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Material Management Practices and Operational Efficiency in the Nigerian Manufacturing Industry

[1]Nwibere, Barinedum Michael & [2]Needorn, Richard Sorle
[1&2]University of Port Harcourt

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Abstract

The study examined the correlation between Material Management Practices (MMP) and Operational Efficiency (OE) in the Nigerian manufacturing industry. A sample of one hundred and forty-five (145) managers and supervisors from twenty (14) purposively drawn manufacturing organisations was used. The study employed the quasi-experimental research design and adopted a cross-sectional survey for data collection. The Statistical Package for Social Sciences (SPSS) Version 25 was utilised for data analysis, employing structural equation modelling (SEM) through the AMOS package. The findings indicate a positive and significant correlation between material management practices (MMP) and operational efficiency (OE) in the Nigerian manufacturing industry. Specifically, the study found a positive and significant correlation between the dimensions of material management practices (Economic Order Quantity, reorder level, and reorder quantity, respectively) and operational efficiency measures (profitability, output, and delivery time/speed, respectively). Similarly, the study also found that technology significantly moderates the relationship between material management practices and operational efficiency in the Nigerian manufacturing industry. Based on these findings, the study concludes that material management practices significantly enhance operational efficiency in the Nigerian manufacturing industry. Specifically, the study concludes that Economic Order Quantity, reorder level, and reorder quantity respectively play significant roles in enhancing profitability, output, and delivery time/speed respectively in the Nigerian manufacturing industry. Similarly, the study also concludes that technology plays a significant moderating role in the relationship between material management practices and operational efficiency in the Nigerian manufacturing industry. The theoretical and managerial implications of these findings were also discussed.

Keywords: *Material Management Practices, Economic Order Quantity, Re-Order Level, Order Quantity, Operational Efficiency, Profitability, Output, Delivery Timely/Speed, Strategic Choice Theory, Structural Equation Modelling*

Corresponding Author: Nwibere, Barinedum Michael

Background to the Study

Context of the Problem

It has been argued that organisations are entities that seek efficiency (Pfizer, 1985). As understood by engineering and management experts, efficiency pertains to the successful execution of relevant actions or "doing things right." At the same time, effectiveness refers to selecting optimal actions or "doing the right thing." In this sense, a firm is considered effective if it identifies appropriate strategic goals and efficient if it accomplishes them using minimal resources (Ayeni & Afolabi, 2012). Operational efficiency, which involves delivering products and services cost-effectively without compromising quality, encompasses a range of methods and techniques aimed at achieving the fundamental objective of providing quality goods and services to clients in the most cost-effective and timely manner (Neil, 2019). Moreover, operational efficiency can be defined as an organisation's ability to minimise undesired outcomes and maximise the utilisation of assets to offer clients superior goods and services (Ghosh & Sanyal, 2019). Enhanced operational efficiency significantly contributes to shareholder wealth, business growth, profitability, and customer satisfaction. It facilitates the enhancement of internal business processes and other endeavours to promote and enhance the organisation's innovation and creativity (Bayo-Moriones & Merino-Díaz de Cerio, 2002). Additional benefits encompass cost reduction, flexibility, and improved quality. Ultimately, satisfactory operational efficiency can lead to increased future economic gains for organisations and their stakeholders (Islami, 2022).

Consequent to the significant contribution of efficiency to organisations from various stakeholders' perspectives, a multitude of empirical studies from diverse disciplinary backgrounds, contexts, and factors have proposed strategies to enhance organisational efficiency. Coordination, improved technology, and organisational structure have been recognised as vital for optimising efficiency (Filley & Aldag, 1980). Additionally, it has been argued that a manager's ability to assess the environment for threats and opportunities, establish productive partnerships with employees, and provide high-quality services to customers contributes to organisational efficiency (Garnsey et al., 2006). Hisatomi (1990) emphasizes the importance of doing things right the first time at minimal cost when considering factors that enhance organisational efficiency. This suggests that organisations aspiring for growth should strive to improve efficiency, effectiveness, reputation, and market share.

Historically, materials management has been challenging due to the issues of excessive inventory with inadequate or insufficient inventory with excessive management, both of which incur severe penalties. According to Lysons (2016), materials management involves controlling stock and inventory levels with the physical distribution function to balance, minimise stock holdings, and maximise handling costs. The problem of materials (inventories) arose with technological advancements, which enabled organisations to produce goods in larger quantities faster and with multiple designs. Ahn (2014) suggests that material control is essential for leveraging organisational productivity and overall performance. It encompasses procurement, utilisation, control, and coordination of available materials. Inventory control focuses on acquiring suitable materials in the correct quantity

and quality at the right place and time and is directly tied to an organisation's production function. Thus, the material management system employed can significantly impact an organisation's profitability, directly or indirectly. Inventories represent the stock of raw materials, work in progress, and finished goods held by a business organisation to facilitate production operations. Failure to efficiently manage materials can lead to profitability issues. The primary goal of material management is to provide the necessary materials for sustaining operations at minimum costs.

