An Evaluation of Key Material Management Practices and Application on Manufacturing-Based Projects

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Abstract
The study intended to determine the important material management strategies used in the implementation of manufacturing-related projects in Imo State. This study used a descriptive survey design as its inquiry approach, using a multi-stage sampling strategy using Taro Yamane's method to choose the sample size from a population of 1850 practitioners working in some manufacturing project-based enterprises in Imo state. The data collection and survey instrument consisted of a well-structured questionnaire, personal observations, and trips to manufacturing project-based outfits to gather information. Tables and charts were used to illustrate the acquired data based on frequency distribution. The primary objectives were analysed using exploratory factor analysis and mean score ranking in SPSS Statistics version 26.0. According to a study of 249 respondents who were involved in materials management-related activities, the key material management practices used in the execution of manufacturing-based projects are as follows: material planning and forecasting; waste control and management; inventory control; and logistics and transportation. This study suggests that project managers and manufacturing organisations can improve supply chain stability by expanding suppliers, maintaining safety stock for crucial components, and forming long-term partnerships with reliable vendors.

Keyword: *Imo State, Material management, Manufacturing-based projects.*

Introduction

Manufacturing organisations face ongoing pressure to optimise their processes due to globalisation, competitive markets, and rising demand for high-quality products at low costs. As a result, material management has progressed from a simple logistics role to a critical component of project and production management (Nwiro, 2026). Modern approaches include demand forecasting, just-in-time delivery, automation, real-time inventory tracking, and lean material handling systems. Despite these developments, many manufacturing projects still face material shortages, excess inventory, inadequate storage conditions, and ineffective procurement processes. An ever-increasing human population has been one of the most significant challenges confronting human society in recent decades (Elemure, 2025), and traditional manufacturing practices have primarily focused on developing solutions that meet humanity's needs while remaining competitive in terms of product quality, timely delivery to market, and innovation. Industrialisation is the primary motor of any advancing economy. Since the discovery of crude oil in Nigeria in the late 1950s, the government has moved its attention away from its booming industrial output base and toward crude oil extraction. This move has not only hampered economic activity but has also increased the unemployment rate. The persistent reliance on a monoeconomic system, as well as the neglect of other sectors such as tourism, mining, and manufacturing, has resulted in widespread poverty, low living

conditions, and rising unemployment. Nigeria, frequently referred to as the "Giant of Africa," is often regarded as a country with immense human and material resources.

In the manufacturing business, the development of industrial energy management systems is supported to achieve green manufacturing (Yonemoto & Suwa, 2020), which aims to optimise raw material procurement as well as energy supply and consumption to reduce production costs and CO2 emissions. In order to respond to today's intensely competitive environment and to obtain high product variety and customisation, along with short product life cycles, by catering the needs of the above-mentioned requirements (Varela, Putnik, Manupati, Rajyalakshmi, Trojanowska & Machado, 2018), a shift of the manufacturing and management paradigms from deterministic to a more rigorous, autonomous, and dynamically adaptive control based on a flexible and agile manufacturing system. Successive Nigerian administrations have attempted to revitalise the manufacturing industry by injecting direct funds into the sector through the Central Bank's bailout funds, developing and implementing diversification policies to shift the focus from crude oil to production activities, and liberalising immigration laws to attract foreign direct investments (Adeleke, 2014; Nwiro, 2026). However, the sector continues to function poorly due to high production costs, low value-added products, capacity underutilisation, large job cutbacks, and low employment levels. Furthermore, little attention has been paid to the crucial success variables that determine the efficacy of these techniques. Without this understanding, organisations may continue to install inefficient systems that impede project success; thus, this research tries to overcome this gap. The primary goal of this research is to investigate existing material management procedures in manufacturing-based projects in Imo state.

