Manufacturing's waste-reduction principles with Agile's adaptability and responsiveness, the hybrid framework aims to enhance productivity, responsiveness, and process optimization. A mixed-method research design was adopted, combining quantitative data from structured surveys with qualitative insights from semi-structured interviews involving 260 employees. Key performance indicators—production lead time, waste generation, and productivity—were analysed before and after implementation. The results show a 25.4% reduction in production lead time, a 29.1% decrease in waste generation, and a 25% increase in productivity. Correlation and regression analyses confirmed statistically significant relationships between framework implementation and all three indicators. Qualitative findings further highlighted

enhanced operational flexibility, improved interdepartmental communication, and greater employee engagement, though challenges such as resistance to change and training gaps were noted. The study concludes that the Hybrid Lean-Agile Framework significantly improves operational efficiency and offers a viable model for firms in volatile and resource-constrained environments.

Key words: Hybrid Lean-Agile Framework, Operational Efficiency, Production Lead Time, Waste Reduction, Productivity Improvement.

Introduction

In today's highly competitive and dynamic global marketplace, manufacturing firms are under increasing pressure to enhance their operational efficiency to maintain profitability and sustain growth. Challenges such as market volatility, rapid technological advancements, and shifting consumer demands have forced organizations to adopt innovative operational strategies. In response, many manufacturing firms are exploring integrated approaches that combine the strengths of established methodologies. One such approach is the Hybrid Lean-Agile Framework, which merges the waste-elimination principles of Lean manufacturing with the flexibility and responsiveness of Agile methodologies.

Originally developed within the automotive and software industries, Lean and Agile have evolved into widely adopted management philosophies across multiple sectors. Lean focuses on maximizing value by systematically identifying and eliminating waste through practices such as Just-in-Time (JIT) production, Kaizen (continuous improvement), and value stream mapping (Womack & Jones, 2019). Agile, by contrast, emphasizes adaptability, iterative development, and close customer collaboration, enabling firms to quickly respond to changes in customer needs and market conditions (Rigby, Sutherland, & Takeuchi, 2016). While both approaches have been individually successful, their hybridization offers a more holistic model for managing complex, fast-paced production environments (Serrador & Pinto, 2023).

The Nigerian manufacturing sector, particularly in Lagos, Nigeria's industrial hub, plays a vital role in the national economy. However, this sector is beset by numerous structural and operational challenges, including unreliable infrastructure, inconsistent power supply, fluctuating raw material

costs, and labour inefficiencies (Adebisi & Olamide, 2021). These factors undermine productivity and increase operational costs. Traditional process improvement methods have proven inadequate in addressing the unique complexities of this environment, prompting the need for more adaptive and integrated solutions.

Cadbury Nigeria Plc, a leading player in the food and beverage manufacturing industry, provides a valuable case for investigating the effectiveness of the Hybrid Lean-Agile Framework. Despite its strong market position, the company has faced challenges in streamlining operations, reducing waste, and adapting quickly to market fluctuations. This study seeks to assess whether implementing a Hybrid Lean-Agile Framework can address these inefficiencies and enhance the firm's operational performance. This research contributes to the growing body of knowledge on lean-agile integration and offers practical insights for Nigerian firms seeking to enhance efficiency and competitiveness.

Objectives of the Study

The broad objective of the study is to determine the nature of the relationship that exits between the adoption of Lean-Agile framework and operational efficiency in Cadbury Nig plc. While specifically, Specifically, the study sought to:

1. Examine the correlation between the adoption of a hybrid Lean-Agile framework and the reduction of production lead time at Cadbury Nigeria Plc.
2. Ascertain the relationship between waste reduction and overall productivity following the implementation of a hybrid Lean-Agile framework at Cadbury Nigeria Plc.

Research Questions

The following questions were structured to guide the study:

1.What is the correlation between the adoption of a hybrid Lean-Agile Framework and the reduction of production lead time at Cadbury Nigeria Plc?

2. How does the implementation of a hybrid Lean-Agile Framework influence the relationship between waste reduction and overall productivity improvements at Cadbury Nigeria Plc?

