



The effect of adaptive thinking on operational efficiency: Evidence from Nigeria's sugar manufacturing sector

Oluwayomi Omotayo Olota * 

University of South Africa, South Africa.

* Corresponding Author. E-mail: olotaoluwayomi@gmail.com

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ABSTRACT

Nigeria's manufacturing sector is undergoing rapid transformation driven by technological advancement and the global transition toward Industry 4.0. However, empirical evidence regarding the role of adaptive thinking in improving operational efficiency, particularly within Nigeria's sugar manufacturing sector, remains limited. This study examined the effects of strategic flexibility, resource agility, and learning from experience on operational efficiency. A descriptive survey design was employed, with a population of 388 employees from selected sugar manufacturing companies in Nigeria. A sample of 195 employees was targeted, of whom 174 provided valid responses for analysis. Data were collected using a structured questionnaire and analyzed using partial least squares structural equation modeling (PLS-SEM). The results revealed that learning from experience had the strongest positive effect on operational efficiency ($\beta = 0.306$, $t = 3.275$, $p = .001$), followed by resource agility ($\beta = 0.259$, $t = 3.648$, $p < .001$) and strategic flexibility ($\beta = 0.247$, $t = 2.933$, $p = .004$). These findings indicate that adaptive thinking contributes significantly to operational efficiency in Nigeria's sugar manufacturing sector. The study highlights the importance of strengthening organizational learning, resource agility, and strategic flexibility to support continuous process improvement and operational performance.

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INTRODUCTION

Nigeria's manufacturing sector is undergoing substantial transformation driven by rapid technological advancement and the global transition toward Industry 4.0. The increasing adoption of technologies such as artificial intelligence, the Internet of Things (IoT), and advanced analytics has reshaped conventional manufacturing processes and altered interactions between employees and management (Alcácer & Cruz-Machado, 2019; Doskenov et al., 2025). To remain competitive in an increasingly interconnected environment, manufacturing firms are therefore required to develop approaches that support both operational performance and long-term sustainability. However, the transition toward more intelligent and responsive manufacturing systems presents considerable challenges, including skills shortages, obsolete infrastructure, and the high costs associated with technology adoption (Javaid et al., 2022; Kumar et al., 2021). These challenges are particularly relevant in Nigeria's sugar manufacturing sector, where two leading sugar refiners reportedly operate at approximately 50% of their installed capacity because of inadequate infrastructure and inconsistent raw-material supply (Kinsanya & Adejuwon, 2024). Such conditions underscore the need for organizational capabilities that facilitate continuous learning, adaptation, and effective responses to changing industrial environments (Attiany et al., 2023; Doskenov et al., 2025).

Within this context, organizational learning has been increasingly recognized as an important driver of productivity and innovation in manufacturing firms. Evidence from Nigerian manufacturing companies indicates that a strong learning culture is associated with improved organizational outcomes, particularly when firms invest in employees' capacity to acquire new knowledge and adapt to changing operational requirements (Bello & Adeoye, 2018; Emoh & Stanislaus, 2023). This evidence is consistent with the broader literature showing that adaptive management approaches can strengthen organizational flexibility and sustainability by enabling firms to respond more effectively to market uncertainty (Lesiv et al., 2025; Tortorella et al., 2020). Accordingly, aligning technological advancement with human capital development has become increasingly important for maintaining sustainable growth and competitiveness in volatile environments (Bello & Adeoye, 2018; Doskenov et al., 2025).

Recent studies have also emphasized the importance of integrating technological innovation with human resource strategies to improve operational performance in emerging economies. The integration of adaptive learning and management practices can strengthen employee engagement and strategic decision-making, thereby helping organizations navigate increasingly complex business environments (Ibokette et al., 2024; Meria et al., 2025). A culture of continuous improvement supported by digital technologies and participatory leadership may further help firms address resource constraints and infrastructural limitations (Emoh & Stanislaus, 2023; Lesiv et al., 2025). Consequently, organizational flexibility and learning have become increasingly important for sustaining operational efficiency and performance (Doskenov et al., 2025; Meria et al., 2025).

