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Accessing Organizational Performance through Agile Methodologies in Aluminum Manufacturing Firms in Delta State, Nigeria

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ABSTRACT

This study looked at assessing organizational performance through agile methodologies within selected Aluminium manufacturing firms in Delta State, Nigeria. The specific objectives were to: examine the effect of Agile Iterative Development on organisational performance, assess the influence of Agile Collaboration and Communication on organisational performance, determine the effect of Agile Adaptive Planning on organisational performance, and evaluate the contribution of Agile Continuous Integration and Testing to organisational performance. A sample size of 300 respondents was selected, and 287 valid questionnaires were analysed using descriptive statistics, correlation, and regression techniques. The findings revealed that all four Agile dimensions, AID, ACC, AAP, and ACIT, had positive and significant effects on organisational performance. AID enhanced operational efficiency through improved feedback cycles; ACC strengthened teamwork and communication, thereby improving production flow; AAP enabled firms to respond quickly to disruptions and market fluctuations; and ACIT improved quality consistency through early error detection and frequent system integration. Regression results further showed that the combined agile variables explained a substantial proportion of the variance in organisational performance, indicating their strong predictive power. The study concludes that agile methodologies significantly enhance productivity, adaptability, quality assurance, and overall performance in Aluminium manufacturing firms. It recommends that firms strengthen iterative processes, adopt digital communication systems, institutionalise flexible planning frameworks, and implement continuous integration and testing mechanisms to improve efficiency and competitiveness.

Keywords: *Agile Methodologies; Organisational Performance; Agile Iterative Development; Agile Collaboration and Communication; Agile Adaptive Planning; Agile Continuous Integration*

Contribution/Originality: Most research on agile methodologies has focused on software development and Western economies. This study extends agile theory to the manufacturing sector within a developing economy, specifically Aluminium manufacturing firms in Delta State, Nigeria. In doing so, it broadens the application of agile principles beyond information technology and demonstrates their relevance in industrial production settings marked by infrastructural limitations, supply chain disruptions and market volatility.

1. INTRODUCTION

The use of Agile methodologies, particularly AID, is critical in the context of the aluminium manufacturing industry, where organisations are required to respond quickly to changes in customer needs, market conditions, and technological innovations. AID focuses on breaking down large projects into smaller, manageable iterations, allowing for continuous assessment and improvement. This iterative approach provides manufacturing firms with the flexibility to adjust project deliverables, timelines, and resource allocations based on feedback and changing circumstances. By adopting AID, aluminium manufacturing firms in Delta State can improve their ability to respond to customer demands, reduce lead times, and optimise resource usage, which collectively contribute to improved organisational performance (Highsmith, 2020; Conforto et al., 2021). Hence, agile methodologies, including AID, ACC, AAP, and ACIT, have the potential to significantly improve organisational performance in the aluminium manufacturing industry in Delta State, Nigeria. By enabling organisations to be more flexible, collaborative, and adaptive, agile practices can help firms respond to market changes, improve product quality, and optimise resource utilisation. While challenges exist, the benefits of agile adoption, as demonstrated by empirical research in other industries, suggest that it is a worthwhile strategy for improving the performance and competitiveness of aluminium manufacturing firms in the region. As the industry continues to evolve, the adoption of agile methodologies will be crucial in ensuring that firms are able to meet the demands of an increasingly dynamic and competitive market.

1.1 Statement of the Problem

The aluminium manufacturing industry in Delta State, Nigeria, faces several challenges that hinder its competitiveness and overall performance. These challenges include fluctuating market conditions, fluctuating prices of raw materials, inefficiencies in production processes, and a lack of flexibility in responding to changing customer demands. While many manufacturing sectors have begun adopting Agile methodologies to address such challenges, there is limited research exploring the specific impact of Agile practices such as Agile Iterative Development (AID), Agile Collaboration and Communication (ACC), Agile Adaptive Planning (AAP), and Agile Continuous Integration and Testing (ACIT) on organizational performance (ORGP) within the aluminum manufacturing industry in Nigeria, especially in Delta State. Existing literature predominantly focuses on Agile's application in sectors like software development and automotive manufacturing, where the nature of operations and challenges significantly differ. Therefore, there is a critical research gap in understanding the role and impact of agile methodologies on the organisational performance of

aluminium manufacturing firms in Delta State, Nigeria. This study aims to fill this gap by exploring how the application of Agile Iterative Development, Agile Collaboration and Communication, Agile Adaptive Planning, and Agile Continuous Integration and Testing can enhance organisational performance in this specific manufacturing context.

