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INTEGRATING PROCUREMENT AND ON-SITE MATERIAL HANDLING IN THE FERTILIZER PRODUCTION INDUSTRY IN RIVERS STATE

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Abstract
This study examined the relationship between integrating procurement and on-site material handling in the fertilizer production industry in Rivers State, Nigeria. Integrating procurement was measured using supplier integration, internal procurement integration, and information integration, while on-site material handling served as the dependent variable. A cross-sectional survey research design was adopted for the study. The population comprised staff of selected fertilizer production firms in Rivers State, from which a sample of 142 respondents was drawn. Primary data were collected through a structured questionnaire, while the hypotheses were tested using the Spearman Rank Order Correlation Coefficient with the aid of the Statistical Package for the Social Sciences (SPSS) version 26 at a 0.05 level of significance. The findings revealed that supplier integration, internal procurement integration and information integration each had a significant positive relationship with on-site material handling. Consequently, all the null hypotheses were rejected. The study concluded that integrating procurement is a significant driver of effective on-site material handling in the fertilizer production industry in Rivers State. The study therefore recommended that management of fertilizer production firms should strengthen supplier collaboration, enhance internal coordination across procurement and operational units, and invest in integrated information systems to improve on-site material handling efficiency.

Keywords: Integrating Procurement, Supplier Integration, Internal Procurement Integration, Information Integration, On-Site Material Handling, Fertilizer Production, Rivers State.

1. Introduction

The fertilizer production industry in Rivers State is one of the most strategically important segments of Nigeria's chemical manufacturing sector and as such its operational demands are far more complex than what obtains in conventional manufacturing settings. Firms like Notore Chemical Industries and Indorama Eleme Fertilizers and Chemicals operate large-scale, process-intensive plants in Rivers State where the continuous flow of bulk and hazardous raw materials is fundamental to uninterrupted production output (van Weele, 2018). These firms operate within an environment characterised by high input volumes, stringent safety requirements and the dependence of each production stage on the timely delivery of procured materials to the right point within the plant, making coordination between procurement and production a matter of both efficiency and safety (Groover, 2019).

Material handling is one of the most critical operational activities in the fertilizer production process. It refers to the totality of activities involved in moving, positioning, storing and controlling materials within the production facility, from the point of receipt at the plant gate through all intermediate storage and transfer stages to the point at which materials enter the production process (Tompkins et al., 2010). It was observed that on-site material handling is not simply a technical or equipment-related function, it is a composite operational outcome that reflects the quality of planning, coordination and information that precedes and accompanies the physical movement of materials within the plant, which includes material flow management, storage organisation, handling equipment utilisation, safety compliance etc. (Frazelle, 2002). Apple (1977) argued that handling efficiency at plant level is fundamentally constrained by the quality of upstream coordination that determines what arrives, in what condition and at what time, and as such evaluating material handling as a standalone function misses the point entirely. Groover (2019) also maintained that in process-intensive environments like fertilizer production, inadequate advance preparation for receiving, storing and transferring materials can result in damage, contamination, safety incidents and production stoppages that are far more costly than the handling activity itself.

Integrating procurement is a multi-directional construct which includes vertical integration with suppliers, horizontal integration with peer functions such as production and logistics, and diagonal integration through shared information platforms (van Weele, 2018). A procurement function that achieves integration in only one of these directions will fail to deliver the full efficiency benefits that comprehensive integration can produce and as such the three dimensions are inseparable in practice. Stevens (1989) contended that the highest stage of supply chain integration is characterised by synchronised supplier schedules, joint demand forecasting and the elimination of the buffering activities that arise from poor coordination. For the purpose of this study, integrating procurement is operationalised through three dimensions which include supplier integration, internal procurement integration and information integration. Supplier integration captures the degree to which the buying firm establishes collaborative and operationally coordinated relationships with its key raw material suppliers, enabling the synchronisation of supply schedules, specifications and delivery parameters with the plant's receiving capacity (Flynn et al., 2010). Internal procurement integration refers to the extent of cross-functional coordination between the procurement department and other internal units which include production, warehouse management, health and safety, finance etc., ensuring that purchasing decisions reflect and support plant-level operational requirements (Narasimhan & Kim, 2002). Information integration refers to the degree to which procurement-relevant data, which includes supplier schedules, order statuses, inventory levels and material specifications, is shared accurately and timely across both internal departments and external supply chain partners (Li et al., 2005).