Research Hypotheses

The following null hypotheses were formulated to guide the study:

H_o: There is no significant correlation between the adoption of a hybrid Lean-Agile Framework and the reduction of production lead time at Cadbury Nigeria Plc.

H_o**:** The implementation of a hybrid Lean-Agile Framework has no significant correlation with overall productivity following waste reduction at Cadbury Nigeria Plc.

Conceptual Review

Lean Manufacturing

The Lean methodology originated from the Toyota Production System and aims to streamline operations by eliminating waste and maximizing value (Womack & Jones, 2019). Lean principles are centered around the continuous improvement of processes, which involve identifying and eliminating non-value-adding activities. Key principles of Lean include, (a) defining value from the customer's perspective, mapping the value stream. (b) Just-in-Time (JIT) Production which entails producing only what is needed, when it is needed, and in the amount needed to reduce inventory and associated costs. (c) Kaizen which is engaging in ongoing, incremental improvements to processes and practice. (d) creating flow. (e) establishing pull, and striving for perfection (Bicheno & Holweg, 2020).

Lean practices have been widely adopted in various industries to enhance operational efficiency. For instance, organizations implementing Lean techniques have reported significant reductions in lead times, improved quality, and increased customer satisfaction (Tapping & Shuker, 2021).

Agile Framework

Agile methodology emerged as a response to the limitations of traditional project management approaches, particularly in the software development industry (Highsmith & Cockburn, 2020). Agile emphasizes flexibility, collaboration, and iterative development, allowing organizations to respond quickly to changes in market demands and customer preferences. Key Agile frameworks,

such as Scrum and Kanban, prioritize teamwork, communication, and the continuous delivery of value (Schwaber & Beedle, 2019).

The Agile approach is particularly useful in environments characterized by uncertainty and rapid change. By adopting Agile practices, organizations can enhance their responsiveness and adaptability, leading to improved operational efficiency (Dikert et al., 2021).

Hybrid Lean-Agile Framework

The hybrid Lean-Agile framework integrates the principles of Lean Manufacturing with Agile methodologies to create a comprehensive approach to process improvement and operational efficiency (Serrador & Pinto, 2023). The rationale behind this hybridization is to combine Lean's focus on waste reduction and process optimization with Agile's emphasis on flexibility, change/responsiveness and iterative progress. This integration allows organizations to harness the strengths of both methodologies while mitigating their weaknesses (Sullivan & McCarthy, 2022). This implies that lean philosophy which is rigid in its operations will adapt the flexibility nature of agile to quickly effect change when the need arises, especially customer feedback.

Production Lead Time

Production lead time refers to the total time it takes for a product to move through the entire manufacturing process, from the initiation of production to the final product's completion and delivery. Reducing lead time is often a key goal of both Lean and Agile methodologies, as it directly influences operational efficiency, customer satisfaction, and overall responsiveness to market demand.

Recent studies emphasize the importance of reducing production lead time in maintaining a competitive edge in manufacturing industries. According to Habib et al. (2023), shorter lead times enable firms to quickly respond to customer demands and market changes, improving overall operational agility. Additionally, strategies such as Just-In-Time (JIT) production and continuous improvement have been shown to significantly reduce production lead time, allowing for better resource utilization and reduced inventory holding costs (Kumar & Singh, 2022).

Incorporating digital technologies, such as automation and predictive analytics, further reduces lead time by optimizing workflow and enabling real-time decision-making (Garza-Reyes et al., 2022). These advancements align with the goals of Lean-Agile frameworks, which seek to eliminate non-value-adding activities and reduce delays in the production process.

Waste Reduction

Waste reduction is a central tenet of Lean manufacturing and refers to the elimination of activities and processes that do not add value to the customer. Lean manufacturing identifies seven types of waste, including overproduction, waiting, transportation, over-processing, excess inventory, motion, and defects (Womack & Jones, 2023). By systematically addressing these forms of waste, organizations can improve operational efficiency, reduce costs, and enhance product quality.