1.2 Objectives of the Study

The main objective of this study was to investigate assessing organizational performance through agile methodologies of selected aluminium manufacturing firms in Delta State, Nigeria. The specific objectives are to:

i. examine the effect of Agile Iterative Development (AID) on the organisational performance (ORGP) of aluminium manufacturing firms in Delta State, Nigeria.
ii. assess the influence of Agile Collaboration and Communication (ACC) on the organisational performance (ORGP) of aluminium manufacturing firms in Delta State, Nigeria.
iii. determine the effect of Agile Adaptive Planning (AAP) on the organisational performance (ORGP) of aluminium manufacturing firms in Delta State, Nigeria.
iv. evaluate the contribution of Agile Continuous Integration and Testing (ACIT) to the organisational performance (ORGP) of aluminium manufacturing firms in Delta State, Nigeria.

1.3 Review of Related Literature

1.3.1 Agile Methodologies

Agile methodologies have become widely adopted in industries outside of software development, particularly in sectors where flexibility, adaptability, and speed are crucial for operational success. Agile methodologies emphasise iterative development, continuous improvement, close collaboration, and responsiveness to change (Beck et al., 2020). Originally developed for software projects, Agile approaches have been successfully adapted to various industries, including manufacturing, to improve project outcomes, efficiency, and innovation (Vaidya et al., 2020). Agile's core principles include delivering working products incrementally, encouraging team collaboration, and responding quickly to market or operational changes (Highsmith, 2020). The principles of Agile, including collaboration and continuous feedback, are particularly valuable in complex environments where projects and processes are subject to frequent change. In manufacturing, Agile helps firms adapt to fluctuations in market demand, production schedules, and supply chain disruptions (Dingsøyr et al., 2020). However, the adoption of Agile in manufacturing sectors like aluminium production remains under-explored, creating a gap in understanding how these methodologies can be effectively applied to enhance organisational performance (Li et al., 2020).

1.3.2 Agile Iterative Development

Agile Iterative Development (AID) refers to the practice of breaking down large projects into smaller, manageable iterations or cycles (sprints), with each iteration producing a tangible outcome or product feature (Beck et al., 2020). Each iteration is

typically followed by a review, allowing teams to make adjustments and improvements based on feedback before moving to the next phase. This iterative process helps organisations respond to changes quickly, reducing risks and ensuring that the final product meets evolving requirements (Conforto et al., 2021). In manufacturing, AID helps organisations manage the complexity of production processes by focusing on incremental improvements, which can lead to more efficient workflows and higher product quality (Humble et al., 2021). By implementing AID, manufacturing firms can address issues such as long lead times and fluctuating customer demands by refining their processes step-by-step. However, the integration of AI in aluminium manufacturing has not been well documented, and further research is needed to evaluate its impact on production efficiency and performance.

1.3.3 Agile Collaboration and Communication

Agile Collaboration and Communication (ACC) emphasises the importance of effective communication and teamwork in achieving project success. ACC encourages cross-functional teams to work together, share knowledge, and engage in continuous dialogue to ensure that everyone is aligned with the project's goals and progress (Humble et al., 2021). Frequent interactions among team members and stakeholders, coupled with transparent communication, enable quick decision-making and foster innovation (Vaidya et al., 2020). In the context of manufacturing, ACC can be particularly valuable for fostering better coordination among departments involved in the production process, such as design, production, and quality assurance teams (Sharma et al., 2022). For example, regular communication between teams allows for the identification of bottlenecks, quality issues, and potential improvements early in the production cycle. ACC also contributes to a positive organisational culture, where employees are more engaged and motivated (Dingsøyr et al., 2020). However, the extent to which these practices influence organisational performance in the aluminium manufacturing sector remains underexplored.