One capability that may facilitate such adaptation is adaptive thinking, which refers to the capacity of individuals and organizations to adjust their cognitive frames, strategies, and behaviors in response to uncertainty, environmental change, and complex challenges (Hinss et al., 2022; Nyamboga, 2025; Park & Park, 2021). In organizational settings, adaptive thinking is closely associated with dynamic decision-making and innovation because it enables managers and teams to continuously reassess objectives and strategies under conditions of volatility and ambiguity (Nyamboga, 2025). Rather than simply responding to change after it occurs, adaptive thinking also involves anticipating environmental developments, considering alternative scenarios, maintaining situational awareness, and integrating different perspectives when addressing emerging problems (Hinss et al., 2022; Park & Park, 2021). These capabilities enable organizations to learn from both successful and unsuccessful experiences and to respond more effectively when unexpected circumstances arise (Hinss et al., 2022; Nyamboga, 2025; Park & Park, 2021).

Adaptive thinking is particularly relevant to operational efficiency, which reflects an organization's ability to deliver products or services while using resources efficiently, maintaining output quality, and minimizing waste (Kazanskaia, 2025; Xue et al., 2025). Operational efficiency involves process optimization, effective resource utilization, and continuous improvement initiatives aimed at reducing waste and enhancing productivity (Tébar-Rubio et al., 2023). Digital technologies can further contribute to operational efficiency by optimizing workflows and improving decision-making accuracy (Sirait & Apriadi, 2025; Xue et al., 2025). Maintaining operational efficiency is therefore important for competitiveness in dynamic markets, and organizations frequently adopt systematic approaches such as lean management and Six Sigma to identify and address inefficiencies (Kazanskaia, 2025). Nevertheless, operational efficiency should not be regarded as a static outcome; changing customer requirements and technological developments require organizations to continuously adapt their operational practices (Kazanskaia, 2025; Tébar-Rubio et al., 2023; Xue et al., 2025).

The relationship between adaptive thinking and operational efficiency, however, is not necessarily straightforward. Adaptive thinking may enable organizations to modify processes rapidly in response to internal and external changes, identify operational bottlenecks, and develop solutions that support continuous improvement (Hinss et al., 2022; Nyamboga, 2025; Xue et al., 2025). At the same time, excessive adaptation without sufficient strategic direction may introduce complexity, inconsistent processes, or inefficient resource allocation (Nyamboga, 2025). Organizations therefore need to balance adaptability with sufficiently structured operational systems so that flexibility does not undermine standardization and performance quality (Hinss et al., 2022; Nyamboga, 2025; Xue et al., 2025).

In this study, adaptive thinking is examined through three dimensions: strategic flexibility, resource agility, and learning from experience. Strategic flexibility enables organizations to restructure resources, modify processes, and implement innovative responses to environmental turbulence, thereby potentially improving operational efficiency (Ajike et al., 2024; Herhausen et al., 2021). It can also support ambidextrous operational capabilities that facilitate the simultaneous pursuit of flexibility and efficient operations (Kortmann et al., 2014). However, the benefits of strategic flexibility depend on how it is developed and applied. Meta-analytic evidence suggests that although flexibility is generally positively associated with performance, continuous restructuring may generate coordination and adjustment costs that can compromise operational stability (Herhausen et al., 2021). Excessive flexibility may also lead organizations to shift repeatedly between strategic alternatives and underinvest in long-term efficiency-enhancing commitments, thereby weakening stable routines and economies of scale (Brozovic, 2018; Herhausen et al., 2021; Ivanov et al., 2018). Thus, strategic flexibility can improve operational efficiency when appropriately managed, but excessive or poorly coordinated flexibility may produce the opposite outcome.

Similar trade-offs apply to resource agility, which refers to an organization's ability to rapidly mobilize, allocate, and reallocate resources in response to changing conditions. Empirical evidence suggests that resource agility can enable firms to optimize workflows, minimize waste, maintain service levels, and strengthen resilience during disruptions (Alipour et al., 2022; Manzoor et al., 2022; Queiroz et al., 2024). Agile supply chains and lean organizational cultures can enhance operational performance by enabling firms to respond quickly to fluctuations in demand and supply-related risks (Manzoor et al., 2022) while resource agility can support rapid responses to resource shortages and broader disruptions (Queiroz et al., 2024).

The incorporation of agile approaches into human resource management can also facilitate innovation and continuous improvement (Alipour et al., 2022). Nevertheless, agility does not automatically generate efficiency. Highly agile or flexible manufacturing systems may involve trade-offs with efficiency and quality (Qamar et al., 2020), while poorly coordinated investments in supply-chain agility and resilience may create redundant capabilities, additional costs, and organizational complexity (Gligor et al., 2019; Ivanov et al., 2018). Combining high levels of external and internal flexibility may similarly undermine operational resilience when flexible resource structures become excessively complex (Gligor et al., 2019; Li et al., 2023; Qamar et al., 2020).