Recent research indicates that effective waste reduction practices lead to substantial cost savings and improved environmental performance. Garza-Reyes et al. (2022) noted that waste reduction not only enhances efficiency but also aligns with the principles of sustainable manufacturing. By minimizing waste in production, companies can reduce their environmental footprint and contribute to sustainability goals.

However, successful waste reduction requires a strong organizational commitment to continuous improvement and a culture that encourages employee participation in identifying and solving waste-related issues (Tan & Peng, 2023). This aligns with the Agile philosophy of empowering teams to rapidly address and adapt to operational inefficiencies.

Overall Productivity

Productivity is defined as the ratio of output produced to the inputs used in the production process. In manufacturing, improving productivity means producing more with the same or fewer resources, thus enhancing overall efficiency. Lean and Agile frameworks focus heavily on productivity improvement by streamlining workflows, eliminating bottlenecks, and maximizing the utilization of both human and material resources.

According to Singh and Singh (2023), implementing Lean practices, such as continuous improvement (Kaizen) and value stream mapping (VSM), significantly enhances productivity by identifying and eliminating non-value-adding activities. By focusing on improving the flow of materials and information through the production process, companies can increase output while minimizing waste and inefficiencies. Agile practices, such as cross-functional teams and iterative work cycles, also contribute to higher productivity by fostering faster decision-making and adapting to changes in production requirements (Tan & Peng, 2023).

Recent studies have highlighted the role of digital technologies in further boosting productivity. For instance, Industry 4.0 tools, such as advanced robotics, data analytics, and artificial intelligence, allow manufacturers to optimize their processes and predict production issues before they occur, resulting in improved productivity and operational efficiency (Li & Huang, 2023).

Conceptual Framework

The conceptual framework of this study is built on the integration of Lean Manufacturing and Agile Methodologies into a single hybrid system aimed at improving operational efficiency in manufacturing. This framework posits that combining Lean's structured approach to waste reduction with Agile's responsiveness to change can create a more resilient and adaptive operational environment.

The hybrid Lean-Agile framework is conceptualized as a strategic mechanism to address persistent operational challenges—specifically, long production lead times, high waste levels, and low productivity. These three performance indicators serve as the primary outcome variables in assessing operational efficiency. The model suggests that implementing Lean-Agile practices leads to improvements in these areas through streamlined workflows, increased flexibility, and enhanced employee engagement. This is illustrated below in a conceptual model:

Conceptual Model

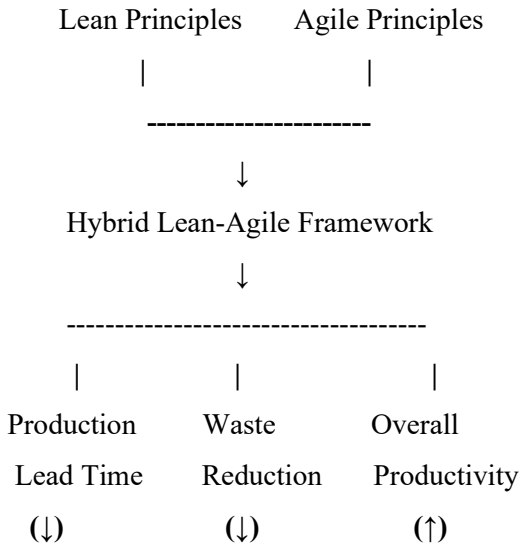

Figure 1: Conceptual Model. Source: Author, 2024

This model reflects the hypothesized relationships investigated in the study, specifically:

- A negative relationship between the hybrid framework and production lead time,
- A negative relationship with waste generation, and
- A positive relationship with overall productivity.

Theoretical Framework

This study is grounded in the Operational Excellence Theory, a management philosophy that emphasizes continuous improvement, process optimization, and value creation through efficient resource utilization. Operational excellence is not a static goal but a dynamic pursuit of superior performance across organizational functions, driven by both technical tools and cultural enablers (Conti, 2019).

Lean Manufacturing and Agile Methodologies are widely recognized as enablers of operational excellence. Lean contributes through systematic waste elimination and process discipline, while Agile provides the flexibility needed to navigate uncertainty and rapidly adapt to customer

feedback. The hybridization of these approaches represents a strategic evolution in the quest for operational excellence, particularly in volatile and resource-constrained environments like Nigeria.