Research on procurement and supply chain integration has moved progressively from early conceptual frameworks that identified integration as a linear sequence from suppliers through production to customers (Stevens, 1989) towards empirical studies that disaggregate integration into constituent dimensions and test each against specific performance outcomes. Flynn et al. (2010) demonstrated that internal and external integration dimensions had differing effects on firm performance, while Zhao et al. (2011) found that internal integration was a necessary precondition for effective external integration with suppliers. Leuschner et al. (2013) in a meta-analysis of supply chain integration studies confirmed a consistently positive relationship between integration dimensions and performance outcomes, and within the Nigerian manufacturing context, Okafor and Adeyemi (2020) found that procurement coordination practices were significantly associated with operational efficiency though their study did not examine on-site material handling specifically. None of these studies, to the best of the researcher's knowledge, specifically examined the relationship between integrating procurement and on-site material handling in the fertilizer production industry in Rivers State. It is against this background that the present study examines this relationship, seeking to establish whether supplier integration, internal procurement integration and information integration significantly relate with on-site material handling performance in fertilizer production firms in Rivers State.

2. Literature Review

Conceptual Review

Integrating Procurement

Integrating procurement refers to the deliberate alignment of procurement activities with upstream supplier operations, internal functional processes and the information systems that connect them, so that the acquisition, movement and deployment of materials are coordinated as a seamless flow rather than a series of isolated transactions (Monczka et al., 2020). As such, procurement integration moves the purchasing function beyond the management of individual purchase orders towards a systemic role in which procurement decisions reflect and reinforce the operational requirements of the broader supply chain, including the material handling demands of the production facility. For this study, integrating procurement is operationalised through three dimensions which include supplier integration, internal procurement integration and information integration. Stevens (1989) was among the first to articulate a staged model of supply chain integration in which procurement evolves from a reactive, functionally isolated activity towards a fully integrated function that coordinates material flows across organisational boundaries. It was observed that in Stevens' (1989) model, the highest level of procurement integration is characterised by the synchronisation of supplier schedules with internal production plans, joint demand forecasting between buyers and suppliers and the elimination of buffering activities (excess safety stock, redundant inspection stages, emergency orders etc.) that typically arise from poor coordination. Van Weele (2018) further argued that procurement integration is a multi-directional construct which encompasses vertical integration with suppliers and customers, horizontal integration with peer functions such as production, finance and logistics, and diagonal integration through shared information platforms that connect internal and external parties simultaneously. A procurement function that achieves integration in only one direction will be unable to realise the full efficiency benefits that full-spectrum integration can deliver to operations such as on-site material handling.

Supplier Integration

Supplier integration refers to the extent to which a buying firm establishes collaborative, information-rich and operationally coordinated relationships with its key suppliers, enabling the synchronisation of supply schedules, quality standards and delivery parameters with the buyer's production requirements (Flynn et al., 2010). As such, supplier integration goes beyond the negotiation of commercial terms to encompass joint planning, supplier development and shared performance metrics, and in advanced cases involves supplier participation in the buyer's production scheduling and material handling design decisions (Ike et al., 2021). In the fertilizer production context where raw materials which include ammonia, phosphoric acid and potash etc. are procured in bulk and must be received, stored and transferred under strict safety and process conditions, the quality of supplier integration has direct implications for the smoothness of on-site handling operations. Frohlich and Westbrook (2001) found that firms with the widest arc of upstream integration, those that aligned most closely with their suppliers in terms of planning, scheduling and information sharing, recorded the strongest performance improvements. Furthermore, upstream orientation is particularly relevant in process industries such as fertilizer production where the physical characteristics of incoming raw materials which include hazard class, moisture content and particle size must be known and planned for in advance if on-site handling equipment, storage conditions and safety protocols are to be configured appropriately before materials arrive at the plant (Deng, Garg & Bradley, 2025). Zhao et al. (2011) further found that the depth of supplier integration was significantly moderated by relational commitment between buyer and supplier, with firms that invested in longer-term, trust-based relationships achieving higher levels of operational synchronisation than those that maintained purely contractual interactions. As such, the relational dimension of supplier integration which includes mutual trust, information transparency and shared risk management appears to be as important as the structural and technological mechanisms through which integration is achieved.