The third dimension, learning from experience, enables organizations to systematically extract lessons from previous actions, identify inefficiencies, implement corrective measures, and establish a culture of continuous improvement (Chan et al., 2024; Cyfert et al., 2021; Inthavong et al., 2023). Organizational learning can directly improve performance and indirectly contribute to operational outcomes through enhanced innovation capabilities (Chan et al., 2024). From a dynamic capabilities perspective, learning and adaptation also enable organizations to identify opportunities and continuously adjust their operations (Cyfert et al., 2021), while the combination of learning, networking, and innovation can support sustainable organizational performance (Inthavong et al., 2023).

Nevertheless, learning from experience may become counterproductive when accumulated knowledge develops into rigid organizational routines or "core rigidities." Excessive dependence on established experience can restrict process modernization and discourage more substantial organizational change (Brozovic, 2018). It may also encourage incremental responses when more fundamental changes are required, delaying the adoption of digital and data-driven practices that could improve operational performance (Al-Surmi et al., 2022). During major disruptions such as COVID-19, excessive reliance on established operating routines and network relationships may further constrain organizations' ability to realign internal capabilities with changing external conditions (Brozovic, 2018; Li et al., 2023; Rialti et al., 2020).

These relationships can be understood through Organizational Adaptation Theory, which conceptualizes firms as open systems that continually reorganize their structures, strategies, and processes in response to changing environments. Drawing on the foundational work of Lawrence and Lorsch (1967) and subsequent developments in organizational adaptation research, the theory emphasizes learning, innovation, and purposeful adaptation as important foundations of sustained organizational performance (Howard-Grenville & Lahneman, 2021; Levinthal, 1991). Adaptation is

also path-dependent because accumulated experiences and established routines can both guide and constrain future organizational change (Levinthal, 1991). Although Organizational Adaptation Theory has been criticized for insufficiently accounting for structural inertia and external constraints such as regulation, resource limitations, and institutional pressures (Howard-Grenville & Lahneman, 2021), it remains relevant for understanding adaptive thinking in volatile manufacturing environments. Empirical evidence similarly indicates that firms with stronger adaptive and dynamic capabilities are better positioned to maintain organizational performance and operational effectiveness under uncertain conditions (Akpan et al., 2022; Keskin et al., 2022; Shafizadeh, 2024).

Existing empirical studies provide further support for these relationships across different organizational settings. Al-Abbadi et al. (2024), for example, found that dynamic and systematic dimensions of strategic thinking positively influenced organizational excellence among employees in Jordan's ICT sector. Setiyadi et al. (2024), through a systematic review of 36 empirical studies, similarly identified adaptive performance at individual, team, and organizational levels as an important capability for maintaining performance under changing conditions. In another context, Chan et al. (2024) found that organizational learning contributed to organizational performance among Iranian construction firms both directly and indirectly through organizational innovation. Likewise, Inthavong et al. (2023), examining 710 SME manufacturing owners in Laos, demonstrated that organizational learning contributed to sustainable firm performance, with networking and innovation playing important intervening roles. Collectively, these findings suggest that adaptive capabilities, organizational learning, flexibility, and agility can contribute to organizational and operational performance across diverse contexts.

Despite this growing body of evidence, the literature remains fragmented across different constructs, industries, and national contexts. Existing studies have predominantly examined strategic flexibility, organizational learning, adaptive performance, agility, or related capabilities separately, while comparatively limited empirical attention has been given to adaptive thinking as an integrated organizational capability comprising strategic flexibility, resource agility, and learning from experience in relation to operational efficiency within Nigeria's sugar manufacturing sector. This context is particularly important because Nigerian sugar manufacturers operate under infrastructural, resource, technological, and operational constraints that may shape the effectiveness of adaptive organizational capabilities differently from those observed in other industries and economies. Examining these dimensions simultaneously therefore provides an opportunity to clarify their respective contributions to operational efficiency within this specific manufacturing environment.

Accordingly, this study aims to examine the effect of adaptive thinking on operational efficiency in selected sugar manufacturing companies in Nigeria. Specifically, it investigates the effects of strategic flexibility, resource agility, and learning from experience on operational efficiency. Based on the preceding theoretical arguments and empirical evidence, the study proposes that strategic flexibility has a positive influence on operational efficiency (H1), resource agility has a positive influence on operational efficiency (H2), and learning from experience has a positive influence on operational efficiency (H3). These relationships provide an integrated framework for understanding how different dimensions of adaptive thinking contribute to operational efficiency within Nigeria's sugar manufacturing sector.