Literature Review

A variety of procedures, including casting, forming, machining, and fabrication, are used to create a completed product that meets the client's specifications. Applying Industry 4.0 technologies improves quality control and reduces costs for such processes, ultimately leading to profitability. To achieve this goal, industrial procedures that leverage data analytics and AI are important for improving product quality and accelerating production. All input variables are guarantyd to be correct and consistent if a consistent and rigorous procedure is used (Nwiro, 2026). According to Duru et al. (2023), the manufacturing industry has made a significant contribution to Nigeria's GDP. Manufacturing accounts for 8% of Nigeria's GDP and generates jobs (Nwiro, 2026). Effective Nigerian manufacturing can absorb a significant amount of the country's growing labour population while cutting unemployment rates. However, the sector has faced challenges such as inadequate infrastructure and a talent shortage, which have hampered its employment potential. Limited foreign direct investment in manufacturing may have aided technology transfer, skill development, and industrial progress. The Nigerian government has lately implemented measures to encourage FDI inflows into the sector, leading in increased investment and expansion. Nigeria's manufacturing sector is diverse, with sub-sectors including food processing, textiles and garments, pharmaceuticals, chemicals, cement, and cars. However, the sector has obstacles such as raw material import dependency, limited access to financing, and high energy costs, all of which have a detrimental impact on entrepreneurial performance (Nwiro, 2026). As the manufacturing industry advances, managers are forced to develop better techniques for guiding their businesses (Ismail, 2016). Typically, new competences can be developed through investment, either internally or through mergers and acquisitions. Improvement is difficult since there are elements that can impede any development effort. Nonetheless, there are numerous reasons to be optimistic, as organisations have the ability to adapt their production methods and increase overall performance.

Nigeria urgently requires industrialisation to advance its manufacturing industry. Industrialisation transforms an extraction-based economy into a manufacturing-based economy. Nigeria has long been an extraction-based economy, since it has been involved in the extraction and exportation of primary products (raw materials). For a long time, activities such as farming, fishing, mining, and animal husbandry dominated Nigeria's economy. Nigeria even exports some of these raw resources, such as palm produce, to nations such as Malaysia, where they are used to make finished goods and then sent back to Nigeria.
Overall, the Nigerian manufacturing industry is in the early phases of adopting lean and green methods. However, as these techniques become more widely accepted, there is significant opportunity to improve efficiency and sustainability.

Concept of material management
Material management is the planning, organization, and control of the flow of materials from their initial acquisition via internal operations to the service point via distribution. Nwiro (2026) define material management as all actions connected to material purchase, storage, handling, inventory control, and distribution that are completed on time and within budget.
The primary material management functions are material planning and eradication, vendor evaluation and selection, purchase, expense, shipping, material acceptance, warehousing and inventory, and material distribution. Improper handling and material handling during construction have an impact on project cost, time, and quality. Key practices for material management in manufacturing projects are:

1. Material Planning and Forecasting
This first phase identifies the specific materials, quantities, and timing needed to satisfy the production schedule. Proper planning helps to avoid material shortages or surpluses, which can result in expensive project delays or high inventory holding costs. Implementing Lean manufacturing requires an excellent planning and control system capable of enhancing overall organisational efficiency through steady forecasting and scheduling (Inuwa, 2024). Planning activities are carried out in response to market demand, and solid supplier relationships will ensure that raw materials are supplied at the appropriate time. Planning and control have a favourable and significant impact on Lean readiness evaluation among humanitarian organisations due to the indirect effect of organisational culture (Inuwa, 2024).

2. Procurement and Sourcing
The process of getting materials from suppliers entails evaluating vendors, purchasing, and guaranteeing timely delivery of the appropriate quality and quantity at a reasonable cost. This function is crucial to material management and has a substantial impact on project performance. Procurement is a critical component of every state's operations. It refers to the purchase of goods and services of the appropriate quality, source, and price to suit a certain need (Njeru, 2015). The level of conformity with procurement legislation, the minimisation of procurement spending, the openness and accountability of procurement funds, and the quality of bought goods and services all contribute to the effective execution of procurement procedures.

3. Logistics and Transportation
Logistics personnel move materials and goods from warehouses to manufacturing workstations, ensuring adequate quantity and quality (Sulírová et al. 2017). The customer demands an even wider choice of items; therefore, it is vital to set up the production system properly and synchronise the logistics accordingly. This includes the actual movement of materials, such as external transportation to the plant and internal distribution on-site. Efficient logistics planning is critical for ensuring products arrive on schedule and without damage.

Efficient logistics integration and strategic information exchange improve delivery performance, shorten lead times, and boost reliability. Timely delivery increases customer satisfaction and repeat business, which boosts financial performance (Obiri-Yeboah, Amoatey, Ottou, & Yirenkyi-Fianko, 2025). Similarly, information exchange and logistical integration, commonly regarded as core SCM strategies, have had variable effects on performance across studies and circumstances. Obiri-Yeboah et al. (2025) discovered that certain information sharing techniques had no meaningful impact on operational performance in their research of manufacturing organisations.