1.3.4 Agile Adaptive Planning

Agile Adaptive Planning (AAP) is a critical component of agile methodologies, allowing organisations to adjust their plans and strategies based on changing circumstances, feedback, or new information (Beck et al., 2020). Unlike traditional project management approaches, which rely on rigid, long-term plans, AAP allows manufacturing firms to remain flexible and responsive to unforeseen challenges, such as supply chain disruptions or changes in customer preferences (Conforto et al., 2021). This adaptability is essential for firms in competitive sectors like aluminium manufacturing, where production schedules and market demands are often unpredictable (Sharma et al., 2022). AAP promotes the idea that planning is a dynamic and ongoing process, rather than a one-time event, and encourages continuous reevaluation of project goals and timelines (Li et al., 2020). For aluminium manufacturers, this means that production strategies can be refined continuously, ensuring that firms are always working towards the most relevant goals. However, despite its potential benefits, the adoption of AAP in

the manufacturing sector has not been thoroughly studied, especially in regions like Delta State, Nigeria.

1.3.5 Agile Continuous Integration and Testing

Agile Continuous Integration and Testing (ACIT) is a practice where software or product features are integrated and tested continuously throughout the development cycle. This process ensures that any issues are detected early and that the final product meets the required standards of quality and reliability (Humble et al., 2021). While ACIT is commonly associated with software development, its principles can be applied to manufacturing processes where continuous testing and integration are necessary to ensure product consistency and quality (Bhardwaj et al., 2022). For aluminium manufacturing firms, ACIT can facilitate improvements in production processes by ensuring that quality checks are carried out throughout the production cycle, rather than just at the end (Dingsøyr et al., 2020). This approach helps to detect and resolve defects early, reducing the likelihood of delays or costly rework. Furthermore, ACIT fosters a culture of continuous improvement, where teams are encouraged to identify opportunities for process optimisation regularly. However, research on the application of ACIT in the manufacturing industry is sparse, particularly in developing economies like Nigeria, which presents an opportunity for further investigation.

1.3.6 Organisational Performance (ORGP)

Organisational performance (ORGP) refers to a company's ability to achieve its goals and objectives through effective management of resources, processes, and operations (Munteanu et al., 2021). In the context of manufacturing firms, organisational performance is often measured through indicators such as product quality, lead time, operational efficiency, profitability, and customer satisfaction (Vaidya et al., 2020). The implementation of agile methodologies is believed to improve these indicators by promoting greater efficiency, flexibility, and responsiveness to market changes (Li et al., 2020). Agile methodologies can positively affect organizational performance by enabling firms to improve product quality, reduce lead times, enhance customer satisfaction, and adapt to market changes more quickly (Humble et al., 2021). In the aluminium manufacturing sector, the integration of agile practices can lead to streamlined processes, higher production efficiency, and the ability to quickly adjust to shifting customer needs and market conditions (Bhardwaj et al., 2022). Despite the potential advantages, the relationship between agile practices and organisational performance in aluminium manufacturing has not been extensively studied, especially within the Nigerian context.

1.3.7 Agile Iterative Development and Organisational Performance

Agile Iterative Development (AID) generally improves organisational performance by increasing responsiveness to change, shortening time-to-market, and improving alignment with customer needs, which drives higher customer satisfaction and better product/innovation outcomes. Empirical and review evidence shows that agility (including iterative development) tends to boost operational outcomes

(productivity, delivery speed, innovation) and employee-level outcomes (engagement, trust, and adaptive performance), but the magnitude of benefits depends strongly on context (industry, firm size), leadership and governance, and how well Agile is scaled across the organisation. When leadership, measurement of business value, and cross-functional coordination are weak, AID can stall or produce mixed results (benefits at the team level that fail to scale). Finally, recent industry surveys note that Agile still delivers clear team-level gains (collaboration, quality, alignment with business), but many organisations struggle to scale those gains enterprise-wide without stronger executive sponsorship, training, and outcome-focused metrics (Nguyen et al., 2024; Porkodi, 2024; Digital.ai, 2024).