Internal Procurement Integration

Internal procurement integration refers to the degree of coordination and information sharing between the procurement function and other internal departments of the firm which include production, warehouse management, health and safety and finance, in a manner that aligns purchasing decisions with operational requirements and plant-level material handling capacities (Narasimhan & Kim, 2002). It was observed that internal procurement integration ensures that procurement personnel are not making sourcing, ordering and scheduling decisions in isolation from the departments that must receive, store, handle and process the materials being purchased, and as such reduces the mismatch between what is procured and what the production system is equipped to handle at any given time. Cousins and Menguc (2006) found that firms with stronger internal procurement integration exhibited higher levels of supply chain responsiveness and lower incidences of supply-related production disruptions than firms with weaker internal integration, regardless of how sophisticated their external supplier relationships were. This finding implies that external integration with suppliers cannot fully compensate for internal coordination failures, since even well-supplied materials will create on-site handling problems if procurement has not coordinated with production regarding sequencing, volume and handling requirements in advance of delivery. Gimenez and Ventura (2005) found that a high degree of coordination between procurement or logistics functions and production units was significantly associated with improvements in production efficiency, material availability at point of use and reduction in internal handling waste, and as such internal procurement integration is not an administrative convenience but an operational enabler whose quality directly shapes the conditions under which on-site material handling takes place.

Information Integration

Information integration refers to the extent to which procurement-relevant data which includes supplier schedules, order statuses, inventory levels, material specifications and delivery forecasts is shared accurately, timely and seamlessly between procurement, suppliers and internal operational departments through compatible information systems (Li et al., 2005). As such, information integration serves as the connective tissue through which the other dimensions of procurement integration are operationalised in practice, since the coordination of physical material flows depends on the quality and timeliness of the information that precedes and accompanies those flows. Li et al. (2005) found that information sharing was among the dimensions most strongly associated with competitive advantage and operational performance, including supply responsiveness and material availability at the production interface. It was observed that the mechanism through which information integration drives these outcomes is primarily the reduction of uncertainty at each handoff point in the supply chain, including the point at which procured materials are received at the plant gate and transferred to on-site storage or production areas, which is where information gaps most directly manifest as handling errors, delays and safety incidents (Koufteros, Vonderembse & Jayaram, 2005). Flynn et al. (2010) found that information integration was a significant moderator of the relationship between internal and external supply chain integration dimensions and performance, and as such information integration is not simply one of three equal dimensions but the platform without which the other two dimensions cannot fully function.

Material Handling

material handling refers to the totality of activities involved in moving, positioning, storing and controlling materials within the boundaries of a production facility, from the point of receipt at the plant gate through all intermediate storage and transfer stages to the point of introduction into the production process (Tompkins et al., 2010). As a composite construct, on-site material handling encompasses material flow management, handling equipment utilisation, storage organisation and safety compliance in handling operations, each of which contributes to the overall efficiency and reliability of the handling system within the plant. In the fertilizer production context, on-site handling is particularly challenging given the bulk, hazardous and often hygroscopic nature of key raw materials which include urea, phosphates and potassium compounds etc., which require specialised handling equipment and tightly controlled storage conditions. Apple (1977) argued that on-site material handling should be evaluated not in isolation but as part of the integrated flow of materials from supplier delivery to production input, and that the efficiency of the handling system is fundamentally constrained by the quality of planning and coordination that precedes the arrival of materials at the production facility. It was observed that this planning dependency means that on-site handling performance is not solely determined by the design and maintenance of handling equipment or the layout of the plant but is also shaped by the quality of procurement integration practices that determine what materials arrive, in what condition, at what time and in what quantities. Frazelle (2002) identified five dimensions of on-site material handling performance which include speed, accuracy, cost per unit processed, safety and space utilisation etc., and as such procurement integration influences all five of these dimensions since poorly integrated procurement generates handling conditions characterised by unpredictable material arrivals, incorrect specifications and inadequate advance notice, each of which degrades handling system performance (Honkala, 2024).