METHOD

This study employed a descriptive survey design to examine the effect of adaptive thinking on operational efficiency in Nigeria's sugar manufacturing sector. The study population comprised 388 employees from five major sugar manufacturing companies in Nigeria: Dangote Sugar Refinery, Golden Sugar Company, Flour Mills Sugar Company, Sunti Golden Sugar Company, and Savannah Sugar Company. These companies were selected because of their substantial operations, economic significance, and established presence in Nigeria's sugar manufacturing sector. Their inclusion also provided organizational diversity relevant to examining adaptive thinking and operational efficiency across different operational contexts.

Proportionate stratified random sampling was employed to ensure adequate representation of employees across organizational levels. This technique was preferred to simple random sampling because employees at different hierarchical levels may provide distinct strategic, tactical, and

operational perspectives relevant to adaptive thinking and operational efficiency. Based on the population of 388 employees, the target sample size was determined using Taro Yamane's formula, resulting in a sample of 195 respondents. The sample was proportionally distributed across the five companies, with 39 employees selected from each company. Within each company, respondents were further stratified by organizational level, comprising eight employees from top-level management, 12 from middle-level management, and 19 from lower-level positions. This sampling procedure was intended to ensure representation across different levels of organizational responsibility. Of the 195 targeted respondents, 174 provided valid responses, representing a response rate of 89.2%, and these responses were included in the final analysis.

Data were collected using a structured questionnaire designed to measure the study constructs. The instrument was subjected to pilot testing and expert review to assess its construct validity, while internal consistency was evaluated using Cronbach's alpha. Data collection was conducted between January and March 2026. The data were subsequently analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS. The analysis involved evaluating the measurement model and structural model to assess construct reliability and validity, potential multicollinearity, explanatory power, effect sizes, and the significance of the hypothesized relationships between the dimensions of adaptive thinking and operational efficiency.

Adaptive thinking was specified as the independent construct and operational efficiency as the dependent construct. Adaptive thinking was represented by three dimensions: strategic flexibility, resource agility, and learning from experience. Strategic flexibility was operationalized through distinguishable offerings (DO) and unique features (UF), based on Herhausen et al. (2020); resource agility was operationalized through innovation (INN) and waste minimization (WM), drawing on Gligor et al. (2019); and learning from experience was operationalized through effective utilization (EU) and task efficiency (TE), based on Inthavong et al. (2023). The structural relationship examined in the study was specified as follows:

$$OE = f [SF(DO, UF) + RA(INN, WM) + LFE(EU, TE)]$$

where OE represents operational efficiency, SF represents strategic flexibility, RA represents resource agility, LFE represents learning from experience, DO represents distinguishable offerings, UF represents unique features, INN represents innovation, WM represents waste minimization, EU represents effective utilization, and TE represents task efficiency.

RESULTS AND DISCUSSION

Results

Descriptive Analysis

Of the 195 questionnaires distributed, 174 valid responses were obtained, representing a response rate of 89.2%. The remaining 21 questionnaires were not returned or did not yield valid responses. Accordingly, the 174 valid responses were included in the subsequent analysis. Table 1 presents the descriptive statistics for the study indicators, including the mean, standard deviation, excess kurtosis, and skewness. As shown in [Table 1](#), the mean scores ranged from 3.017 for Task Efficiency to 3.782 for Brand Credibility. Brand Credibility recorded the highest mean ($M = 3.782$, $SD = 1.325$), followed by Industry Recognition ($M = 3.580$, $SD = 1.233$) and Waste Minimization ($M = 3.489$, $SD = 1.254$). In contrast, Task Efficiency recorded the lowest mean ($M = 3.017$, $SD = 1.280$), followed by Positive Reputation ($M = 3.080$, $SD = 1.288$) and Distinguishable Offerings ($M = 3.103$, $SD = 1.318$). The standard deviations ranged from 1.213 to 1.365, indicating variability in respondents' assessments across the measured indicators.

The skewness values ranged from -0.846 to -0.070 , while the excess kurtosis values ranged from -1.170 to -0.475 . All values fell within the stated acceptable range of -2 to $+2$, indicating no substantial departures from normality based on these descriptive distributional measures. Overall, the descriptive results provide an initial overview of respondents' assessments across the indicators before the measurement and structural models are evaluated.