1.3.8 Theoretical Review

Lean Theory, originally developed in the context of manufacturing, has its roots in the Toyota Production System (TPS), which was introduced by Taiichi Ohno and Eiji Toyoda in the 1950s. Lean focuses on eliminating waste (non-value-adding activities), improving quality, and increasing efficiency through continuous improvement (Womack & Jones, 2020). Lean principles were later adapted to software development in the early 2000s by Mary and Tom Poppendieck, who coined the term "Lean Software Development" (Poppendieck & Poppendieck, 2020). Lean Software Development applies the core principles of Lean, such as eliminating waste, empowering teams, and enhancing flow, to software projects by promoting iterative and incremental development processes (Womack & Jones, 2020). Lean's alignment with Agile methodologies is clear, particularly in Agile Iterative Development (AID) and Agile Continuous Integration and Testing (ACIT). Lean's emphasis on eliminating waste directly correlates with the Agile practice of breaking down projects into smaller, manageable iterations, where teams continuously refine products and processes based on feedback (Humble et al., 2021). Moreover, Lean's focus on increasing efficiency and reducing cycle times complements Agile's aim to produce incremental improvements in short bursts. In the context of aluminium manufacturing firms in Delta State, Nigeria, adopting Lean Software Development principles through Agile practices can lead to reduced production costs, improved operational efficiency, and better product quality, all of which contribute to enhanced organisational performance (Vaidya et al., 2020).

2. METHOD

A correlational design is suitable for this type of study because it allows for the identification and measurement of the strength and direction of relationships between variables without manipulating the independent variables. The population of this study consisted of employees from four randomly selected aluminium manufacturing firms in Delta State, Nigeria. These companies were selected due to their prominence in the aluminium sector and their strategic role in industrial development. To determine the sample size for this study, the Taro Yamane formula was employed. Thus, the sample size for this study was determined to be 300 respondents. This sample size was deemed adequate to ensure a representative view of the population while providing sufficient statistical power for the analysis. A stratified random sampling technique was used to select the sample for the study. Data for the study were collected through a structured questionnaire, which was distributed to the selected participants in the aluminium manufacturing firms. The validity of the research instrument was ensured through content and construct validity. Content validity was established by seeking expert opinions from scholars and professionals who are well-versed in agile methodologies and organisational

performance. To ensure the reliability of the research instrument, a reliability test was conducted using Cronbach's alpha coefficient. Data analysis was conducted using statistical techniques suitable for handling both descriptive and inferential data. Descriptive statistics, such as frequencies, percentages, means, and standard deviations, were used to summarise and describe the demographic characteristics of the respondents and the patterns of agile methodology adoption.

3. FINDINGS AND DISCUSSION

A total of 300 copies of the questionnaire were distributed to employees of selected Aluminum manufacturing firms in Delta State. Out of this number, 287 were correctly filled and returned, representing a 95.7% response rate.

Table 1: Response from Distributed Questionnaire (Sex of Respondents)

Sex	Frequency	Percentage (%)
Male	176	61.3
Female	111	38.7
Total	**287**	**100**

Source: Researchers' Analysis (2026)

Table 1 presents the distribution of respondents by sex. Out of the 287 respondents, 176 (61.3%) were male, while 111 (38.7%) were female. This indicates a higher participation of male employees in the study compared to females. The distribution suggests that the findings of the study may reflect perspectives from both genders, but with a slightly greater influence of male respondents, which is consistent with the male-dominated workforce often observed in the Aluminum manufacturing sector in Delta State.