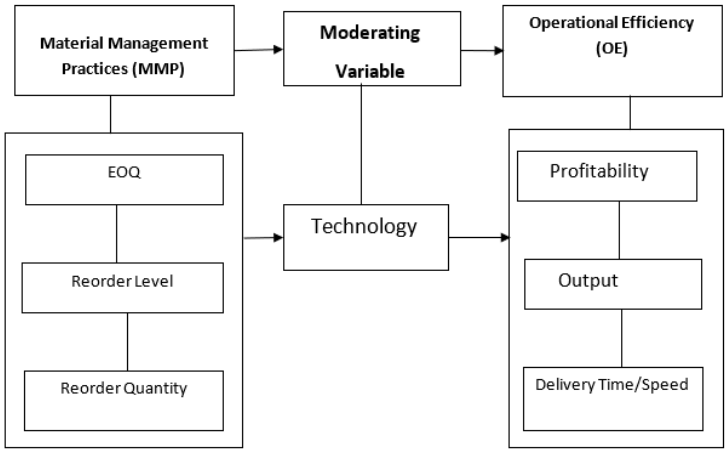
As Anichebe and Agu (2013) highlighted, materials or inventory are critical to the successful functioning of manufacturing and retailing organisations, encompassing raw materials, work in progress, spare parts/consumables, and finished goods. Effective inventory management is crucial, considering that a substantial portion of a firm's funds is invested in them. Every company must ensure that inventory is maintained at desirable levels to avoid the negative impacts of excessive or insufficient stocks on profitability. Kotabo (2002) argues that proper material control requires an organisation to undertake stock valuation using appropriate methods to prevent underestimation or overestimation of profits. Biderman (2004) asserts the significance of material management for almost every type of business, as it ensures the right quality and quantity of materials in the appropriate place and at the correct time, while optimising investment. Donald (2009) further argues that the material management system helps firms manage the flow of raw materials and semi-finished products, facilitating effective material management by coordinating various activities and increasing demand, supply, and customer satisfaction. As emphasised by Lewis (2014), material or inventory management has become a critical concern that requires careful attention in modern organisations to ensure the availability of necessary materials for seamless production processes.

Based on the preceding discussion, it is evident that numerous studies have focused on material management practices and operational efficiency. However, the existing literature reviewed thus far reveals that scholars' perspectives and prescriptions are often rooted in their disciplinary backgrounds, sometimes being static, restrictive, and traditional. While acknowledging the value of their recommendations, this study argues that these prescriptions may not align with the needs of contemporary organisations facing rapid change. Therefore, this research investigates how material management can enhance organisational efficiency. Notably, previous studies, such as those of Daniel (2019) and Asaolu et al. (2012), focus primarily on the profitability of the organisation, Akinola et al. (2019) explore the issues of financial performance, and Ramakrishna (2005) centre on minimising material costs. However, with expectations, experiences, competitive factors, and core competencies continuously evolving, exploring better approaches and models for enhancing or sustaining efficiency is essential. Thus, this study seeks to examine the role of material management as a catalyst for operational efficiency in Nigerian manufacturing firms, offering a fresh perspective and potentially uncovering new strategies for enhancing efficiency in the field.

Conceptual Framework

The conceptual framework for this study is presented below:

Figure 1: Conceptual Framework Showing the Hypothesized Relationship between Materials Management and Operational Efficiency in the Nigerian Manufacturing Industry.



Source: Conceptualized by the Researchers

The present study focuses on materials management as the independent variable. The dimensions of materials management were derived from the studies of Sophia (2019) and Cooper (2006), and the measures were obtained from the research conducted by Megeid, Abd Elmegeed, and Reid (2020).

This study aims to explore the correlation between material management and operational efficiency in the manufacturing industry of Nigeria, with the ultimate goal of improving organisational efficiency. Based on the comprehensive literature review of the dimensions and measures of both the predictor and criterion variables, which together form the core subject of this research, the following hypotheses were formulated to guide the statistical analysis:

Ho_1: There is no significant relationship between economic order quantity and profitability of manufacturing firms in Nigeria.

Ho_2: There is no significant relationship between economic order quantity and the output of manufacturing firms in Nigeria.

Ho_3: There is no significant relationship between economic order quantity and delivery time/speed of manufacturing firms in Nigeria.

Ho_4: There is no significant relationship between re-order level and profitability of manufacturing firms in Nigeria.

Ho_5: There is no significant relationship between the re-order level and the output of manufacturing firms in Nigeria.

Ho_6: There is no significant relationship between re-order level and delivery time/speed of manufacturing firms in Nigeria.

Ho_7: There is no significant relationship between re-order quantity and profitability of manufacturing firms in Nigeria.

Ho_8: There is no significant relationship between re-order quantity and output of manufacturing firms in Nigeria.

Ho_9: There is no significant relationship between re-order quantity and delivery time/speed of manufacturing firms in Nigeria.

Ho_{10}: Technology does not significantly moderate the relationship between material management and the operational efficiency of manufacturing firms in Nigeria.

Review of Related Literature

Theoretical Framework: Strategic Choice Theory

Strategic Choice Theory

The strategic choice theory examines the relationship between management decisions and firm performance, as well as the interactions between a firm's internal and external environment (Child, 2016). This theory emphasizes the significant impact of management decisions on firm performance. Michelson (2013) developed a strategic choice model that demonstrates the interdependence between the environment, organisational actions, and overall business performance. The model places a focus on achieving higher performance to improve efficiency, especially when faced with limited resources. When making decisions to enhance organisational performance, managers consider various material management techniques. This research study aims to provide insights into the inventory management techniques chosen by managers in order to improve the organisational performance of consumer goods manufacturing firms, specifically in terms of profitability, quality, efficiency, optimal production, production targets, and on-time delivery.

The strategic choice theory highlights the role of leaders or leading groups in influencing organisations through the process of making choices in a dynamic political context (Child & John, 1997). Strategic choice theory offers an alternative perspective that emphasizes the agency of individuals and groups within organisations to make choices that may serve their own interests and dynamically shape the development of those organisations. The roots of the Strategic Choice Theory can be traced back to the research conducted by Alfred Chandler in 1962, which focused on the relationship between organisational strategy and structure. Strategic Choice Theory is relevant to material management because managers must make choices and decisions regarding inventory/material usage in order to achieve optimum profitability for the organisation.

Material Management

There have been numerous definitions of materials management in the academic literature. Sundararajan and Shanmugapriya (2014) define materials management as an organising function responsible for planning, procuring, storing, receiving, and distributing materials. Arnold and Chapman (2004) define it as controlling the flow of materials. Materials Management encompasses all operations management functions, from purchasing raw materials through the production processes to the final delivery of the end products. It combines the management responsibility for determining the manufacturing requirement, scheduling the manufacturing processes, and procuring, storing, and dispensing materials (Wild, 1995; Ondiek, 2009). Ballot (1971) defines materials management as planning,

acquiring, storing, moving, and controlling materials to use facilities, personnel, resources, and capital effectively. Tersine and Campbell (1977) state that materials management is a process that provides suitable materials at the right place and time to maintain a desired production level at a minimum cost. Beekman-Love (1978) indicates that a materials management structure should be organised to allow for integral planning and coordination of the flow of materials, to use the resources optimally, and to minimise costs.