Table 1. Descriptive Statistics of the Study Indicators

Indicator	Mean	SD	Excess Kurtosis	Skewness	N
Brand Credibility	3.782	1.325	-0.475	-0.846	174
Distinguishable Offerings	3.103	1.318	-1.170	-0.238	174
Effective Utilization	3.460	1.333	-1.119	-0.375	174
Industry Recognition	3.580	1.233	-0.964	-0.419	174
Innovation	3.322	1.213	-0.802	-0.308	174
Positive Reputation	3.080	1.288	-1.072	-0.070	174
Task Efficiency	3.017	1.280	-1.122	-0.115	174
Unique Features	3.362	1.365	-1.167	-0.336	174
Waste Minimization	3.489	1.254	-0.750	-0.530	174

Assessment of Measurement Model

Figure 1 illustrates the path model of adaptive thinking's impact on Operational Efficiency, visually representing the relationships tested in Table 5. The model depicts arrows from Learning From Experience, Resource Agility, and Strategic Flexibility to Operational Efficiency, with path coefficients of 0.306, 0.259, and 0.247, respectively, based on the bootstrapping results. The significant paths ($p < 0.05$) indicate that each dimension positively influences Operational Efficiency, with Learning From Experience having the strongest effect. The model visually confirms the structural relationships and their statistical significance. The implications for the study's objective are critical: the path model visually validates that adaptive thinking, through its three dimensions, significantly enhances operational efficiency, rejecting the null hypothesis. This reinforces the study's focus on strategic sensitivity as a driver of competitive advantage, highlighting the need to integrate learning, agility, and flexibility into operational strategies to strengthen market competitiveness.

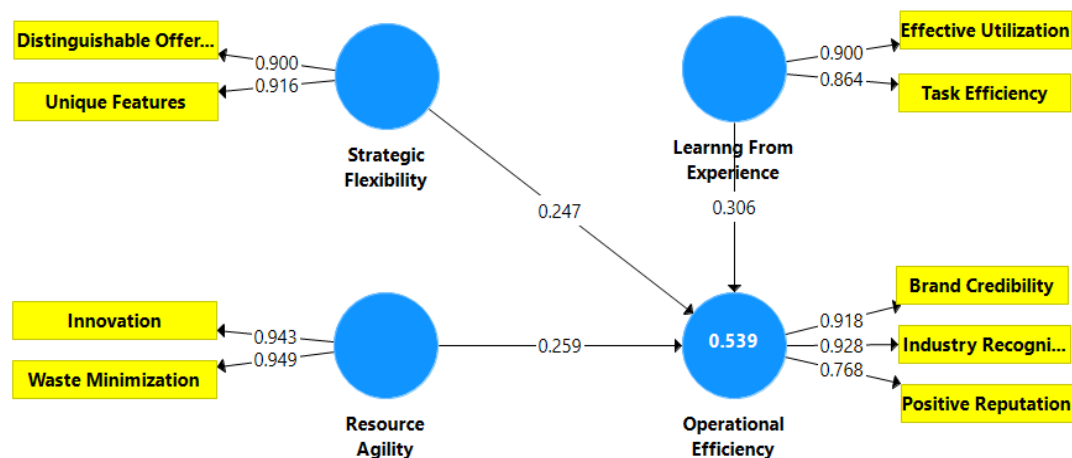


Figure 1. A path model of Adaptive Thinking and Operational Efficiency

Table 2. Construct Reliability and Validity

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Learning From Experience	0.716	0.875	0.778
Operational Efficiency	0.847	0.907	0.765
Resource Agility	0.882	0.944	0.894
Strategic Flexibility	0.788	0.904	0.825

Table 2 evaluates the reliability and validity of constructs related to adaptive thinking and operational efficiency. Learning From Experience has a Cronbach's Alpha of 0.716, Composite Reliability (CR) of 0.875, and Average Variance Extracted (AVE) of 0.778, indicating acceptable reliability and convergent validity. Operational Efficiency shows strong reliability with a Cronbach's

Alpha of 0.847, CR of 0.907, and AVE of 0.765, reflecting robust internal consistency and variance explanation. Resource Agility exhibits the highest reliability (Cronbach's Alpha = 0.882, CR = 0.944, AVE = 0.894), suggesting it is a highly cohesive construct. Strategic Flexibility also demonstrates good reliability (Cronbach's Alpha = 0.788, CR = 0.904, AVE = 0.825).