4. Receiving, Acceptance, and Inspection

Upon delivery, materials must be inspected to verify their quantity, quality, and condition against purchase orders and specifications. This practice helps identify and document damaged or incorrect shipments promptly (Nwiro, 2026).

5. Storage and Inventory Control

Proper warehousing and stock management are vital for protecting supplies from damage, loss, or theft, as well as avoiding stockouts or oversupply. Currently, the trend is to maximise warehouse capacity, which can be accomplished through block storing, horizontal enlargement of the warehouse, or the use of narrow lanes in warehouses. Sulírová et al. (2017) recommend using higher racks or narrowing aisles for dispatching things. It is vital to evaluate the capacity and available area, the quantity of warehouse products and their turnover, and, in terms of pallets, whether each pallet must be accessible, whether full pallets are despatched, and how many pallets there are. An efficient warehouse optimally connects the rack system to the handling machinery. Tracking stock levels, determining safety stock levels, and taking stock on a regular basis are all part of effective inventory control.

Resolving inventory management challenges in SMEs is critical, not only for their long-term viability but also for the region's economic growth. Effective inventory management can save costs, improve service quality, and boost customer happiness (Flores-Cruz & Yañez-Jurado, 2024).

6. Waste Control and Management

Minimising material waste is an important technique for economic savings and environmental compliance. This includes applying waste minimisation strategies, reusing materials whenever possible, and managing waste generation throughout the manufacturing process. According to Elemure (2025), lean manufacturing aims to reduce waste and increase efficiency from the start of manufacturing operations. According to research, a substantial amount of manufacturing-related operations might produce a high percentage (up to 95%) of activities that add no value. As a result, some automotive firms have successfully implemented this production method to improve the efficiency of their everyday operations, resulting in higher quality, more product value, better customer service, and increased profitability. Despite this, numerous organisations have failed to implement lean manufacturing. Studies (Elemure, 2025) show that lean manufacturing helps to improve operational procedures while guaranteeing that the quality of both the product and the service fulfils consumer expectations.

7. Quality Assurance

Quality is critical to a company's long-term viability and competitiveness in the face of increased commercial competition (Salma & Purnawati, 2025). In the manufacturing business, quality is more than just a measure of customer happiness; it also reflects process efficiency and the success of company strategies.

Quality control enables businesses to ensure that their products meet criteria and specifications, hence increasing customer satisfaction and brand reputation (Lario, Mateos, Psarommatis, & Ortiz, 2024). Every decade, the burden on products to meet customer quality requirements increases, resulting in significant human expenditures for inspections and no value-adding activity. Ensuring that the materials used fulfil the necessary quality standards is critical to the end product's quality and overall project success. Quality Assurance (QA) is a program that covers the tasks required to ensure quality work that meets project criteria. (QA) include developing project-specific rules, methods, standards, training, guides, and systems required to produce quality. The design professional and constructor are in charge of creating a suitable program for each project. (QA) protects against quality concerns by providing early warning of impending trouble. Early warnings are critical for preventing both internal and external problems.

8. Procurement planning

Procurement is a critical component of every state's operations. It refers to the purchase of goods and services of the appropriate quality, source, and price to suit a certain need (Njeru, 2015). It entails estimating demand, evaluating suppliers, and planning material purchases.

Procurement planning entails determining what needs to be procured (as determined by a Needs Assessment), how the organization's needs can be best met, the scope of the goods, works, or services required, the procurement strategies or methods to be used, time frames, and accountability for the entire procurement process (Muberarugo & Madichie, 2023). It does require determining what needs to be obtained, when, how, and by whom.

A well-designed and implemented procurement policy is critical in providing a foundation for implementing effective procurement processes (Njeru 2015).

Procurement planning is supported and encouraged by project management experts and government departments because failure to do so can result in dissatisfaction and time-consuming detours; and its absence is usually the causal factor identified when auditing the entrails of what went wrong in the procurement process experts and government departments (Chepngetich, 2018).

9. Inventory control

Businesses are always looking for the right amount of goods at the right moment and within the right timeframe. In today's global and volatile environment, good inventory management is critical for success, both strategically and tactically. Although just-in-time inventory is the ultimate goal of any inventory planning process, it is not achievable, particularly in the ETO industry, where decoupling begins at the design stage (Nwiro, 2026).