Materials Management gained attention with the advent of liberalisation and globalisation, which brought intense competition to the business environment. Previously, it was regarded as a Cost Centre since the Purchasing Department was spending money on materials. At the same time, the Store held a significant inventory of materials, tying up money and space (Ramakrishna, 2005). With the process of liberalisation, the market underwent drastic changes, compelling manufacturing companies to develop strategies to minimise production costs and maintain competitiveness. Since then, Materials Management has been acknowledged as a source of opportunities to reduce production costs and can be considered as a Profit Centre. Today, the market environment is witnessing dramatic evolutions, and every organisation must strive to remain in business. The primary competition has shifted from the market to the production floor, where manufacturing costs can be reduced and profitability enhanced to enable firms to compete effectively. The dimensions of this shift are discussed below.

i. **Economic Order Quantity:** Economic Order Quantity, also known as economic batch quantity, refers to the optimal amount of goods to be ordered. It strikes a balance between holding costs (costs associated with keeping inventory) and reorder costs (costs associated with placing a new order). By determining the right order quantity, a company can minimise costs and avoid stockouts.

ii. **Re-Order Level:** The re-order level is the point at which an organisation needs to replenish its stock. It is determined by considering factors such as lead time (the time it takes for an order to be delivered) and demand (the customer's need for the product). The re-order level varies depending on the demand during the lead time. If the demand or demand during the lead time is high, the re-order level will be higher, and vice versa.

iii. **Order Quantity:** Order quantity refers to the amount of stock that a company orders in each batch. The decision on order quantity is strategic and depends on various factors, including consumption patterns and cost implications. Nigerian Manufacturing organisations must carefully consider the quantity they order, as it can have significant cost implications, particularly in terms of holding costs. The specific order quantity may be dictated by the organisation's policies.

Operational Efficiency

Operational efficiency encompasses the methods and techniques employed to deliver high-quality products and services to customers in a cost-effective and timely manner (Neil, 2019). Researchers commonly identify asset utilisation, production, distribution, and inventory

management as critical dimensions of operational efficiency. This concept also refers to an organisation's ability to minimise waste and maximise resource utilisation to meet customer expectations (Ghosh & Sanyal, 2019). Neil (2019) describes operational efficiency as the various techniques and strategies adopted to deliver quality goods and services to customers in a cost-effective and efficient manner.

Achieving operational efficiency often involves optimizing core business processes to effectively respond to dynamic market conditions in a cost-effective manner (Vangie, 2019). The concept of efficiency is discussed in manufacturing and strategic management literature as a combination of firm-specific factors such as management skills, innovation, cost control, and market share, all of which contribute to a firm's current performance and sustainability. Based on the perspectives of Kalluru and Bhat (2009), operational efficiency refers to an organisation's ability to reduce waste and enhance resource utilisation in delivering quality goods and services to customers. The measures utilized in this study are further discussed below.

Profitability

Maximizing profit is a fundamental objective for a firm to sustain its business operations and withstand competition from similar industry players (Odusanya et al., 2018). It is a crucial prerequisite for the long-term survival and success of a firm, as well as a vital condition for achieving other financial goals of a business entity (Gitman & Zutter, 2012). Profitability serves as a core measure of a firm's performance and plays a critical role in its financial reporting. It signifies the firm's ability to generate earnings in relation to its sales, assets, and capital over a specific period (Margaretha & Supartika, 2016).

As a result, debates surrounding firms' profitability and strategies for enhancing it have been prominent in the literature and remain relevant in the fields of economics, finance, accounting, and management. Profitable firms create value, drive employment, demonstrate innovation and social responsibility, and contribute to overall economic growth through tax payments. Indeed, a high level of firm performance significantly contributes to income generation and the overall development of an economy (Olutunla & Obamuyi, 2008; Lazar, 2016). Profitability is defined as a company's ability to generate profit from its economic activities utilising its resources (Cojocaru, 2000). It represents one of the most comprehensive indicators for assessing the efficiency of a firm's economic and financial activities, including the utilisation of production means and the labour force throughout the various stages of the economic cycle: procurement, production, and sale (Moroşan, 2006).

Output

Output improvement has become a prevalent trend in numerous industries in recent decades. Output refers to the total quantity of goods and services produced within a given timeframe. It represents the quantity of items a firm produces over a specific period. A firm's performance and growth are considered favorable if there is consistent growth in the quantity of goods produced within the defined timeframe. This serves as an indicator and determinant of organisational performance and growth. The manifestation of this phenomenon within a

firm demonstrates effective and efficient utilisation of all factor inputs and their optimal functioning, as well as continued customer patronage, which indicates product appeal and ensures revenue and profit.

Delivery Time/Speed

This factor pertains to the time required for delivering services to customers. It measures the time gap between a requisition being made and the service being provided. The faster the delivery time, the more efficient the firm is. Every firm strives to minimise the time interval between customer requests and service delivery. Prolonged time gaps between requisitions lead to customer dissatisfaction, resulting in diminished interest in the transaction. Consequently, firms aim to reduce their service time during the delivery process.

Moderating Variable: Technology

Technology is believed to play a crucial role in firms' capacity planning and overall effectiveness. It can be defined as applying and understanding organisational tools, techniques, crafts, systems, or methods to solve problems or serve specific purposes. Using technology as a tool and action has brought about significant cultural changes. According to Rosenberg and Frischtak (1985), technology refers to organisation-specific information related to production processes, product design characteristics, and performance properties. Therefore, technology is implicit and accumulative. Burgelman et al. (1996) describe technology as theoretical and practical knowledge, skills, and artefacts to develop products, services, production, and delivery systems. Technology is also embodied in individuals, materials, cognitive and physical processes, facilities, machinery, and tools (Lin, 2003). Mascus (2003) expands the concept of technology by defining it as "the information required to achieve a specific production outcome by combining or processing selected inputs, which may include production processes, intra-firm organisational structures, management techniques, and sources of finance, marketing methods, or any combination thereof.