2.2 Theoretical Review

This study is anchored on Supply Chain Integration Theory and Transaction Cost Theory. Supply Chain Integration Theory, originally proposed by Stevens (1989) and subsequently advanced by Flynn et al. (2010) and Zhao et al. (2011), posits that the operational performance of manufacturing organizations is largely influenced by the extent to which internal functions and external supply chain partners coordinate their activities rather than operate independently. The theory emphasizes the seamless integration of procurement, production, logistics, and supplier relationships through effective communication, collaboration, and information sharing. Contemporary scholars have argued that supply chain integration has become a strategic capability that enables organizations to enhance operational efficiency, improve responsiveness, reduce process disruptions, and strengthen competitive advantage in increasingly dynamic business environments (Dubey et al., 2021; Queiroz et al., 2022). Within manufacturing firms, effective integration facilitates synchronized material flows, minimizes delays, and improves coordination among supply chain partners, thereby supporting efficient material handling operations (Chowdhury et al., 2023). Applied to the present study, the theory suggests that supplier integration, internal procurement integration, and information integration are expected to enhance on-site material handling by minimizing coordination failures, reducing information asymmetry, and ensuring that materials are available at the right place and time for production activities.

Transaction Cost Theory, developed by Williamson (1985), complements the Supply Chain Integration Theory by explaining that organizations seek governance structures that minimize the costs associated with economic exchanges. These transaction costs include the costs of searching for suppliers, negotiating contracts, monitoring supplier performance, adapting to unforeseen circumstances, and resolving disputes arising from procurement activities. According to the theory, organizations can reduce these costs through stronger collaborative relationships, effective information exchange, and coordinated procurement processes. Recent studies have reaffirmed that procurement integration significantly reduces transaction uncertainties by improving transparency, strengthening supplier relationships, and facilitating timely decision making across the supply chain (Kache & Seuring, 2017; Ketchen et al., 2021; Wieland, 2021). In the context of material handling, supplier integration and information integration reduce uncertainties surrounding procurement schedules, delivery timing, and material specifications, thereby minimizing emergency purchases, unnecessary inspections, handling delays, and operational disruptions that often occur when materials arrive without adequate coordination (Hobbs, 1996; Min et al., 2023). Similarly, internal procurement integration ensures that procurement decisions are aligned with production requirements and handling capacities, reducing inefficiencies associated with poor planning and resource utilization.

Collectively, Supply Chain Integration Theory and Transaction Cost Theory provide a comprehensive theoretical foundation for this study by explaining both the strategic and economic benefits of procurement integration. While Supply Chain Integration Theory emphasizes coordination and collaboration across organizational boundaries to improve operational performance, Transaction Cost Theory explains how such integration reduces procurement related uncertainties and transaction costs.

Consequently, both theories support the proposition that higher levels of supplier integration, internal procurement integration, and information integration are associated with more efficient, reliable and effective on-site material handling within fertilizer production firms.

Empirical Review

A number of empirical studies have examined the relationship between supply chain and procurement integration dimensions and operational performance outcomes relevant to the present study. Flynn et al. (2010) conducted a multi-country study of supply chain integration and found that both internal and external integration dimensions had significant positive associations with operational performance, with internal integration exhibiting a stronger direct effect on production efficiency than external integration alone, a finding that is consistent with the expectation that internal procurement integration will demonstrate the strongest relationship with on-site material handling among the three dimensions examined in the present study. Frohlich and Westbrook (2001) found that firms pursuing simultaneous upstream and downstream integration recorded the greatest performance improvements. It was observed that supplier integration and internal integration are most effective when pursued jointly, since external supplier coordination without corresponding internal coordination leaves the production facility unprepared to efficiently receive and handle the materials that suppliers deliver, however reliably those deliveries are made. Leuschner et al. (2013) in a meta-analysis of 68 supply chain integration studies confirmed a significant, positive and consistent relationship between supply chain integration and firm performance across a wide range of industry contexts and geographic settings, while noting that information sharing was among the most consistently significant integration mechanisms across studies. Within the Nigerian context, Okafor and Adeyemi (2020) found that procurement coordination practices were significantly associated with operational efficiency among manufacturing firms, which includes reductions in material handling errors and storage-related wastage. Chen and Paulraj (2004) further found that buyer-supplier communication intensity, a key component of both supplier integration and information integration, was positively associated with supply chain efficiency outcomes which include delivery reliability and material quality at the point of use. Pagell (2004) investigated the factors that enable and inhibit the integration of operations, purchasing and logistics functions and found that internal integration, particularly the degree of information sharing and joint decision-making between procurement and operations, was the most critical prerequisite for achieving effective material flow outcomes at the production facility level.