Mourtzis et al. (2022) emphasized that Lean-Agile integration is instrumental in achieving operational excellence in modern manufacturing, especially when aligned with digital transformation and employee empowerment. Similarly, Serrador and Pinto (2023) argue that operational excellence is best achieved through frameworks that can accommodate both efficiency and adaptability.

In the context of Cadbury Nigeria Plc, the theoretical framework suggests that implementing a hybrid Lean-Agile system will result in more effective operations, improved responsiveness to market changes, and higher levels of organizational performance. This alignment between theory and practice forms the foundation for the study's hypotheses and analytical approach.

Empirical Studies

Effect of Hybrid Lean-Agile Framework on Production Lead Time

The relationship between the implementation of hybrid Lean-Agile Frameworks and production lead time has been a focus of recent studies, particularly in industries where time-to-market is critical. A study by Recker et al. (2023) investigated the application of a hybrid Lean-Agile framework in the automotive manufacturing sector. The study found that integrating Lean's process optimization with Agile's iterative cycles significantly reduced production lead time by 22%. This reduction was attributed to the Agile practices of incremental progress and continuous feedback, which complemented Lean's focus on eliminating bottlenecks in production processes.

Similarly, an empirical study by Patel and Singh (2022) examined the adoption of a hybrid Lean-Agile approach in Indian electronics manufacturing industry. The researchers observed a 15% reduction in production lead time, primarily due to the streamlined processes and enhanced flexibility introduced by the hybrid framework. The study concluded that the ability of Agile to adapt to changes in production schedules played a crucial role in minimizing delays and improving overall efficiency.

Effect of Hybrid Lean-Agile Framework on Waste Reduction

Waste reduction is a core tenet of Lean Manufacturing, and recent empirical studies have explored how Agile methodologies can complement these efforts. For instance, Singh and Kumar (2022) conducted a study on the hybridization of Lean and Agile frameworks in the food processing industry. The study reported a 30% reduction in waste, highlighting that Agile's iterative approach allowed continuous process improvements and the quick identification and elimination of waste. The researchers noted that the frequent feedback loops inherent in Agile practices enabled more effective waste management, particularly in reducing overproduction and unnecessary inventory.

In another study, Johnson and Brown (2023) analyzed the impact of a hybrid Lean-Agile framework on waste reduction in the textile manufacturing industry. The study found that implementing Agile's sprint-based cycles, coupled with Lean's waste identification techniques, led to a 25% reduction in material waste. The researchers emphasized that the Hybrid Framework's adaptability allowed for real-time adjustments in production processes, which were critical in minimizing waste and improving resource efficiency.

The studies provide strong evidence that a hybrid approach can substantially reduce waste, thereby contributing to more efficient and sustainable manufacturing processes.

Effect of Hybrid Lean-Agile Framework on Overall Productivity

Recent studies have also examined the influence of Hybrid Lean-Agile Frameworks on overall productivity in manufacturing. A study by Garcia et al. (2022) explored the integration of Lean and Agile methodologies in a large-scale furniture manufacturing company. The study reported a 28% increase in productivity following the implementation of the hybrid framework. The increase was attributed to the efficient use of resources and the ability to quickly respond to changes in customer demands, facilitated by Agile's flexible approach.

Additionally, a study by Zhou and Li (2023) investigated the effects of a hybrid Lean-Agile Framework on productivity in the pharmaceutical manufacturing industry. The researchers found that productivity improved by 32% after the adoption of the hybrid framework. The study highlighted that Lean's emphasis on process optimization, when combined with Agile's iterative improvements, led to more streamlined operations and higher output with the same level of input.

These studies support the hypothesis that the hybrid Lean-Agile framework positively correlates with overall productivity, which is a key focus of this research. For Cadbury Nigeria Plc, the evidence suggests that adopting such a framework could lead to significant productivity gains, thereby enhancing the company's competitive advantage.

Gap in Literature.