Other scholars, such as Tepstra and David (1985), suggest that technology is a cultural system that pertains to human relationships and their environment. The increasing accessibility of technology has been a significant catalyst for advancements in production firms and nations in recent years. Information technology has brought about innovative developments in information collection, storage, processing, transmission, and presentation. This has transformed the information technology sector into a highly dynamic and expanding field, affecting other related sectors and aspects of life. Based on Sahal's (1981) notion, Bozeman (2000) argues that technology and knowledge are inseparable, as the diffusion of a technological product also involves the diffusion of the knowledge on which it is based. The rapid growth and unprecedented influence of new technologies, mainly information and communication technologies, including the internet, have increased global recognition of the power of technology as a whole. Many companies rely on software to obtain real-time inventory data, which is especially critical in an increasingly globalised economy. In today's society, businesses and individuals connect rapidly through technological innovations. Technological advancements have facilitated the distribution of information through various modes of mass communication, such as computers, telephones, television, radio, and

newspapers, in numerous developing countries. Understanding technology is a prerequisite for making informed choices in acquiring and utilising knowledge resources, which should be fully harnessed for human development and welfare.

Empirical Review

Daniel (2019) conducted a study exploring the impact of materials management on organisational productivity. The findings indicated that effective materials management practices contribute to the organisation's profitability. Adequate storage facilities play a crucial role in preventing disruptions in the production process. Consequently, the study emphasised the importance of maintaining a reliable records system for materials, as this has implications for production, staff training, and knowledge acquisition, ultimately leading to improved profitability for the organisation.

Akinola et al. (2019) examined the influence of materials management practices on financial performance in selected manufacturing firms in Southwestern Nigeria. The study employed a sample of 354 workers representing various positions: procurement officer, logistics officer, store officer, production manager, research and development officer, and accountant. The research findings revealed that the Nigerian manufacturing companies evaluated exhibited high materials management practices, including warehousing and storing, production and procurement, distribution, production planning and control, and inventory management. From a descriptive standpoint, the study highlighted the competitive capabilities of these companies, which encompassed product quality, networking, investment, and innovation. Moreover, the regression analysis demonstrated that production planning and control ($t = 7.45$, $p < 0.05$), distribution ($t = 4.49$, $p < 0.05$), warehouse and store ($t = 4.71$, $p < 0.05$), and inventory management ($t = 2.39$, $p < 0.05$) positively influenced financial performance. In light of these noteworthy findings, the study concluded that materials management effectively enhanced the financial performance of manufacturing companies in Southwestern Nigeria.

Asaolu et al. (2012) investigated the impact of materials management on profitability, focusing on a sample of 100 staff members from Nigerian Food and Beverage (F&B) Manufacturing firms, with a case study explicitly analysing Nigerian Bottling Company (NBC) Plc. The research results demonstrated a significant increase in the company's profitability due to efficient materials management practices. These practices were facilitated by inter-departmental coordination among materials-related departments, effective inventory management techniques, favourable vendor relationships, and state-of-the-art facilities supported by information and communication technology (ICT). The study also identified notable constraints faced by the company concerning materials management, including unreliable public power supply and deficiencies in the transportation network.Ibegbulem and Okorie (2015) conducted a study that explored the relationship between material management and organisational profitability. Their findings indicated that the material management practices implemented by an organisation have a positive impact on the company's profitability. This includes the role of adequate storage facilities in preventing disruptions in the production process, among other benefits. Therefore, the study recommended the establishment of a robust record system for materials used in the

organisation's operations. Additionally, it emphasized the importance of continuous employee training to enable them to acquire the necessary skills and knowledge required for their respective roles.

In a study centered on the Nigerian Bottling Company Plc (NBC), Unam (2012) examined how Materials Management influences the success of manufacturing firms. The study established a significant positive relationship between efficient Materials Management and firm success. This implies that by effectively managing materials, a manufacturing firm can achieve considerable cost savings, improve production efficiency, and increase profitability. The study also identified significant success factors in Materials Management, including interdepartmental coordination, effective inventory management, establishing good relationships with vendors, and utilizing state-of-the-art facilities and information and communication technology (ICT). The research highlighted the vital role of Materials Management as a holistic concept for manufacturing industries to achieve remarkable performance.

Using a sample of 79 respondents in a case study of Mumias Sugar Company Limited, Bagaka & Moronge (2017) examined the impact of material management on the performance of sugar manufacturing industries in Kenya. The findings revealed that materials procurement and inventory control have a positive influence on the performance of sugar manufacturing industries in the country. Based on these findings, the study recommended the full adoption of materials procurement tools as they facilitate auditing processes related to invoicing, receipt and inspection of goods, quality control, supplier appraisal, and clarification of payments. Furthermore, the study advised manufacturing industries to implement inventory control systems and flexible supply chains. These elements were identified as critical factors in reducing costs and ensuring a more streamlined operation.

Research Methods

This study utilized a descriptive and cross-sectional survey technique. The target population consisted of all 814 registered manufacturing firms in Nigeria (www.dnb.com). Among these, 71 firms are listed on the Nigerian stock exchange and operate within 7 dominant sectors (www.selectglobal.com).

For convenience, 14 manufacturing firms were selected for examination in this study. Since the focus is at the organisational level, all inquiries and investigations were directed towards the management staff. The companies were chosen based on accessibility through judgmental and convenience sampling techniques. In this study, the independent variable is Material management, while the dependent variable is operational efficiency. The dimensions of Material management considered in this study include economic order quantity, reorder level, and reorder quantity. Conversely, this study's measures or components of operational efficiency include profitability, output, and delivery time/speed.