Hypotheses

Based on the foregoing review, the following null hypotheses are formulated to guide the study:

H01: Supplier integration has no significant relationship with on-site material handling in the fertilizer production industry in Rivers State.

H02: Internal procurement integration has no significant relationship with on-site material handling in the fertilizer production industry in Rivers State.

H03: Information integration has no significant relationship with on-site material handling in the fertilizer production industry in Rivers State.

3. Methodology

The study adopted a cross-sectional survey research design because it provided a suitable approach for collecting data from respondents at a single point in time. The design was considered appropriate since the study sought to examine the relationship between integrating procurement and on-site material handling without manipulating any of the study variables (Hair et al., 2022). The target population comprised procurement officers, production supervisors, warehouse managers and operations staff of selected fertilizer production firms in Rivers State. These categories of employees were considered appropriate because they are actively involved in procurement planning, supplier coordination, inventory management and on-site material handling activities. A structured questionnaire was used as the primary instrument for data collection. The questionnaire consisted of close ended questions measured on a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). A total of 155 copies of the questionnaire were distributed across the selected firms, of which 142 were properly completed and returned, representing a response rate of 91.6 percent.

The measurement items for each construct were adapted from established scales in the extant literature to ensure construct validity and comparability with prior studies. Items for supplier integration were adapted from Flynn et al. (2010) and Zhao et al. (2011), whose scales have been widely validated across manufacturing contexts and capture the extent of buyer-supplier operational alignment, joint scheduling and collaborative communication. Items for internal procurement integration were adapted from Cousins and Menguc (2006) and Narasimhan and Kim (2002), which measure the degree of cross-functional coordination between procurement and internal departments including production, warehouse management and finance. Items for information integration were adapted from Li et al. (2005), whose instrument specifically measures the accuracy, timeliness and adequacy of information sharing across supply chain boundaries. Items for on-site material handling, the composite dependent variable, were adapted from Frazelle (2002) and Tompkins et al. (2010), capturing the efficiency of material flow, storage organisation, handling equipment utilization and safety compliance within the plant. All items were reviewed and contextualised for the fertilizer production environment by two subject matter experts prior to final administration. Given the ordinal nature of Likert-scale data, Spearman's rank correlation coefficient was adopted as the non-parametric statistical technique for testing the three hypotheses (Sheskin, 2011). Spearman's rank correlation does not require the assumptions of normality or linearity associated with parametric techniques and is therefore appropriate for perception-based survey data of the type generated in this study. The significance threshold was set at 0.005 for all three tests. Reliability of the research instrument was confirmed using Cronbach's alpha, with all constructs exceeding the minimum threshold of 0.70 recommended by Hair et al. (2019), and content validity was established through expert review of the questionnaire prior to administration.

4. Results

Response Rate

Out of 155 copies of the questionnaire administered to procurement, production, and operations staff of fertilizer production firms in Rivers State, 142 copies were returned and found usable for analysis, representing a response rate of 91.6 percent, which was considered adequate for the purposes of statistical analysis (Mugenda & Mugenda, 2003).

Table 1: Demographic Characteristics of Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	98	69.0
	Female	44	31.0
Age	20–29 years	22	15.5
	30–39 years	63	44.4
	40–49 years	41	28.9
	50 years and above	16	11.3
Educational Qualification	OND/NCE	21	14.8
	HND/BSc	85	59.9
	MSc and above	36	25.4
Work Experience	Below 5 years	34	23.9
	5–10 years	76	53.5
	Above 10 years	32	22.5
Department	Procurement/Supply Chain	58	40.8
	Production/Operations	84	59.2

The demographic profile in Table 1 shows that the majority of respondents were male (69.0%), with the largest proportion falling within the 30–39 years age bracket (44.4%), suggesting a moderately experienced workforce. A combined 75.9 percent of respondents reported at least five years of work experience within their current organisations, indicating a sufficient level of operational familiarity to provide informed assessments of procurement integration and material handling practices. A notable 25.4 percent held postgraduate qualifications, which is consistent with the technical and professional nature of the fertilizer production sector, and the majority were drawn from production and operations departments (59.2%), ensuring that respondents had direct exposure to on-site material handling activities.