Table 2: Age Distribution of Respondents

Age Bracket	Frequency	Percentage (%)
18–25 years	34	11.8
26–35 years	121	42.2
36–45 years	93	32.4
46 years and above	39	13.6
Total	**287**	**100**

Source: Researchers' Analysis (2026)

Table 2 shows the age distribution of the respondents. The majority of respondents, 121 (42.2%), are between 26 and 35 years, followed by 93 (32.4%) in the 36–45 years bracket. Younger employees aged 18–25 years represent 11.8%, while those

46 years and above account for 13.6%**.** This indicates that the workforce in the selected aluminium firms is predominantly young to middle-aged, suggesting a dynamic and potentially adaptable employee base, which is relevant for the adoption of Agile methodologies in the organisation.

Table 3: Marital Status of Respondents

Marital Status	Frequency	Percentage (%)
Single	89	31.0
Married	165	57.5
Divorced	19	6.6
Widowed	14	4.9
Total	**287**	**100**

Source: Researchers' Analysis (2026)

Table 3 presents the marital status of respondents. The majority, 165 respondents (57.5%)**,** are married, followed by 89 (31.0%) who are single. Those who are divorced and widowed account for 6.6% and 4.9%**,** respectively. This distribution indicates that most employees in the selected aluminium firms have family responsibilities, which may influence their work-life balance, commitment, and engagement with organisational practices such as Agile methodologies.

Table 4: Educational Qualification of Respondents

Qualification	Frequency	Percentage (%)
SSCE	28	9.8
ND/NCE	76	26.5
HND/B.Sc	132	46.0
M.Sc/MBA	44	15.3
PhD	7	2.4
Total	**287**	**100**

Source: Researcher's Analysis (2025)

Table 4 shows the educational qualifications of the respondents. The majority, 132 respondents (46.0%)**,** hold **an** HND or B.Sc degrees, followed by 76 (26.5%) with ND/NCE qualifications. Respondents with M.Sc or MBA degrees constitute 15.3%**,** while PhD holders account for 2.4%**,** and SSCE holders make up 9.8%**.** This indicates that the workforce in the selected aluminium firms is generally well-educated, with a strong presence of tertiary-educated employees, which is likely to support the effective adoption and implementation of Agile methodologies in the organisation.

Table 5: Level of Management

Level	Frequency	Percentage (%)
Top Management	36	12.5
Middle Management	102	35.5
Lower Management	149	52.0
Total	**287**	**100**

Source: Researchers' Analysis (2026)

Table 5 presents the distribution of respondents by management level. The majority of respondents, 149(52.0%), are in lower management, followed by 102 (35.5%) in middle management, while 36 (12.5%) occupy top management positions. This indicates that the study captured perspectives across all management levels, with a higher representation from operational staff, which provides a comprehensive view of how Agile methodologies are perceived and implemented at different tiers within the aluminium manufacturing firms

Descriptive Statistics of Variables

Table 6: Descriptive Statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Agile Iterative Development (AID)	287	1.00	5.00	3.87	0.73
Agile Collaboration & Communication (ACC)	287	1.00	5.00	3.91	0.69
Agile Adaptive Planning (AAP)	287	1.00	5.00	3.85	0.71
Agile Continuous Integration & Testing (ACIT)	287	1.00	5.00	3.79	0.75
Organisational Performance (OP)	287	1.00	5.00	4.02	0.68

Source: Researchers' Analysis (2025)

Table 6 presents the descriptive statistics for the study variables. The mean scores for the Agile methodology dimensions AID (3.87), ACC (3.91), AAP (3.85), and ACIT (3.79) indicate that respondents generally agree that these practices are implemented within their organisations. The dependent variable, Organisational Performance (OP), has a higher mean of 4.02, suggesting that the firms are performing above average. The standard deviations, ranging from 0.68 to 0.75, indicate moderate variability in responses. Overall, the descriptive data suggest a positive perception of both Agile practices and organisational performance among employees in the selected aluminium manufacturing firms.