The hypotheses were tested using structural equation modelling (SEM), which consists of measurement and structural models. The measurement model is based on the standard factor

model (Thurstone, as cited in Dimitris, George, Malvina, & Demosthenes, 2017). The validation and significance testing criteria were set at a 95% confidence level. Descriptive statistics were measured using the mean and standard deviation, which were employed to capture the characteristics of the variables under investigation through the Statistical Package for Social Sciences (SPSS) software version 25. A 5-point Likert scale was used to assess ordinal data, which tends towards normality with large sample sizes (Hoyle, 2012). It is suitable for testing using SEM if there are several observations (Altman & Bland, 1995). The AMOS (Analysis of Moment Structure) software was utilised in this study. AMOS is a widely-used specialised SEM software program (Byrne, 2001; 2010; 2012) that offers an easy-to-use graphical interface, clear model representation, and various advantages, such as extensive bootstrapping capabilities (Tabachnick & Fidell, 2007; Bagozzi & Yi, 2012). The moderating effect of technology on the relationship between materials management and operational efficiency was tested using Cohen's (1988) effect size criterion.

Research Results

The table below presents details of the number of manufacturing organisations from each Sub-Sector, the number of copies of the questionnaire distributed to each organisation, and the number retrieved from them.

Table 1: Sub-sector Classification, Names of Manufacturing organisations, Number of copies of the Questionnaire Distributed and Number Returned

S/N	MANUFACTURING ORGANISATIONS	Administered	Returned
A	**Cement/Limestone**		
1	Dangote Cement	18	13
2.	BUA	17	10
B	**Noodles/Foods**		
1.	Dufil Prima Foods PLC	18	11
2.	Golden Penny	16	10
C	**Drinks**		
1.	Nigerian Bottling Co. PLC	19	12
2.	Nigerian Breweries	17	11
D	**Beverages**		
1.	Nestle Nigeria	17	11
2.	Unilever Nigeria	20	13
E	**Construction**		
1.	Julius Berger Nigeria Plc	17	12
2.	Reynold Construction Firm	16	10
F	**Textiles**		
1.	African Textiles Man. Limited	16	10
2.	Apapa Sunrise Stores	17	11
G	**Cosmetics**		
1.	PZ Cussion	16	11
2.	Givanas Nig Ltd	16	10
	TOTAL	**220**	**145**

Source: Info from different firms

The study being predominantly quantitative and thus, generated data using a structured questionnaire. A total of 220 copies of the questionnaire were distributed to target manufacturing companies within a specified time frame. We had a contact person in each of the manufacturing organisations who helped in both the distribution and retrieval of the survey instrument. Out of 220 copies of the distributed questionnaire, 145 were retrieved and used for the analysis in this study. This represents a 65.9% success rate.

Table 2: Measurement Model Analysis of Economic order quantity

Model	Chi-Square (df), Significance	NFI	TLI	CFI	RMSEA	Variable	Standardized Factor Loading Estimates	Error VAR
Economic Order Quantity	(35df) =242, p > 0.000	1.0	0.54	1.0	0.16	EOQ 1	0.64	0.36
						EOQ 2	0.86	0.43
						EOQ 3	0.84	0.54
						EOQ 4	0.74	0.46
						EOQ 5	0.91	0.28

Source: Research data, 2023.

All indicators of economic order quantity loaded significantly, all above 0.5 (50%). This shows that all the indicators can be employed for subsequent analysis.

Table 3: Measurement Model Analysis of Reorder Level

Model	**Chi-Square (df), Significance**	**NFI**	**TLI**	**CFI**	**RMSEA**	**Variable**	**Standardised Factor Loading Estimates**	**Error VAR**
Reorder level	(2df) = 4.56, p > 0.000	0.94	0.97	0.98	0.69	RL 1	0.77	0.40
						RL 2	0.70	0.30
						RL 3	0.72	0.22
						RL 4	0.67	0.23
						RL 5	0.81	0.37

Source: Research data, 2023

All indicators of reorder level loaded significantly as they were all above 0.5(50%). This shows that all the indicators can be employed for subsequent analysis.

Table 4: Measurement Model Analysis of Order Quantity

Model	Chi-Square (df), Significance	NFI	TLI	CFI	RMSEA	Variable	Standardized Factor Loading Estimates	Error VAR
Order Quantity	(33df) =241, p>0.000	0.82	0.75	0.84	0.16	OQ1	0.80	0.36
						OQ2	0.84	0.22
						OQ3	0.74	0.34
						OQ4	0.82	0.24
						OQ 5	0.75	0.14

Source: Research Data, 2023

All indicators of order quantity loaded significantly as they were all above 0.5(50%). This shows that all the indicators can be employed for subsequent analysis.

Assessing Model Fit

Assessing model fit is a composite reliability used to evaluate internal consistency, individual indicator reliability and average variance extracted (AVE) to evaluate convergent validity.