All constructs meet the thresholds for Cronbach's Alpha (>0.7), CR (>0.7), and AVE (>0.5), confirming their suitability for structural modeling. The implications for the study are clear: the reliable and valid constructs ensure that the measurement model accurately captures adaptive thinking's dimensions and their impact on operational efficiency. This supports the objective of determining how adaptive thinking drives competitive advantage, as the strong psychometric properties validate the use of these constructs to test the hypothesis that adaptive thinking significantly affects operational efficiency, reinforcing the study's focus on strategic sensitivity as a driver of organizational performance.

Table 3. Discriminant Validity

	Learning From Experience	Operational Efficiency	Resource Agility	Strategic Flexibility
Learning From Experience	0.882			
Operational Efficiency	0.669	0.875		
Resource Agility	0.711	0.660	0.946	
Strategic Flexibility	0.723	0.660	0.740	0.908

Multicollinearity

This assesses the correlation between the independent variable. This assessment determines whether problematic correlations exist among the independent variables. The variance inflation factor (VIF) is used in this study to assess likely correlation between the independent variables.

Table 4. Inner VIF Values

	Learning From Experience	Operational Efficiency	Resource Agility	Strategic Flexibility
Learning From Experience		2.444		
Operational Efficiency				
Resource Agility		2.579		
Strategic Flexibility		2.671		

Table 4 reports the Variance Inflation Factor (VIF) values to assess multicollinearity among independent variables. The VIF values are 2.444 (Learning From Experience), 2.579 (Resource Agility), and 2.671 (Strategic Flexibility), all below the threshold of 5, indicating no significant multicollinearity. This suggests that the independent variables are not highly correlated, ensuring that each uniquely contributes to explaining Operational Efficiency without redundancy.

The implications for the study's objective are critical: the absence of multicollinearity validates the structural model's integrity, confirming that Learning From Experience, Resource Agility, and Strategic Flexibility independently influence operational efficiency. This supports the hypothesis that adaptive thinking, through these distinct dimensions, enhances competitive advantage by allowing each factor to contribute uniquely to operational improvements, aligning with the study's focus on strategic sensitivity as a driver of organizational performance.

Assessment of Structural Model

Table 5 presents the bootstrapping results for the structural model, showing the effects of the three dimensions of adaptive thinking on operational efficiency. All three paths were positive and statistically significant. Learning from Experience had the largest path coefficient ($\beta = 0.306$, $t = 3.275$, $p = .001$), indicating a significant positive effect on Operational Efficiency. Resource Agility also had a significant positive effect ($\beta = 0.259$, $t = 3.648$, $p < .001$), followed by Strategic Flexibility ($\beta = 0.247$, $t = 2.933$, $p = .004$). These findings indicate that higher levels of Learning from Experience, Resource Agility, and Strategic Flexibility are associated with higher Operational Efficiency. Accordingly, the results provide empirical support for the three hypothesized relationships proposed in this study.

Table 5. Bootstrapping Results for the Structural Model

Structural Path	β (O)	M	SD	t	p	Result
Learning from Experience $\rightarrow$ Operational Efficiency	0.306	0.307	0.093	3.275	.001	Supported
Resource Agility $\rightarrow$ Operational Efficiency	0.259	0.262	0.071	3.648	< .001	Supported
Strategic Flexibility $\rightarrow$ Operational Efficiency	0.247	0.247	0.084	2.933	.004	Supported

Note. β (O) = original sample/path coefficient; M = sample mean; SD = standard deviation

Beyond the significance of the individual structural paths, the explanatory power of the model was assessed using the coefficient of determination (R^2). As presented in Table 6, the R^2 value for Operational Efficiency was 0.539, with an adjusted R^2 of 0.531. This indicates that Learning from Experience, Resource Agility, and Strategic Flexibility collectively explained 53.9% of the variance in Operational Efficiency, while the remaining 46.1% was attributable to other factors not included in the model. The adjusted R^2 value of 0.531 further indicates that the model retained a comparable level of explanatory power after adjustment for the number of predictors. Overall, these results demonstrate that the three dimensions of adaptive thinking collectively account for a substantial proportion of the variation in operational efficiency.