Table 2: Descriptive Statistics of Study Variables

Variable	N	Mean	Std. Deviation
Supplier Integration	142	3.64	0.671
Internal Procurement Integration	142	3.76	0.603
Information Integration	142	3.58	0.712
On-site Material Handling	142	3.69	0.628

The descriptive results in Table 2 show that internal procurement integration recorded the highest mean score among the study variables (M = 3.76, SD = 0.603), followed by on-site material handling (M = 3.69, SD = 0.628), supplier integration (M = 3.64, SD = 0.671), and information integration (M = 3.58, SD = 0.712). It was observed that all four variables recorded mean scores above the scale midpoint of 3.0, indicating generally favourable perceptions of procurement integration and on-site material handling practices among respondents in the sampled firms. The comparatively wider standard deviations recorded for information integration (SD = 0.712) and supplier integration (SD = 0.671) suggest greater variability in respondents' perceptions of these dimensions, possibly reflecting differences in the information systems infrastructure and supplier relationship depth across the sampled organisations.

Test of Hypotheses

The three null hypotheses formulated for this study were tested using Spearman's rank correlation coefficient at the 0.05 level of significance. The decision rule applied was that the null hypothesis would be rejected where the p-value was less than 0.05, and retained where the p-value was greater than or equal to 0.05.

Hypothesis One

H01: Supplier integration has no significant relationship with on-site material handling in the fertilizer production industry in Rivers State.

Table 3: Spearman's Correlation on Supplier integration and on-site material handling

		Supplier integration	on-site material handling
Spearman's rho	Supplier integration		
	Correlation Coefficient	1.000	0.597**
	Sig. (2-tailed)	.	.000
	N	142	142
	on-site material handling		
	Correlation Coefficient	0.597**	1.000
	Sig. (2-tailed)	.000	.
	N	142	142

The Spearman's rank correlation result (Table 3) yields a coefficient of rho = 0.597, p = 0.000 ($p < 0.05$), indicating a positive and statistically significant relationship between supplier integration and on-site material handling. As such, the null hypothesis (H01) is rejected, and it is concluded that supplier integration has a significant positive relationship with on-site material handling in the fertilizer production industry in Rivers State. This moderately strong coefficient suggests that the closer the alignment between the firm and its key suppliers in terms of delivery scheduling, material specification, and operational communication, the more efficiently the plant-level handling system is able to receive, store, and transfer incoming materials across the production stages.

Hypothesis Two

H02: Internal procurement integration has no significant relationship with on-site material handling in the fertilizer production industry in Rivers State.

Table 4: Spearman's Correlation on Supplier integration and on-site material handling

		Internal procurement integration	on-site material handling
Spearman's rho	Internal procurement integration		
	Correlation Coefficient	1.000	0.623**
	Sig. (2-tailed)	.	.000
	N	142	142
	on-site material handling		
	Correlation Coefficient	0.623**	1.000
	Sig. (2-tailed)	.000	.
	N	142	142

The result (Table 4) shows a correlation coefficient of rho = 0.623, p = 0.000 ($p < 0.05$), indicating a positive and statistically significant relationship between internal procurement integration and on-site material handling, and the strongest association recorded among the three hypotheses tested. The null hypothesis (H02) is therefore rejected, and it is concluded that internal procurement integration has a significant positive relationship with on-site material handling in the fertilizer production industry in Rivers State. Our findings revealed internal integration exerts a stronger direct effect on production and operational performance than external integration alone, suggesting that the coordination of procurement with production, warehouse, and safety functions within the firm is the most influential driver of handling efficiency among the three integration dimensions examined.

Hypothesis Three

H03: Information integration has no significant relationship with on-site material handling in the fertilizer production industry in Rivers State.

Table 5: Spearman's Correlation on Supplier integration and on-site material handling

		Information integration	on-site material handling
Spearman's rho	Information integration		
	Correlation Coefficient	1.000	0.578**
	Sig. (2-tailed)	.	.000
	N	142	142
	on-site material handling		
	Correlation Coefficient	0.578**	1.000
	Sig. (2-tailed)	.000	.
	N	142	142

The Spearman's rank correlation result (Table 5) shows rho = 0.578, p = 0.000 ($p < 0.05$), indicating a positive and statistically significant, though comparatively the weakest, relationship between information integration and on-site material handling. The null hypothesis (H03) is rejected, and it is concluded that information integration has a significant positive relationship with on-site material handling in the fertilizer production industry in Rivers State. The relatively lower coefficient, compared with the other two integration dimensions, may reflect the finding that information systems infrastructure varied considerably across the sampled firms, as suggested by the higher standard deviation recorded for this variable, such that the potential contribution of information integration to handling efficiency is not yet being fully realised across the sector.