Inventories are stocks of raw materials, work in progress, finished goods, and supplies kept by a business to aid production processes (Nwiro, 2026). Inventory management is involved with maintaining stock levels of a certain group of items with the goal of minimising inventory handling and ordering expenses while also meeting other relevant management aims and objectives. They represent things that have been accumulated for sale, are now being manufactured, or are materials that have yet to be used.

Inventory management and control is the use of data gathering, demand and forecasting, lean and operational concepts to manage the overall amount of inventory in the supply chain at any given time while also controlling inventory holding costs (Njeru, 2015; Nwiro, 2026).

10 Storage and warehousing

Storage and warehousing include material classification, labelling, shelf-life management, and preservation methods. To be successful, today's manufacturing enterprises must seek out inventive ways to increase competitiveness. Two prominent techniques to increasing

competitiveness are the implementation of a Product-Service System (PSS) and an inventory control system (Ismail, 2016). The current trend is to maximise warehouse capacity by methods such as block storing, horizontal extension, and narrow aisles (Sulírová et al. 2017). If any things need to be dispatched, upward racks or aisle narrowing are required. It is vital to evaluate the capacity and available area, the quantity of warehouse products and their turnover, and, in terms of pallets, whether each pallet must be accessible, whether full pallets are despatched, and how many pallets there are. An efficient warehouse optimally connects the rack system to the handling machinery.

11 Material handling

Refers to methods for efficiently conveying and distributing commodities along production lines. Many manufacturing processes rely heavily on material handling techniques. As a result, the study and design of efficient systems has been a topic of ongoing research (Sagar, Zlatanov, Zoppi, Nattero, & Sreekumar, 2016). Although conventional MHSs for equipment movement and transfer are still significant, there is growing interest in agent-based flexible material handling systems. This strategy relies on the utilisation of robots and manipulators, whose coordination and mobility contribute to flexibility.

Material handling is an important variable expense that is often overlooked by enterprises. It is extremely inefficient in warehouses. It accounts for 55% of plant floor space, 25% of personnel, and up to 70% of total material costs. It adds up to a significant expense that industries must face. It can be fixed by automating certain operations. Efficient material handling has an impact on a wide range of plant KPIs. Effective material handling leads to improved material distribution to cells on the assembly line, which means that the packaging and shipping line is not overburdened at the end of the day. Automation can replenish workstations faster by delivering the correct stuff at the right time to the right spot, guaranteeing that the worker does not have to leave their cell to conduct such a tedious task (Ammar et al., 2021).

12 Technology integration (smart manufacturing)

Smart manufacturing is the application of emerging technology to manufacturing assets to create an integrable, autonomous, and resilient environment that is sensitive to changing consumer expectations (Parhi, Joshi, & Akarte, 2021).

Smart manufacturing combines current and future production assets with sensors, computing platforms, communication technologies, data-intensive modelling, control, simulation, and predictive engineering. Smart manufacturing draws on cyber-physical systems, the internet of things (and everything), cloud computing, service-oriented computing, artificial intelligence, and data science (Kusiak, 2018). Use ERP (Enterprise Resource Planning), RFID, barcoding, and warehouse automation solutions to increase tracking and coordination. Smart manufacturing is a popular word for describing future production. The number of publications about smart manufacturing is rapidly increasing (Kusiak, 2018). Many publications provide in-depth coverage of the issues that influence smart manufacturing.

Industry 4.0 technologies are now widely employed throughout the world. These technologies have enormous promise and have caused significant changes in nearly every industry. In Industry 4.0, the integration of information technology and operations technology resulted in new digital solutions and advanced technologies such as additive manufacturing, advanced robotics, augmented and virtual reality, big data, cloud computing, and the internet of things (IoT), which created a cyber-physical environment. Additive manufacturing significantly advances the research and development process. Industry 4.0 can have an impact on entire production processes due to significant advancements in digitisation and technologies such as the internet of things (IoT), artificial intelligence (AI), and so on (Nwiro, 2026). The integration

of these technologies with existing systems and processes across the value and supply chain has resulted in a digital revolution of the industrial sector.