Table 6. Coefficient of Determination for Operational Efficiency

Endogenous Construct	R^2	Adjusted R^2
Operational Efficiency	0.539	0.531

The contribution of each predictor to the explanatory power of the structural model was further examined using the effect size (f^2), as shown in Table 7. Learning from Experience produced the largest effect size ($f^2 = 0.083$), followed by Resource Agility ($f^2 = 0.057$) and Strategic Flexibility ($f^2 = 0.050$). Although Learning from Experience showed the greatest relative contribution among the three predictors, the effect-size values indicate that each predictor made a comparatively limited individual contribution to the explained variance in Operational Efficiency. Taken together with the path coefficients and R^2 results, these findings suggest that the explanatory capacity of the model arises from the combined contribution of the three adaptive-thinking dimensions rather than from a single dominant predictor.

Table 7. Effect Sizes (f^2) of the Predictor Constructs

Predictor Construct	Endogenous Construct	f^2
Learning from Experience	Operational Efficiency	0.083
Resource Agility	Operational Efficiency	0.057
Strategic Flexibility	Operational Efficiency	0.050

Overall, the structural model results consistently demonstrate positive and statistically significant relationships between the three dimensions of adaptive thinking and Operational Efficiency. Learning from Experience exhibited the largest path coefficient ($\beta = 0.306$) and effect size ($f^2 = 0.083$), followed by Resource Agility ($\beta = 0.259$, $f^2 = 0.057$) and Strategic Flexibility ($\beta = 0.247$, $f^2 = 0.050$). Collectively, the three predictors explained 53.9% of the variance in Operational Efficiency ($R^2 = 0.539$). These findings therefore support H1, H2, and H3, indicating that Strategic Flexibility, Resource Agility, and Learning from Experience each have a significant positive influence on Operational Efficiency.

Discussion

The findings demonstrate that the three dimensions of adaptive thinking—learning from experience, resource agility, and strategic flexibility—have significant positive effects on operational efficiency in the selected sugar manufacturing companies in Nigeria. Among these dimensions, learning from experience exhibited the strongest relationship with operational efficiency ($\beta = 0.306$, $p = .001$), followed by resource agility ($\beta = 0.259$, $p < .001$) and strategic flexibility ($\beta = 0.247$, $p = .004$). These results suggest that operational efficiency in the sugar manufacturing sector is associated

not only with firms' ability to adjust their strategies and reallocate resources but also, and more strongly, with their capacity to learn from previous operational experiences and translate such learning into improved organizational practices.

The significant positive effect of learning from experience indicates that organizations that effectively draw lessons from previous activities, challenges, and outcomes are better positioned to improve their operational processes. Experiential learning may enable firms to identify recurring inefficiencies, refine established routines, avoid previous mistakes, and develop more effective responses to operational problems. This finding is consistent with [Atobishi et al. \(2024\)](#), who emphasized the importance of learning from experience in improving organizational efficiency, and with the broader organizational-learning perspective discussed in this study. In the context of Nigerian sugar manufacturing, where firms operate under infrastructural, technological, and resource constraints, the ability to systematically learn from previous operations may be particularly valuable because it enables organizations to improve existing processes without relying exclusively on additional resources or major structural changes.

Resource agility also had a significant positive effect on operational efficiency ($\beta = 0.259$, $p < .001$). This finding suggests that the ability to mobilize, allocate, and reallocate resources in response to changing operational requirements contributes to more efficient organizational processes. For sugar manufacturing companies operating in an environment characterized by resource constraints and supply uncertainties, resource agility may facilitate faster responses to changes in production requirements and resource availability while reducing unnecessary operational disruptions. This finding is consistent with [Qader et al. \(2025\)](#), who emphasized the importance of resource agility in organizational performance. It also supports the argument that organizational responsiveness is particularly important in dynamic environments, where rigid resource allocation may limit firms' ability to respond effectively to emerging operational demands.

Strategic flexibility similarly demonstrated a significant positive effect on operational efficiency ($\beta = 0.247$, $p = .004$). This result indicates that firms capable of modifying their strategic priorities and organizational responses in accordance with changing environmental conditions are more likely to maintain efficient operations. Strategic flexibility can enable organizations to reconsider existing approaches, respond to changes in market and production conditions, and align operational decisions with emerging organizational needs. This finding is consistent with [Cosa and Torelli \(2024\)](#), who highlighted the contribution of strategic flexibility to organizational and operational outcomes. Nevertheless, the comparatively smaller coefficient for strategic flexibility in the present study suggests that strategic adjustment alone may be insufficient to generate operational improvements unless it is accompanied by effective resource deployment and organizational learning.