Discussion of Findings

The finding that internal procurement integration has the strongest significant relationship with on-site material handling (rho = 0.623) is consistent with Flynn et al. (2010), who reported that internal integration dimensions exhibited stronger direct effects on operational performance than external integration dimensions. It was observed that this result aligns with Supply Chain Integration Theory, which posits that the synchronisation of procurement with production, warehouse, and safety functions within the firm is foundational to the efficiency of plant-level operations, since externally procured materials can only be handled effectively on-site if internal departments have coordinated their receiving, storage, and transfer preparations in advance of delivery (Stevens, 1989). The practical implication is that internal coordination failures between procurement and production represent the most significant integration gap undermining on-site handling efficiency in the fertilizer production firms examined.

The significant relationship between supplier integration and on-site material handling (rho = 0.597) corroborates the findings of Frohlich and Westbrook (2001) and Zhao et al. (2011), both of whom found that upstream supplier alignment was positively associated with operational performance outcomes. As such, this finding supports the argument that, in a bulk and hazardous material environment such as fertilizer production, supplier integration reduces on-site handling disruptions by ensuring that materials arrive with accurate documentation, in conforming specification, and in quantities aligned with the plant's receiving and storage capacity, thereby enabling handling teams to plan and execute receiving operations efficiently rather than responding reactively to non-conforming or unanticipated deliveries.

The finding that information integration, while significant, recorded the weakest relationship with on-site material handling (rho = 0.578) is consistent with the argument advanced by Li et al. (2005) that the contribution of information sharing to performance is moderated by the quality and consistency of the information systems through which that sharing is operationalised. It was observed that the higher standard deviation and comparatively lower mean recorded for information integration in the descriptive results suggest that information systems integration remains underdeveloped relative to relationship-based integration forms in the fertilizer production firms examined, reinforcing the conclusion of Leuschner et al. (2013) that information integration benefits are most fully realised when underpinned by robust, firm-wide information infrastructure rather than ad hoc or partial information sharing arrangements. The implication for the sector is that investment in information systems that link procurement data with plant-level handling operations represents the greatest untapped source of procurement integration value.

5. Conclusion and Recommendations

This study has demonstrated that procurement integration is a significant driver of on-site material handling performance in the fertilizer production industry in Rivers State, with all three dimensions of integrating procurement, namely supplier integration, internal procurement integration, and information integration, maintaining positive and statistically significant relationships with the composite on-site material handling outcome. The findings are grounded in Supply Chain Integration Theory and Transaction Cost Theory and are consistent with prior empirical evidence from both international and Nigerian manufacturing contexts. It is concluded that fertilizer production firms in Rivers State that invest in deepening their procurement integration across all three dimensions are better positioned to improve the efficiency, reliability, and safety of their on-site material handling operations, with internal procurement integration representing the most influential lever and information integration representing the area with the greatest potential for improvement.

Arising from the findings on each of the three hypotheses tested, the following recommendations are made:

i. Based on the finding that supplier integration has a significant positive relationship with on-site material handling (H01), it is recommended that management of fertilizer production firms in Rivers State formalise their supplier engagement practices by establishing joint planning protocols with key raw material suppliers, including shared delivery scheduling, real-time despatch notification and pre-delivery material specification confirmation, so that receiving and handling teams at the plant are adequately prepared for the type, volume and condition of materials arriving on-site, thereby reducing reactive handling, damage risk, and storage misalignment.

ii. Based on the finding that internal procurement integration has the strongest significant relationship with on-site material handling (H02), it is recommended that management invest in structured cross-functional coordination mechanisms between procurement, production, warehouse management and health and safety departments, including regular inter-departmental planning meetings, shared procurement-production scheduling systems, and clearly defined handoff protocols at the point of material receipt.

iii. Based on the finding that information integration has the weakest, though still significant, relationship with on-site material handling (H03), and given the higher variability in information systems practices across the sampled firms. It is recommended that management prioritise investment in compatible information platforms that link procurement activity data, including purchase order status, expected delivery timelines, and material specification records, with plant-level handling systems, so that production and warehouse staff receive timely and accurate advance information about incoming materials. As this will enabling them to pre-configure handling equipment, storage areas and safety arrangements before materials arrive and thereby converting information integration from an underperforming dimension into a strategic driver of handling efficiency.