The Nigerian manufacturing sector faces distinct challenges, including infrastructure limitations, supply chain disruptions, and a less predictable regulatory environment. Existing studies on Lean and Agile Frameworks largely focus on more stable and developed manufacturing environments, where these methodologies have been widely implemented and refined. There is a lack of empirical research examining how these methodologies, particularly in a hybrid form, can be effectively applied in Nigerian manufacturing firms. This gap is significant because the operational challenges faced by Nigerian firms may require adaptations to these frameworks that have not been explored in the literature.

Methodology

Research Design

This study adopted a **mixed-methods research design,** combining both quantitative and qualitative approaches to gain a comprehensive understanding of how the Hybrid Lean-Agile Framework influences operational efficiency. The quantitative component employed structured surveys to capture measurable changes in performance metrics—production lead time, waste reduction, and

productivity—before and after framework implementation. The qualitative component utilized semi-structured interviews to explore the lived experiences of employees, uncovering contextual insights that complement the numerical findings. This triangulation of data enhances the validity and depth of the research (Creswell & Creswell, 2017).

Area of the Study

The area of this study focuses on the manufacturing sector, specifically within the context of Cadbury Nigeria Plc, a prominent food and beverage manufacturing company based in Lagos, Nigeria. Cadbury Nigeria Plc.

Population of the Study

The study population consisted of **600 employees** of Cadbury Nigeria Plc. This included permanent and contract staff across key departments such as production, quality assurance, supply chain, administration, and management. These individuals were selected for their direct or indirect involvement in operational processes affected by the framework

Sample size and sampling technique.

The sample size was determined using Cochran's formula, with an added 10% non-response buffer, resulting in an adjusted sample of 260 participants. To ensure representation across organizational levels, a stratified random sampling technique was employed. This involved grouping staff into strata based on departmental functions and using Bowley's proportional allocation method to determine sample sizes for each subgroup: Production: 115 employees**,** Quality Control: 55 employees**,** Supply Chain: 40 employees**,** Administration: 35 employees**,** Management: 15 employees**.** This approach ensured that perspectives across various operational units were adequately captured.

Method of Data Collection

Survey questionnaires were distributed in person and electronically, with follow-up reminders to maximize response rates. Semi-structured interviews were conducted with 12 purposively selected employees from different departments and job levels to ensure diversity in qualitative insights.

Interviews were audio-recorded, transcribed, and coded thematically following Braun and Clarke's (2006) framework.

Instrument for Data Collection:

Data was collected using two primary instruments: a structured survey questionnaire and semi-structured interview guides. The survey questionnaire consists of closed-ended questions designed to measure the perceived effectiveness of the Hybrid Lean-Agile Framework in improving operational efficiency. The questionnaire comprised of a five (5) Point Likert Scale of Strongly Agreed, Agreed, Disagreed, Strongly Disagreed, and Undecided. It was divided into two sections A and B. While section A comprises the personal data of respondents, section B comprises questions relating to the research question of the study.

The semi-structured interview guide comprised open-ended questions aimed at eliciting in-depth qualitative responses regarding employees' experiences with the hybrid framework, including perceived benefits, challenges, and behavioural responses to change.

Validity and Reliability of the Instrument

To ensure content validity, a pilot study was conducted with 18 non-sample employees from Cadbury Nigeria Plc. Feedback from the pilot informed revisions to questionnaire items for clarity and relevance. Additionally, expert reviews were sought from faculty and industry professionals.

Instrument reliability was assessed using Cronbach's Alpha, yielding a coefficient of 0.828, indicating high internal consistency (Tavakol & Dennick, 2011).

Data Analysis Technique

Quantitative Data Analysis

Quantitative data were analysed using SPSS Version 27. The following statistical methods were employed:

- Descriptive statistics to compare mean scores before and after framework implementation
- Pearson correlation analysis to test the strength and direction of relationships between the hybrid framework and performance indicators
- Regression analysis to assess the predictive power of the hybrid framework on operational outcomes

Qualitative Data Analysis

Qualitative data were analysed using thematic analysis. Transcripts were reviewed for emerging themes such as communication, employee engagement, flexibility, and resistance to change. Coding was done manually and verified independently to ensure consistency.