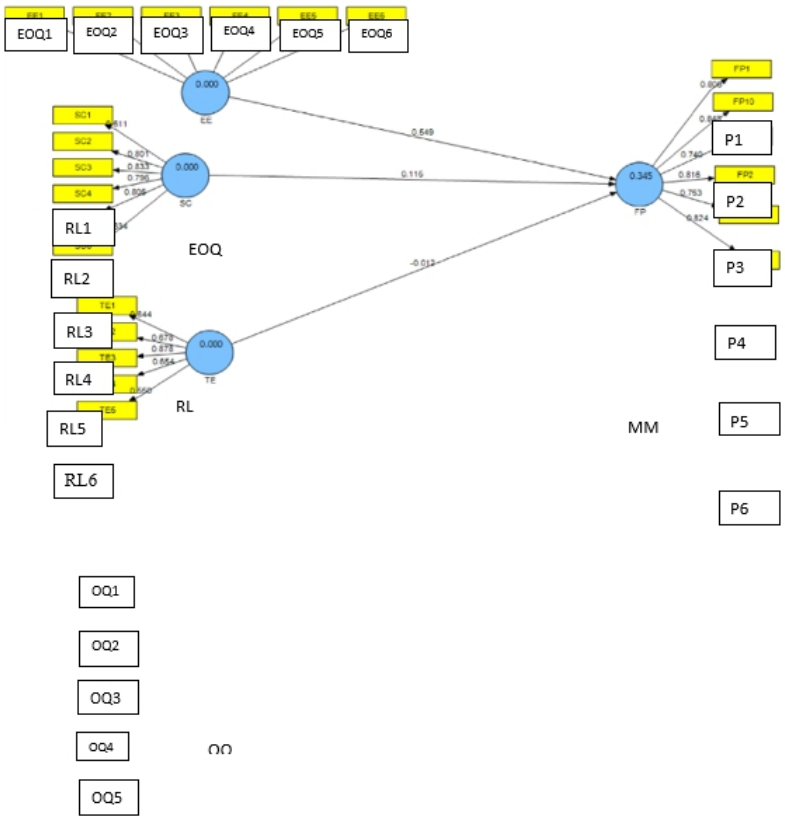


Figure 2: Measurement Model

Figure 2 above shows how the model fit the study with individual indicators showing the reliability and the validity of the variables. Table 5 below further explains the figure.

Table 5: Construct Reliability and Validity

Variable	Items	Loadings	AVE	CR	CA
Reorder level	RT1	0.81	0.64	0.91	0.845
	RT2	0.82			
	RT3	0.75			
	RT9	0.82			
	RT10	0.84			
	RT11	0.74			
Economic order quantity	IN1	0.64	0.68	0.93	0.715
	IN 2	0.86			
	IN 3	0.84			
	IN 4	0.74			
	IN 5	0.91			
	IN 6	0.92			
Order Quantity	P1	0.84	0.53	0.85	0.643
	P2	0.68			
	P3	0.88			
	P4	0.65			
	P5	0.55			

Table 6: Discriminant Validity using Fornell-larcker criterion

	Construct	1	2	3	4
1	Order quantity	**0.83**			
2	Reorder level	0.58	**0.80**		
3	Economic order quantity	0.25	0.25	**0.75**	

Source: Field Survey, (2022).

Table 6 is the result of discriminant validity. For discriminant validity, the square root of the AVE of each construct must be higher than other correlations. The AVE of order quantity is 0.83. All other correlations below 0.83 are lesser than .83. Similarly, for the reorder level, the AVE is 0.80. All other correlations column and row-wise are below .80. Likewise, for Economic Order Quantity (EOQ), the AVE coefficient is 0.75. All other correlations, column and row-wise, are below 0.75. Finally, technology has an AVE coefficient of 0.73. All other correlations, column and row-wise, are below 0.73. Judging by the Fornell-locker discriminant validity criterion, the data shows that discriminant validity has been achieved, as the square root of the AVE of each construct is higher than other correlations (Garson, 2016).

Bootstrapping Analysis

A bootstrapping analysis was carried out to determine the direct effect of the independent variables on the study's dependent variable. Based on this result, Figure 2 is presented, which

shows the structural model of the direct impact of economic order quantity, reorder level, order quantity, and technology on the operational efficiency of manufacturing firms in Nigeria.

Table 7: Result of standardised and unstandardised regression estimate of the model.

S/N	Mediation Stage	Relationship	Std. Beta	Actual Beta	S.E.	C.R.	P	Remark
1.	X →Y (Hypothesis 1)	Economic order quantity	0.69	0.87	0.13	2.51	0.000	Not Supported
2.	X →Y (Hypothesis 2)	Reorder level	0.76	0.83	0.22	3.40	0.000	Not Supported
3.	X →Y (Hypothesis 3)	Order quantity	0.58	0.82	0.18	4.32	0.000	Not Supported
4.	X →Y (Hypothesis 1)	Economic order quantity	0.74	0.87	0.13	2.51	0.000	Not Supported
5.	X →Y (Hypothesis 2)	Reorder level	0.78	0.83	0.22	3.40	0.000	Not Supported
6.	X →Y (Hypothesis 3)	Order quantity	0.60	0.82	0.18	4.32	0.000	Not Supported
7.	X →Y (Hypothesis 1)	Economic order quantity	0.71	0.87	0.13	2.51	0.000	Not Supported
8.	X →Y (Hypothesis 2)	Reorder level	0.79	0.83	0.22	3.40	0.000	Not Supported
9.	X →Y (Hypothesis 3)	Order quantity	0.61	0.82	0.18	4.32	0.000	Not Supported
10.	X →Z =>Y (Hypothesis 1)	Technology	0.74	0.87	0.13	2.51	0.000	Not Supported

Source: Research Data, 2023.

Hypotheses Testing

Hypothesis One

H_{01}: *There is no significant relationship between economic order quantity and profitability of manufacturing firms in Nigeria.*

The first hypothesis (H_{01}) examined the association between economic order quantity and profitability of manufacturing firms in Nigeria. As shown in Table 7 above, the result of data analysis revealed that $\beta=0.87$, $r=0.69$ and $p = 0.000$. Based on the decision criteria, which states that we should accept the null hypothesis if $\beta<0.3$, $r<0.7$ and $p > 0.05$ or reject the null hypothesis if $\beta>0.3$, $r>0.7$ and $p < 0.05$), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between economic order quantity and profitability of manufacturing firms in Nigeria ($\beta=0.87 >0.3$, $r=0.69 > 0.7$, and $p = 0.000 < 0.05$). H_{01} is not supported. Based on this finding, we conclude that economic order quantity plays a solid and significant role in enhancing the profitability of manufacturing firms in Nigeria.

Hypothesis Two

Ho_2: *There is no significant relationship between economic order quantity and the output of manufacturing firms in Nigeria.*

The second hypothesis (H_{02}) examined the association between economic order quantity and the output of manufacturing firms in Nigeria. As shown in Table 7 above, the result of data analysis revealed that β=0.83, r=0.76 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between economic order quantity and the output of manufacturing firms in Nigeria (β=0.83 >0.3, r=0.76 > 0.7, and p = 0.000 < 0.05). $H_{02}$is not supported. Based on this finding, we conclude that economic order quantity plays a solid and significant role in enhancing the output of manufacturing firms in Nigeria.