Methodology

This section describes the methodology utilised to conduct the study. It describes the research design, study population, sample methodology, data gathering instruments, and data analysis processes. The chapter ensures that the techniques are logical, systematic, and consistent with the study's objectives. Elemure (2025) defines research as an activity in which people systematically acquire information. It entails thorough inquiry or examination, with a special emphasis on studying or experimenting in order to discover and interpret facts, review established theories or laws in light of new data, or practically apply newly discovered or changed theories or laws. This study used a descriptive survey design. This design is appropriate for gathering data from a sample population with the goal of describing current material management techniques and their influence on productivity in manufacturing-based projects. This design was chosen based on the requirement to collect quantitative and qualitative data from project and operations workers at selected industrial enterprises in Imo state. The term "population" refers to a group of species in a community that have similar traits and have roots in a certain segment (Lakmali, 2022). It may not be necessary to collect responses from each individual in a large community. This study's population consists of people working in material management, procurement, inventory, and production departments in manufacturing organisations. Materials managers, manufacturing supervisors, warehouse people, and procurement officers are among those employed by chosen enterprises in Imo State, Nigeria. According to Lakmali (2022), sampling processes are critical for reducing the amount of data required from the sampled population. Furthermore, a random sample is expected to accurately represent a population (Nwiro, 2026). For this investigation, easy sampling was used. Individuals are chosen depending on their immediate availability. A multi-stage sampling technique was used to guarantee that the sample was representative. First, the purposive sample technique was utilised to choose five (5) significant industrial and project hubs in Imo State that are known for hosting manufacturing-related initiatives. They are located in Owerri Municipal, Nekede, Avu, the Onitsha Road Axis, Egbeda, and other areas of Orlu and Okigwe. This indicated that the research is focused on settings with similar activities. Second, the stratified random sampling technique was used. The population around these hubs was classified according to the respondents' discipline. This confirmed that each expert group is proportionally represented in the sample. Thirdly, simple random sampling was used. Individual specialists from each specialised stratum were selected using a basic random sampling procedure (e.g., a random number generator on a list of registered professionals). This eliminated selection bias and ensured that every strata affiliate had an equal chance of being selected. In order to estimate a representative sample size from the fixed population of 1,850, the Taro Yamane (1967) approach was utilised, which is appropriate for a determinate population and provides a 95% level of confidence with an accuracy level (e) of 0.05.

The formula is:

$n = N / (1 + N(e)^2)$

Where:

n = sample size

N = population size (1,850)

e = level of precision (0.05)

Calculation:

$n = 1850 / (1 + 1850 (0.05)^2)$

$n = 1850 / (1 + 1850*0.0025)$

$n = 1850 / (1 + 4.625)$

n = 1850 / 5.625
n = 328.88
Therefore, the minimum calculated sample size is 329 respondents. Primary data was used in this study. This information was gathered through the use of structured questionnaires. Secondary data were gathered from journals, textbooks, industry publications, and business papers on material management and productivity. The primary research instrument was a structured questionnaire. The questionnaire included closed-ended questions to collect quantitative data and a few open-ended questions to elicit qualitative observations. The questionnaire was organised into four sections: section A contained demographic information, section B included current material management techniques, and section C discussed the influence of material management on productivity. The final section, D, discusses issues influencing the effectiveness of material management. Responses in parts B-D were rated on a 5-point Likert scale, with 1 representing Strongly Disagree and 5 representing Strongly Agree. Experts in manufacturing project management and operations research evaluated the questionnaire's face and content validity. Adjustments were made in response to their feedback. While the reliability was assessed using a pilot test on 20 responders outside the main sample to determine internal consistency. Cronbach's Alpha was used to compute the reliability coefficient, which resulted in a value of 0.82, indicating high dependability. The data collection methods for this study are surveys and case studies, which will be briefly detailed in the following subsections (Ismail, 2016). Questionnaires, as suggested by Nwiro (2026), were distributed to respondents at manufacturing-based project firms, and the researcher used the 'drop and pick later' technique because they were expected to be busy, and the researcher gave them enough time to complete the questionnaire before coming to collect it. The researcher used other online platforms, such as Google Forms. The acquired data was analysed using descriptive and inferential statistics, as well as the Statistical Package for Social Sciences (SPSS). First, inferential statistics such as exploratory factor analysis and mean score rank were employed to investigate the association between material management techniques and manufacturing-based initiatives. While factor analysis was performed to determine the essential elements driving material management effectiveness.