Taken together, the three dimensions explained 53.9% of the variance in operational efficiency ($R^2 = 0.539$), indicating that adaptive thinking accounts for a substantial proportion of differences in operational efficiency among the firms examined. This finding is consistent with [Ogbeta-Ogwu and Chidi \(2025\)](#), who reported that adaptive capabilities contribute to organizational performance in dynamic environments. Importantly, however, the individual effect sizes were relatively small, with learning from experience exhibiting the largest effect ($f^2 = 0.083$), followed by resource agility ($f^2 = 0.057$) and strategic flexibility ($f^2 = 0.050$). Thus, the findings suggest that operational efficiency is not driven by any single dimension of adaptive thinking; rather, it reflects the combined contribution of organizational learning, resource responsiveness, and strategic adaptability. This interpretation is consistent with the structural-model results, in which all three dimensions made statistically significant contributions to operational efficiency. The model explains 53.9% of the variance, while the three individual f^2 values remain comparatively limited.

The findings also provide empirical support for Organizational adaptation theory. From this theoretical perspective, organizations sustain their effectiveness by continuously adjusting their strategies, resources, routines, and behaviors in response to changing environmental conditions. The significant effects observed for all three dimensions of adaptive thinking are consistent with this proposition, as strategic flexibility reflects the capacity to modify strategic responses, resource agility reflects the capacity to redeploy organizational resources, and learning from experience reflects the capacity to refine organizational routines based on accumulated knowledge. The stronger coefficient

observed for learning from experience may indicate that, within the context examined, adaptation is particularly effective when organizations are able to translate accumulated experience into improvements in their operational routines. This interpretation is also consistent with the theoretical foundation developed earlier in the manuscript, which emphasizes that adaptation is path-dependent and that accumulated organizational experience can shape subsequent organizational change. The introduction specifically grounds this argument in organizational adaptation theory and the path-dependent role of organizational experience.

Overall, the findings extend the existing literature by demonstrating that strategic flexibility, resource agility, and learning from experience simultaneously contribute to operational efficiency within Nigeria's sugar manufacturing sector. Previous research has frequently examined flexibility, agility, learning, and related adaptive capabilities independently or in organizational settings outside this specific sector. By examining these dimensions within an integrated model, the present study provides evidence that adaptive thinking operates through complementary organizational capabilities rather than through a single mechanism. For managers in sugar manufacturing companies, the findings imply that improving operational efficiency requires a balanced emphasis on learning from previous operations, maintaining sufficient agility in resource deployment, and developing strategic flexibility to respond to changing operating conditions.

CONCLUSION

This study concludes that adaptive thinking contributes significantly to operational efficiency in selected sugar manufacturing companies in Nigeria. Specifically, learning from experience, resource agility, and strategic flexibility were all found to have significant positive effects on operational efficiency, with learning from experience showing the strongest contribution. These findings indicate that operational efficiency can be strengthened when organizations are able to systematically learn from previous operations, deploy resources responsively, and adjust their strategies to changing operational and environmental conditions. Collectively, the three dimensions highlight adaptive thinking as an important organizational capability for managing the challenges faced by sugar manufacturing firms in a dynamic and resource-constrained environment. The findings also provide empirical support for Organizational Adaptation Theory by demonstrating how different adaptive capabilities contribute to organizational responses to environmental change. In the context examined, learning from experience emerged as the strongest predictor, suggesting that the ability to translate accumulated operational experience into improved routines may play a particularly important role in enhancing efficiency. Resource agility and strategic flexibility complement this capability by enabling firms to reallocate resources and adjust strategic responses when operating conditions change. Rather than indicating that one adaptive capability is sufficient on its own, the findings suggest that operational efficiency benefits from the combined development of organizational learning, resource responsiveness, and strategic adaptability.

Based on these findings, sugar manufacturing companies should strengthen mechanisms for capturing, sharing, and applying lessons from previous operations to support continuous process improvement. Structured knowledge-management practices may help preserve operational knowledge and facilitate its application to recurring production challenges. Firms should also develop employees' capacity to respond flexibly to changing resource requirements, including the reallocation of personnel and production resources when operational conditions require adjustment. In addition, strategic planning processes should provide sufficient flexibility to accommodate changes in market conditions, regulatory requirements, resource availability, and other environmental pressures. Integrating these learning, resource, and strategic capabilities may enable sugar manufacturing companies to respond more effectively to operational challenges and sustain improvements in operational efficiency.

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