Hypothesis Three

Ho_3: *There is no significant relationship between economic order quantity and the delivery time/speed of manufacturing firms in Nigeria.*

The third hypothesis (H_{03}) examined the association between economic order quantity and manufacturing firms' delivery time/speed in Nigeria. As shown in Table 7 above, the result of data analysis revealed that β=0.82, r=0.58 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a moderate positive and significant correlation between economic order quantity and the delivery time/speed of manufacturing firms in Nigeria (β=0.82 >0.3, r=0.58 > 0.7, and p = 0.000 < 0.05). H_{03} is not supported. Based on this finding, we conclude that economic order quantity plays a moderate and significant role in enhancing the delivery time/speed of manufacturing firms in Nigeria.

Hypothesis Four

H_{04}: *There is no significant relationship between reorder level and profitability of manufacturing firms in Nigeria.*

The fourth hypothesis (H_{04}) sought to examine the association between reorder level and profitability of manufacturing firms in Nigeria. As shown in Table 7 above, the result of data analysis revealed that β=0.87, r=0.74 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between the reorder level and profitability of manufacturing firms in Nigeria (β=0.87 >0.3, r=0.74 > 0.7, and p = 0.000 < 0.05). $H_{04}$is not supported. Based on this finding, we conclude that the reorder level plays a vital and significant role in enhancing the profitability of manufacturing firms in Nigeria.

Hypothesis Five

Ho_5: *There is no significant relationship between reorder level and the output of manufacturing firms in Nigeria.*

The fifth hypothesis (H_{05}) examined the association between reorder level and the output of manufacturing firms in Nigeria. As shown in Table 7 above, the result of data analysis revealed that β=0.83, r=0.78 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between reorder level and the output of manufacturing firms in Nigeria (β=0.83 >0.3, r=0.78 > 0.7, and p = 0.000 < 0.05). H_{05} is not supported. Based on this finding, we conclude that the reorder level plays a vital and significant role in enhancing the output of manufacturing firms in Nigeria.

Hypothesis Six

Ho_6: *There is no significant relationship between reorder level and delivery time/speed of manufacturing firms in Nigeria.*

The sixth hypothesis (H_{06}) examined the association between reorder level and the delivery time/speed of manufacturing firms in Nigeria. As shown in Table 7 above, the result of data analysis revealed that β=0.82, r=0.60 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between reorder level and the delivery time/speed of manufacturing firms in Nigeria (β=0.82 >0.3, r=0.60 > 0.7, and p = 0.000 < 0.05). $H_{06}$is not supported. Based on this finding, we conclude that the reorder level plays a vital and significant role in enhancing the delivery time/speed of manufacturing firms in Nigeria.

Hypothesis Seven

H_{07}: *There is no significant relationship between re-order quantity and profitability of manufacturing firms in Nigeria.*

The seventh hypothesis (H_{07}) sought to examine the association between order quantity and profitability of manufacturing firms in Nigeria. As shown in Table 7 above, the result of data analysis revealed that β=0.87, r=0.71 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between order quantity level and profitability of manufacturing firms in Nigeria (β=0.87 >0.3, r=0.71 > 0.7, and p = 0.000 < 0.05). $H_{07}$is not supported. Based on this finding, we conclude that order quantity plays a solid and significant role in enhancing the profitability of manufacturing firms in Nigeria.

Hypothesis Eight

Ho_8: *There is no significant relationship between order quantity and the output of manufacturing firms in Nigeria.*

The eighth hypothesis (H_{08}) sought to examine the association between re-order quantity and the output of manufacturing firms in Nigeria. As shown in Table 7 above, the result of data analysis revealed that β=0.83, r=0.79 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between order quantity and the output of manufacturing firms in Nigeria (β=0.83 >0.3, r=0.79 > 0.7, and p = 0.000 < 0.05). H_{08} is not supported. Based on this finding, we conclude that order quantity plays a solid and significant role in enhancing the output of manufacturing firms in Nigeria.

Hypothesis Nine

Ho_9: *There is no significant relationship between order quantity and the delivery time/speed of manufacturing firms in Nigeria.*

The ninth hypothesis (H_{09}) examines the association between reorder quantity and the manufacturing firms' delivery time/speed in Nigeria. As shown in Table 7 above, the result of the data analysis revealed that β=0.82, r=0.61 and p = 0.000. Based on the decision criteria, which states that we should accept the null hypothesis if β<0.3, r<0.7 and p > 0.05 or reject the null hypothesis if β>0.3, r>0.7 and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. The result of the data analysis indicates that there is a strong positive and significant correlation between order quantity and the delivery time/speed of manufacturing firms in Nigeria (β=0.82 >0.3, r=0.61 > 0.7, and p = 0.000 < 0.05). H_{09} is not supported. Based on this finding, we conclude that order quantity plays a solid and significant role in enhancing the delivery time/speed of manufacturing firms in Nigeria.

Hypothesis Ten

Ho_{10}: *Technology does not significantly moderate the relationship between material management practices and the operational efficiency of manufacturing firms in Nigeria.*

The tenth hypothesis (H_{010}) sought to examine the moderating effect of technology on the relationship between material management practices and the operational efficiency of manufacturing firms in Nigeria. As shown in Table 7 above, the result of the data analysis revealed that technology significantly moderates the effect of material management on the operational efficiency of manufacturing firms given the coefficient of 0.74 at a probability value of 0.000, which is less than the 0.05 threshold and therefore leading to the rejection of the null hypothesis of no moderating effect.