Descriptive Statistics

Descriptive statistics summarize the central tendencies and dispersion of the data collected before and after the implementation of the hybrid Lean-Agile framework.

Table 1: Descriptive Statistics Before and After Implementation

Variable	Mean Before	SD Before	Mean After	SD After	% change
Production Lead Time(hrs.)	48.5	5.2	36.2	4.8	-25.4%
Waste Generated (tons)	15.8	2.1	11.2	1.8	-29.1%

Productivity (cartons/Day)	1200	150	1500	130	+25.0%

Source: Filed work 2024

Interpretation:

The data indicate notable improvements across all performance indicators following the implementation of the hybrid Lean-Agile framework. Production lead time decreased by 25.4%, waste generation reduced by 29.1%, and daily productivity increased by 25%.

Correlation Analysis

Correlation analysis was conducted to determine the strength and direction of relationships between the hybrid framework and the key variables.

Table 2: Pearson Correlation Coefficients

Variables	Correlation Coefficient	Significance (p-Value)
Hybrid Framework & Lead Time	-0.756	0.000
Hybrid Framework & Waste Reduction	-0.682	0.000
Hybrid Framework & Productivity	0.711	0.000

Source: SPSS version 27 Outputs

Interpretation: All relationships are statistically significant at the 0.01 level.

- A strong negative correlation exists between the framework and production lead time ($r = -0.756$, $p < 0.001$), implying that as implementation intensity increases, lead time decreases.
- A strong negative correlation also exists with waste reduction ($r = -0.682$, $p < 0.001$).
- A strong positive correlation is found between the hybrid framework and productivity ($r = 0.711$, $p < 0.001$).

Regression Analysis

Regression analysis was used to predict the impact of the hybrid framework on operational outcomes.

Table .3: Summary of Regression Analysis

Dependent Variable	R-Squared	Beta Coefficient	t-Value	Significance (p-value)
Production Lead Time	0.572	-0.756	-12.34	0.000
Waste Reduction	0.465	-0.682	-10.21	0.000
Productivity	0.505	0.711	11.02	0.000

Source: SPSS version 27 Outputs

Interpretation:

- The model explains 57.2% of the variance in production lead time.
- The hybrid framework predicts 46.5% of the variance in waste reduction.
- It explains 50.5% of the variance in productivity.
  All beta coefficients are significant at the 0.01 level, confirming that the hybrid Lean-Agile framework is a strong predictor of operational performance improvements.

Hypothesis Testing

Rule: Reject H_0 if p-value ≤ 0.05 and accept Ha

Based on the analyses above, the following hypotheses were tested:

Hypothesis 1:

H_0: There is no significant correlation between the hybrid Lean-Agile framework and production lead time.
Ha: There is a significant correlation.

Result: Pearson r = -0.756, $p < 0.001$.
Conclusion: Reject H_0. The hybrid framework significantly reduces production lead time.

Hypothesis 2

H_0: There is no significant correlation between the hybrid Lean-Agile framework and productivity improvement through waste reduction.
Ha: There is a significant correlation.

Result: r = -0.682 (waste); r = 0.711 (productivity); $p < 0.001$.
Conclusion: Reject H_0. The framework significantly improves productivity through waste reduction.

Qualitative Data Analysis: Thematic Summary

Thematic analysis of interview data revealed four key themes:

Theme	Insight
Operational Flexibility	Employees reported faster adaptation to market changes and greater scheduling flexibility.
Improved Communication	Enhanced collaboration across departments helped streamline workflows.
Employee Engagement	Workers felt more empowered and involved in decision-making.
Resistance to Change	Initial scepticism and confusion were observed but were mitigated through training and support.