Results

Current material management practices in manufacturing-based projects

Factor analysis was used in the study to reduce the number of indicators or factors associated with each variable while retaining indicators capable of evaluating the key current material management practices used in the execution of manufacturing-based projects in Imo State. It is interesting to note that factors with loading values greater than 0.5 were maintained and used for further study. Regardless of sample size, variables with loadings greater than 0.5 were typically used for interpretation purposes. This outcome is consistent with previous research that used comparable thresholds. Participants in the survey were asked to rate the extent to which each material management practice was used on a 5-point scale (1 = Very Low Extent, 5 = Very High Extent). These are shown in the table below.

Table 1: KMO and Barlett's Test for current material management practices in manufacturing-based projects

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.653
Bartlett's Test of Sphericity	Approx. Chi-Square	560.120
	df	66

	Sig.	.000

A major component analysis was performed on twelve (12) significant current material management methods used in the execution of manufacturing-based projects in Imo State using IBM SPSS Statistics version 26.0. Prior to this, the data was evaluated to ensure that it was appropriate for analysis. An inspection of the correlation matrix revealed that a significant percentage of the coefficients had values of 0.5 or higher. The Kaiser-Meyer-Olkin (KMO) measure of sample adequacy yielded a value of 0.653. The aforementioned number is within the desired range of 0.6. According to the results in table 1, the Bartlett's test of sphericity provided a value of 560.120, which was statistically significant at the 0.000 level. The Cronbach's alpha rating of 0.847 suggests that the measures and scale have excellent internal consistency and reliability.

Table 2: Communalities for current material management practices in manufacturing-based projects

Communalities		
	Initial	Extraction
Material planning and forecasting	1.000	.781
Procurement and sourcing	1.000	.650
Technology integration (smart manufacturing)	1.000	.896
Receiving, acceptance, and inspection	1.000	.770
Storage and inventory control	1.000	.616
Waste control and management	1.000	.697
Quality assurance	1.000	.623
Procurement planning	1.000	.659
Inventory control	1.000	.645
Storage and warehousing	1.000	.788
Material handling	1.000	.755
Logistics and transportation	1.000	.671
Extraction Method: Principal Component Analysis.		

Table 2 shows that the highest value of the communality was related with technology integration (smart manufacturing) (0.896), while the lowest value was connected with storage and inventory control (0.616). As a result, the derived communalities justify the use of factor analysis with the variables. The data show that all variables match the criteria for further analysis, as none had eigenvalues less than the 0.50 cut-off point.

Table 3: Total variance explained for current material management practices in manufacturing-based projects

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.012	25.097	25.097	3.012	25.097	25.097	1.959	16.323	16.323
2	1.503	12.523	37.620	1.503	12.523	37.620	1.693	14.110	30.433
3	1.252	10.437	48.058	1.252	10.437	48.058	1.593	13.274	43.708
4	1.123	9.362	57.420	1.123	9.362	57.420	1.553	12.941	56.648
5	1.060	8.833	66.254	1.060	8.833	66.254	1.153	9.605	66.254
6	.865	7.206	73.460						
7	.763	6.358	79.818						
8	.665	5.538	85.356						
9	.543	4.527	89.883						
10	.476	3.965	93.848						
11	.444	3.703	97.551						
12	.294	2.449	100.000						
Extraction Method: Principal Component Analysis.									

Table 3 displayed the results of the investigation, which produced a five (5) factor component solution that explained a total variation of 66.2540%. The primary factor represented 25.097% of the variation, succeeded by the secondary factor at 12.523%, the tertiary factor at 10.437%, the quaternary factor at 9.362%, and the concluding fifth factor at 8.833%. The total variation explained exceeds the recommended benchmark of 50%. The designation of the five elements was established according to the factor demonstrating the highest loading inside the cluster.