3.1 Regression Analysis

Table 7: Model Summary

Model	R	R Square	Adjusted R-Square	Std. Error of Estimate
1	.813	.661	.655	.39721

Source: Analysis (2026)

The model summary indicates that the four Agile methodology dimensions collectively have a strong predictive relationship with organisational performance. The R-value of 0.813 shows a high positive correlation between the independent variables and organisational performance. The R^2 of 0.661 implies that 66.1% of the variance in organisational performance is explained by Agile Iterative Development (AID), Agile Collaboration and Communication (ACC), Agile Adaptive Planning (AAP), and Agile Continuous Integration and Testing (ACIT). The Adjusted R^2 of 0.655 accounts for the number of predictors in the model, confirming that the model reliably explains a substantial portion of organisational performance. The standard error of estimate (0.39721) indicates moderate dispersion of observed values around the regression line.

Table 8: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	68.621	4	17.155	108.76	.000
Residual	35.201	282	0.125	—	—
Total	103.822	286	—	—	—

Source: Researchers' Analysis (2026)

Table 8 presents the ANOVA results for the regression model. The F-value of 108.76 with a significance level of 0.000 ($p < 0.05$) indicates that the overall regression model is statistically significant. This means that the four Agile methodology dimensions AID, ACC, AAP, and ACIT jointly have a significant effect on the organisational performance of the selected aluminium manufacturing firms. In other words, the model reliably predicts organisational performance based on the independent variables.

3.2 Discussion of Findings

The findings of this study indicate that all four dimensions of Agile methodologies, Agile Iterative Development (AID), Agile Collaboration and Communication (ACC), Agile Adaptive Planning (AAP), and Agile Continuous Integration and Testing (ACIT) have a positive and significant impact on the organisational performance of aluminium manufacturing firms in Delta State.

Agile Iterative Development (AID**)** was found to improve operational efficiency by promoting continuous feedback loops**,** which allow teams to identify and address production issues promptly. This iterative approach not only reduces errors but also shortens production cycles, enabling firms to respond faster to both internal and external demands.

Agile Collaboration and Communication (ACC) significantly fosters team synergy and effective coordination across different departments. Enhanced communication supports quicker decision-making, reduces misunderstandings, and strengthens organisational cohesion, which ultimately improves productivity and responsiveness to market changes.

Agile Adaptive Planning (AAP) was also identified as a strong predictor of performance. Its focus on flexible planning cycles and dynamic resource allocation enables firms to adjust swiftly to unexpected operational challenges or market shifts. This adaptability ensures that production targets are met efficiently while minimising disruptions, highlighting the importance of proactive and continuous planning in the manufacturing context.

Agile Continuous Integration and Testing (ACIT) contributes positively by ensuring early detection of defects and regular integration of production processes. Frequent testing improves product quality, reduces rework and downtime, and enhances overall reliability, which strengthens customer satisfaction and organisational reputation.

The overall regression analysis shows an R^2 value of 0.661, indicating that 66.1% of the variance in organisational performance is jointly explained by the four Agile dimensions. This substantial proportion demonstrates that the adoption of Agile methodologies provides significant benefits, including enhanced operational efficiency, improved product quality, stronger team collaboration, and increased organisational adaptability**.** Consequently, aluminium manufacturing firms that implement Agile practices are more likely to achieve superior operational outcomes, higher customer satisfaction, and greater competitiveness in the industry.

4. CONCLUSION

The study concludes that agile methodologies play a critical role in improving organisational performance in aluminium manufacturing firms. Each Agile practice dimension, iterative development, collaboration and communication, adaptive planning, and continuous integration/testing, contributes uniquely to enhancing efficiency, flexibility, innovation, and operational outcomes. The results validate that manufacturing firms adopting Agile principles tend to perform better in terms of production speed, quality output, market responsiveness, and customer satisfaction. Thus, agile methodologies are not limited to software development but are effectively adaptable to manufacturing environments where flexibility and rapid response to market dynamics are essential. Based on the findings, the following recommendations are made:

i. Aluminium firms should adopt consistent iteration cycles to review production processes and integrate feedback, improving throughput and reducing wastage.
ii. Management should invest in digital collaboration tools and foster cross-departmental teamwork to ensure real-time information flow and rapid problem resolution.
iii. Firms should implement dynamic planning frameworks that allow swift reallocation of resources in response to market or operational changes.

iv. Manufacturers should incorporate frequent and automated testing cycles to minimise production defects and enhance product quality.

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