Representative Participant Quotes

Theme 1: Enhanced Operational Flexibility

"Since adopting the Lean-Agile approach, we've been able to adjust our production schedules swiftly to meet unexpected demands without compromising quality." (Production Manager)

Theme 2: Improved Communication and Collaboration

"The new framework has broken down silos between departments. We now have regular cross-functional meetings that have significantly improved our coordination and efficiency." (Quality Assurance Supervisor)

Theme 3: Employee Empowerment and Engagement

"I feel more empowered to suggest and implement improvements in my work area. Management is more receptive to feedback, which motivates us to contribute actively." (Production Line Worker)

Theme 4: Challenges and Resistance to Change

"Initially, there was skepticism about the new processes, and some colleagues were resistant. However, with proper training and seeing the benefits firsthand, most have embraced the changes." (Human Resources Officer)

From the analysis, it is important to state that the qualitative data underscores the positive impact of the hybrid Lean-Agile framework on operational processes and workplace dynamics. While challenges were present, effective change management strategies facilitated successful adoption and integration of the new framework.

Synthesis of Findings

The integration of quantitative and qualitative findings provides a comprehensive understanding of the impact of the hybrid Lean-Agile framework on operational efficiency in the candy factory of Cadbury Nigeria Plc.

1. Reduction in Production Lead Time

Quantitative Evidence: A 25.4% reduction in production lead time and strong negative correlations support significant efficiency improvements.

Qualitative Insights: Enhanced operational flexibility and streamlined processes contributed to faster production cycles.

2. Waste Reduction

Quantitative Evidence: A 29.1% decrease in waste generation indicates effective resource utilization.

Qualitative Insights: Improved communication and collaborative problem-solving facilitated identification and elimination of wasteful practices.

3. Increased Productivity

Quantitative Evidence: A 25% increase in productivity demonstrates substantial output enhancement.

Qualitative Insights: Employee empowerment and engagement led to proactive contributions toward process improvements and increased efficiency.

4. Challenges and Mitigation Strategies

Quantitative Evidence: Despite initial challenges, the overall positive outcomes indicate successful implementation.

Qualitative Insights: Addressing resistance through comprehensive training and supportive leadership was critical in realizing the framework's benefits.

The combined data substantiate that the implementation of a hybrid Lean-Agile framework has significantly improved operational efficiency in the candy factory at Cadbury Nigeria Plc. The quantitative improvements are reinforced by qualitative experiences, highlighting not only the effectiveness of the framework but also the importance of organizational culture, employee involvement, and effective change management in achieving and sustaining these improvements.

Discussion, Conclusion, and Recommendations

Discussion of Findings

This study investigated the impact of the **Hybrid Lean-Agile Framework** on operational efficiency at Cadbury Nigeria Plc, focusing on three key performance indicators: **production lead time**, **waste reduction,** and **productivity**. The findings provide empirical evidence that integrating Lean and Agile principles leads to significant operational improvements.

Effect on Production Lead Time

The study revealed a significant reduction in production lead time following the implementation of the hybrid Lean-Agile framework at Cadbury Nigeria Plc. Specifically, production lead time decreased by 25.4%. The correlation analysis showed a strong negative relationship between the adoption of the framework and production lead time, with a Pearson correlation coefficient of -0.756. These findings are consistent with existing literature, which emphasizes that Lean and Agile methodologies streamline processes and reduce waste, leading to shorter cycle times (Poppendieck & Poppendieck, 2021).

The qualitative data also supported these findings, with respondents highlighting improved operational flexibility and quicker response times to market demands. This suggests that the hybrid Lean-Agile framework is effective in enhancing production efficiency by enabling faster adjustments to production schedules and reducing bottlenecks.

Effect on Waste Reduction

The implementation of the hybrid Lean-Agile framework also led to a significant reduction in waste generation, as evidenced by a 29.1% decrease. The correlation between the framework's adoption and waste reduction was strong and negative ($r = -0.682$). Regression analysis further confirmed that the hybrid framework was a significant predictor of waste reduction, explaining 46.5% of the variance in waste levels.

These findings align with Lean principles, which focus on eliminating non-value-adding activities, and Agile practices, which emphasize iterative improvements (Ding et al., 2023). The qualitative

data supported this, with participants noting that improved communication and collaboration across departments helped identify and eliminate sources of waste more effectively.