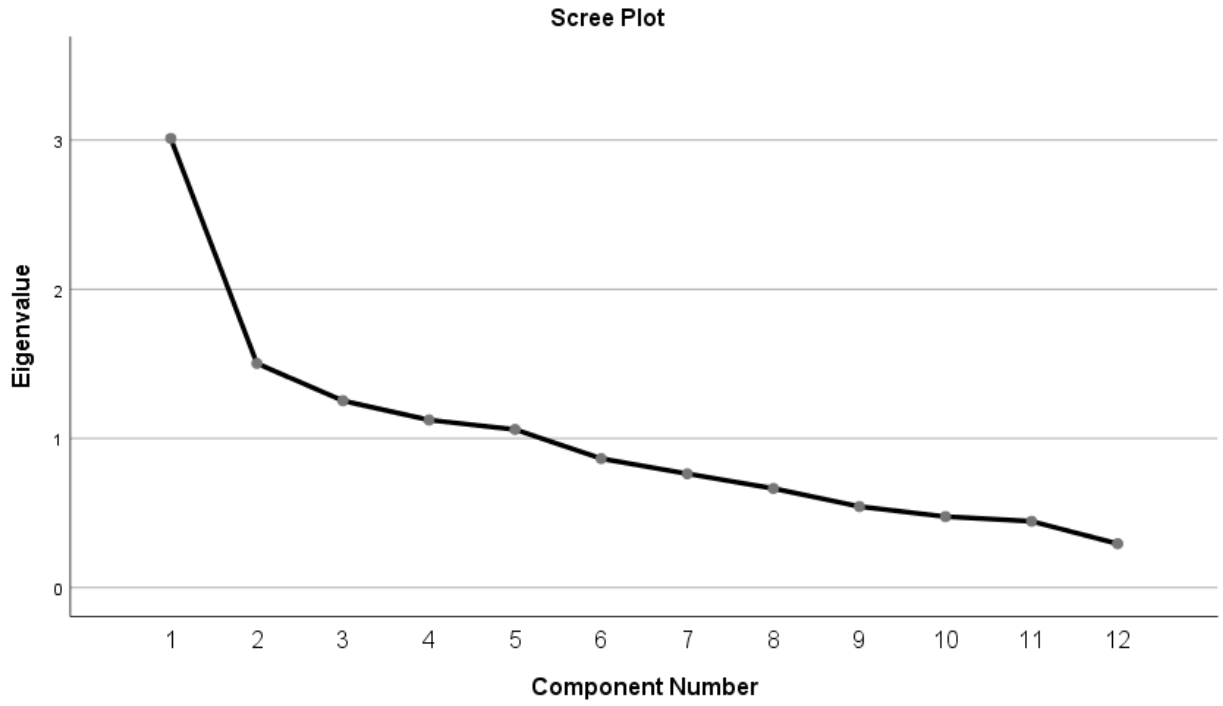


Figure 1: Scree plot for current material management practices in manufacturing-based projects

The responses gathered from the questionnaire scale underwent factor analysis with Varimax rotation. Figure 1 illustrates the scree plot generated from the executed EFA. The report preserves five (5) factors in accordance with Kaiser's criterion, which advises retaining components with eigenvalues exceeding one, and the scree plot shown a substantial decline from the second to the fourth factor. The elements contributed to more than 50% of the overall variance revealed.

Table 4: Component matrix for current material management practices in manufacturing-based projects

Component Matrix[a]					
	Component				
	1	2	3	4	5
Material Planning and Forecasting	.705				
Procurement and Sourcing	.652				
Technology integration (smart manufacturing)	.620				

Receiving, Acceptance, and Inspection	.581				
Storage and Inventory Control	.568				
Waste Control and Management		.733			
Quality Assurance		.729			
Procurement planning		.720			
Inventory control			.743		
Storage and warehousing			.714		
Material handling				.651	
Logistics and Transportation					.654
Extraction Method: Principal Component Analysis.					
a. 5 components extracted.					

The rotated component matrix displayed in table 4 indicates the presence of five (5) unique components, with each variable predominantly linked to one factor (component). The results suggest that specific elements may operate as the fundamental underlying essential material management strategies utilised in the implementation of industrial projects in Imo State. Five (5) material management techniques (elements) were recognised for component one, which encompass: material planning and forecasting; procurement and sourcing; technological integration (intelligent manufacturing); receiving, acceptance, and inspection; and storage and inventory management. In the second element, three (3) aspects were recognised, which encompass waste control and management, quality assurance, and procurement planning. In the third element, two (2) variables were recognised. They encompass inventory management, as well as storage and warehousing. In the fourth element, a single factor was loaded. It encompasses material handling. In the fifth component, a single element was identified, encompassing logistics and transportation. The numerical figures contained therein denote the factor loadings that exceed the 0.5 criterion in table 4.