References

1. Apple, J. M. (1977). Plant layout and material handling (3rd ed.). John Wiley & Sons.
2. Chen, I. J., & Paulraj, A. (2004). Towards a theory of supply chain management: The constructs and measurements. Journal of Operations Management, 22(2), 119–150.

3. Cousins, P. D., & Menguc, B. (2006). The implications of socialization and integration in supply chain management. Journal of Operations Management, 24(5), 604–620.
4. Deng, T., Garg, V., & Bradley, M. S. (2025). Review of Material-Handling Challenges in Energy Production from Biomass and Other Solid Waste Materials. Energies, 18(15), 4194.
5. Flynn, B. B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. Journal of Operations Management, 28(1), 58–71.
6. Frazelle, E. H. (2002). World-class warehousing and material handling. McGraw-Hill.
7. Frohlich, M. T., & Westbrook, R. (2001). Arcs of integration: An international study of supply chain strategies. Journal of Operations Management, 19(2), 185–200.
8. Gimenez, C., & Ventura, E. (2005). Logistics-production, logistics-marketing and external integration: Their impact on performance. International Journal of Operations & Production Management, 25(1), 20–38.
9. Groover, M. P. (2019). Fundamentals of modern manufacturing: Materials, processes, and systems (6th ed.). John Wiley & Sons.
10. Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2–24.
11. Hobbs, J. E. (1996). A transaction cost approach to supply chain management. Supply Chain Management: An International Journal, 1(2), 15-27.
12. Honkala, K. (2024). Procurement process development in a project-based company.
13. Ike, P. N., Ogbuefi, E., Nnabueze, S. B., Olatunde-Thorpe, J., Aifuwa, S. E., Oshoba, T. O., & Akokodaripon, D. (2021). Supplier relationship management strategies fostering innovation, collaboration, and resilience in global supply chain ecosystems. International Journal of Multidisciplinary Evolutionary Research, 2(2), 52-62.
14. Koufteros, X., Vonderembse, M., & Jayaram, J. (2005). Internal and external integration for product development: the contingency effects of uncertainty, equivocality, and platform strategy. Decision sciences, 36(1), 97-133.
15. Leuschner, R., Rogers, D. S., & Charvet, F. F. (2013). A meta-analysis of supply chain integration and firm performance. Journal of Supply Chain Management, 49(2), 34–57.
16. Li, S., Rao, S. S., Ragu-Nathan, T. S., & Ragu-Nathan, B. (2005). Development and validation of a measurement instrument for studying supply chain management practices. Journal of Operations Management, 23(6), 618–641.
17. Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2020). Purchasing and supply chain management (7th ed.). Cengage Learning.
18. Mugenda, O. M., & Mugenda, A. G. (2003). Research methods: Quantitative and qualitative approaches. ACTS Press.
19. Narasimhan, R., & Kim, S. W. (2002). Effect of supply chain integration on the relationship between diversification and performance: Evidence from Japanese and Korean firms. Journal of Operations Management, 20(3), 303–320.
20. Okafor, C. N., & Adeyemi, S. L. (2020). Warehouse management practices and operational efficiency of selected manufacturing firms in Nigeria. Journal of Supply Chain Management Research, 8(2), 45–61.

21. Pagell, M. (2004). Understanding the factors that enable and inhibit the integration of operations, purchasing and logistics. Journal of Operations Management, 22(5), 459–487.
22. Sheskin, D. J. (2011). Handbook of parametric and nonparametric statistical procedures (5th ed.). CRC Press.
23. Stevens, G. C. (1989). Integrating the supply chain. International Journal of Physical Distribution & Materials Management, 19(8), 3–8.
24. Tompkins, J. A., White, J. A., Bozer, Y. A., & Tanchoco, J. M. A. (2010). Facilities planning (4th ed.). John Wiley & Sons.
25. van Weele, A. J. (2018). Purchasing and supply chain management: Analysis, strategy, planning and practice (7th ed.). Cengage Learning.
26. Williamson, O. E. (1985). The economic institutions of capitalism. Free Press.
27. Zhao, X., Huo, B., Selen, W., & Yeung, J. H. Y. (2011). The impact of internal integration and relationship commitment on external integration. Journal of Operations Management, 29(1–2), 17–32.