Effect on Productivity

The study found a significant increase in productivity after the hybrid Lean-Agile framework's implementation, with productivity rising by 25%. The correlation analysis indicated a strong positive relationship between the framework's implementation and productivity ($r = 0.711$), and regression analysis showed that the framework accounted for 50.5% of the variance in productivity.

These results suggest that the hybrid framework not only reduces inefficiencies but also enhances the overall output of the production process. The qualitative data revealed that employee empowerment and engagement were key factors in this improvement, as workers felt more involved and motivated to contribute to productivity enhancements. This finding is in line with studies by Womack and Jones (2022), which argue that Lean-Agile practices empower employees and foster a culture of continuous improvement, leading to higher productivity levels.

Challenges in Implementing the Hybrid Lean-Agile Framework

Despite the positive outcomes, the study identified several challenges in implementing the hybrid Lean-Agile framework. Resistance to change, lack of training, and insufficient resources were the most cited barriers. These challenges are not unique to Cadbury Nigeria Plc, similar issues have been reported in other organizations adopting Lean-Agile methodologies (Smith & Tran, 2022).

The qualitative data highlighted that overcoming these challenges required targeted interventions, such as comprehensive training programs and strong management support. The success of the implementation was closely tied to how well these challenges were addressed, underscoring the importance of change management in deploying new operational frameworks.

Conclusion

The study evaluates the effect of the hybrid Lean-Agile framework on operational efficiency at Cadbury Nigeria Plc. The findings suggest that the framework significantly improves key operational metrics, including production lead time, waste reduction, and productivity. The results

also highlight the importance of effective change management, employee engagement, and continuous training in the successful implementation of the hybrid Lean-Agile framework.

The study concludes that adopting a hybrid Lean-Agile framework can lead to substantial improvements in operational efficiency, making it a valuable strategy for manufacturing firms looking to enhance their competitiveness in a dynamic market environment.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are made:

Strengthening Change Management Processes

To address resistance and ensure smooth implementation, it is recommended that Cadbury Nigeria Plc strengthens its change management processes. This could include more extensive training programs, clear communication of the benefits of the framework, and involving employees in the implementation process from the outset.

Enhance Employee Training and Development

Given the significant role that employee engagement and understanding play in the successful implementation of the hybrid Lean-Agile framework, it is recommended that the company invests in continuous training and development. This should cover both the technical aspects of the framework, and the soft skills needed for effective collaboration and communication.

Monitor and Evaluate Implementation Progress

To ensure that the benefits of the hybrid Lean-Agile framework are sustained, Cadbury Nigeria Plc should establish robust monitoring and evaluation mechanisms. This would involve regularly assessing key performance indicators, gathering feedback from employees, and making necessary adjustments to the implementation process.

Expand the Hybrid Lean-Agile Framework to Other Departments

Given the positive results observed in the production department, it is recommended that Cadbury Nigeria Plc considers expanding the hybrid Lean-Agile framework to other departments, such as

logistics and quality assurance. This could help to further enhance operational efficiency across the organization.

Suggestions for Future Research

While this study provides valuable insights into the impact of the hybrid Lean-Agile framework on operational efficiency, further research is needed to explore the following areas:

1. Long-Term Impact: Future studies could examine the long-term effects of the hybrid Lean-Agile framework on operational efficiency, employee satisfaction, and organizational performance.

2. Comparative Studies: Comparative studies involving multiple manufacturing firms could provide broader insights into the effectiveness of hybrid Lean-Agile frameworks across different organizational contexts.

3. Integration: Research could also explore the role of technology in supporting the implementation of Lean-Agile frameworks, particularly in the context of Industry 4.0.

4.Cultural Factors: Given the importance of organizational culture in the successful implementation of new frameworks, future studies could investigate the cultural factors that influence the adoption and effectiveness of Lean-Agile methodologies.

This study contributes to the growing body of knowledge on Lean-Agile methodologies by demonstrating their applicability and effectiveness in a manufacturing context. The findings provide actionable insights for Cadbury Nigeria Plc and other organizations seeking to improve their operational efficiency through innovative management frameworks.

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