Table 5: Extent of Application of Material Management Practices

Material Management Practice	**Mean Score ($\bar{X}$)**	**Standard Deviation (SD)**	**Rank**
Material Planning & Scheduling			
Detailed material planning prior to project start	3.15	1.24	7th
Tie to master schedule	2.98	1.31	9th
Updating system for materials plan	2.81	1.28	11th
Technology integration (smart manufacturing)			
Composite Mean for Planning	**2.98**		

Procurement & Sourcing			
Supplier selection based on quality vs. price	2.65	1.41	13th
Lead time management	2.52	1.38	14th
Long-term relationships with suppliers	2.31	1.29	15th
Composite Mean for Procurement	**2.49**		
Inventory Control & Management			
Maintaining optimum inventory levels	3.22	1.18	6th
Use of inventory control techniques	3.05	1.33	8th
Standard procedure to issue material	3.41	1.22	4th
Composite Mean for Inventory	**3.23**		
Storage & Warehousing			
Secure storage of items	3.85	1.05	2nd
Storage plan for the site	3.45	1.19	3rd
Regular checks to prevent damage/theft	3.95	0.98	1st
Composite Mean for Storage	**3.75**		
Material Handling & Distribution			
Use of suitable handling equipment	3.28	1.27	5th
Workface delivery	2.92	1.36	10th
System eliminates double-handling	2.74	1.40	12th
Composite Mean for Handling	**2.98**		

The findings suggest that material management methods are executed at both moderate and minimal levels. The predominant applications pertain to Storage & Warehousing (Composite $\bar{X}$=3.75). The most crucial, proactive components of SCM are few. Procurement and Sourcing exhibit the lowest performance (Composite $\bar{X}$=2.49), characterised by a focus on cost minimisation ($\bar{X}$=2.65) and minimal engagement in long-term partnerships ($\bar{X}$=2.31).

Discussions

The research identified that the principal material management strategies utilised in manufacturing projects are, ranked by significance: material planning and forecasting, waste control and management, inventory oversight, and logistics and transportation. The findings of this research correspond with the Economic Order Quantity (EOQ) model and Systems Theory, both of which

highlight that an effective material flow—from forecasting to final delivery—is crucial for operational success. The significance of material planning and forecasting as a primary practice aligns with the findings of Yıldız, Güneş, and Kıvrak (2024), who concurred that material management practices—encompassing planning, supply, logistics, transportation, inventory, and waste management—have a direct effect on project performance metrics like cost, time, quality, and efficiency in construction and manufacturing settings. Their investigation focused on industry workers at various construction locations, and they concurred that the management of material supply, handling, and inventory positively impacts overall project outcomes.

The discovery about trash regulation and management as a crucial practice is very significant. A research conducted by Adeyemi (2025) demonstrated that proficient material management, which includes planning, control, and handling, is essential for reorganising operations and reducing waste, with results indicating a significant positive relationship between effective material management and enhanced organisational productivity. This Nigerian-centric research offers contextually relevant confirmation of the significance of waste management within the local manufacturing environment (Nwiro, 2026). Additionally, the Materials Management Operations Guideline (MMOG/LE), an international benchmark for evaluating supply chain management procedures, indicates substantial advantages from comprehensive material management strategies, such as inventory reductions of 15–60 percent, an 85 percent decrease in premium freight expenses, and an 80 percent decline in obsolete materials. These industry standards underscore the potential effects of the practices recognised in this research when implemented effectively.

The significance of inventory management corresponds with the foundational principle of the EOQ model, which asserts that optimal order quantities reduce overall inventory expenses. Babai et al. (2012) emphasised that effective inventory management, especially for consistent demand, is crucial for reducing the risk of obsolescence and maintaining operational efficiency.

Conclusion and Recommendations

The research reveals that the most prevalent material management strategies currently being used in the execution of industrial projects in Imo State include material planning and forecasting, waste control and management, inventory control and logistics and transportation in this order. Based on the findings, the following suggestions are made: The need for project managers and manufacturing firms to make supply chain more resilient, with a more diverse supplier base, safety stocks of critical supplies and long-term partnerships with trusted vendors. Investing in technological infrastructure and equipment, including inventory management software, real-time tracking systems (including RFID and bar coding), and digital dashboards to monitor schedules and costs is essential.

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