Discussion of Findings, Conclusions, and Recommendations

The first, second, and third hypotheses (H01, H02, and H03) investigated the relationship

between economic order quantity and various operational efficiency measures (profitability, output, and delivery time/speed) in the Nigerian manufacturing industry. The results of the data analysis demonstrate a statistically significant and positive correlation between economic order quantity and the operational efficiency measures: profitability ($\beta=0.87 > 0.3$, $r=0.69 > 0.7$, and $p = 0.000 < 0.05$); output ($\beta=0.83 > 0.3$, $r=0.76 > 0.7$, and $p = 0.000 < 0.05$), and delivery time/speed ($\beta=0.82 > 0.3$, $r=0.58 > 0.7$, and $p = 0.000 < 0.05$). Consequently, the hypotheses H01, H02, and H03 are not supported. Based on these findings, it can be inferred that economic order quantity significantly influences the profitability, output, and delivery time/speed of manufacturing firms in Nigeria. This may be attributed to the common tendency of manufacturing organisations to maintain excessive or inadequate inventory levels, which result in missed sales opportunities, higher inventory costs, increased carrying costs, elevated investment costs, and other unfavourable outcomes. Suppose an organisation's input orders (e.g., raw materials) are huge. In that case, it leads to a substantial portion of their investment funds being tied up in inventory, storage expenses, idle funds, and other negative consequences. Conversely, placing too few orders for inputs prevents the organisation from meeting customers' demands promptly. Here, Economic Order Quantity (EOQ) assists manufacturing organisations in determining the optimal order size and managing their output effectively and efficiently to maximise profit. In this context, delivery time/speed refers to the duration between placing an order and its delivery. EOQ assumes that the lead time is known, and it assumes a consistent unit cost over time despite changes in order quantity. EOQ empowers managers in manufacturing organisations to place timely orders to fulfil customer demands. Furthermore, delivery speed is crucial in the highly competitive business environment, where time equals money and is a valuable resource. On one hand, EOQ enables managers to anticipate when inputs will be received by their organisation. On the other hand, it informs them about the time required to fulfil customers' orders or demands.

The fourth, fifth, and sixth hypotheses (H04, H05, and H06) investigated the relationship between reorder level and operational efficiency measures (specifically profitability, output, and delivery time/speed) of manufacturing firms in Nigeria. The results of the data analysis demonstrate a strong positive and statistically significant correlation between reorder level and operational efficiency measures in these firms: profitability ($\beta=0.87 > 0.3$, $r=0.74 > 0.7$, and $p = 0.000 < 0.05$); output ($\beta=0.83 > 0.3$, $r=0.78 > 0.7$, and $p = 0.000 < 0.05$); and delivery time/speed ($\beta=0.82 > 0.3$, $r=0.60 > 0.7$, and $p = 0.000 < 0.05$). Consequently, H04, H05, and H06 are not supported. Based on these findings, we can conclude that the reorder level significantly enhances profitability, output, and delivery time/speed in manufacturing firms in Nigeria. This outcome can be attributed to the reorder or inventory levels at which a new order is placed, or a new production run is initiated. It allows manufacturing organisations to optimise their inventory turnover, which measures the frequency at which inventory is sold and replenished. By preventing stock-outs and overstocking, knowledge of the reorder level facilitates cost reduction, improved forecasting, and enhanced profitability, output, and delivery time/speed in the Nigerian manufacturing industry. Determining the reorder level considers essential factors such as safety stock, buffer stock, and anticipated demand during the lead time to prevent stockouts and disruptions in the supply chain. Managers in the Nigerian manufacturing industry can adjust the reorder level based on factors such as

seasonal demand patterns, market conditions, or lead time fluctuations. Moreover, the reorder level is influenced by an organisation's lead time for work orders, demand during that period, and the necessity of maintaining a safety stock. The work-order lead time refers to the duration suppliers require to manufacture and deliver the ordered units to the organisation. It is crucial to emphasise the significance of establishing an appropriate reorder level. Setting the reorder level ensures that inventory is replenished promptly, considering the lead time required for order fulfilment. Ordering items too early may result in increased carrying costs, including expenses related to storage/warehouse rent, insurance, potential spoilage, opportunity costs, and the cost of funds tied up in excessive inventory. On the other hand, placing an order too late can lead to stockouts, along with associated costs such as missed sales and customer dissatisfaction. Therefore, the findings of this study underscore the essential role of the reorder level in helping managers determine the work-order lead time, which involves assessing the time required for suppliers to manufacture and deliver the ordered units to the organisation. Understanding the work-order lead time not only enables managers to determine the timeframe needed for order fulfillment by suppliers but also facilitates estimating the organisation's capacity to deliver on customer demands or orders. Please provide the text that you would like me to make more academic.

The seventh, eighth, and ninth hypotheses (H07, H08, and H09) investigated the relationship between reorder quantity and operational efficiency measures (profitability, output, and delivery time/speed, respectively) in the manufacturing sector of Nigeria. The findings from the data analysis indicate a strong positive and statistically significant correlation between reorder quantity and operational efficiency measures: profitability ($\beta=0.87 > 0.3$, $r=0.71 > 0.7$, and $p = 0.000 < 0.05$), output ($\beta=0.83 > 0.3$, $r=0.79 > 0.7$, and $p = 0.000 < 0.05$), and delivery time/speed ($\beta=0.82 > 0.3$, $r=0.61 > 0.7$, and $p = 0.000 < 0.05$). However, the findings did not support hypotheses H04, H05, and H06. Therefore, we conclude that a well-managed reorder level significantly enhances the profitability, output, and delivery time/speed in manufacturing firms in Nigeria. This can be explained by the concept of reorder quantity, also known as just-in-time inventory, which refers to the quantity of units ordered when placing a purchase order. It helps organisations maintain an appropriate inventory level to meet demand without tying up excessive capital. The reorder quantity should not be too high, leading to excessive capital tied up in inventory and subsequent carrying costs, nor too low, resulting in insufficient safety stock and the risk of running out before the next batch of inventory. As the term "just-in-time inventory" suggests, this approach allows organisations to optimise inventory costs, minimise excess stock, improve cash flow by reducing carrying costs, enhance efficiency, reduce waste, and receive goods when needed. Consequently, as indicated by the findings of this study, employing an optimised reorder quantity strategy enhances the profitability, output, and delivery time/speed in the Nigerian manufacturing industry. Determining the reorder quantity involves considering various factors such as order costs, carrying costs, and the trade-off between ordering more to benefit from economies of scale and ordering less to minimise holding costs. Furthermore, the ideal reorder point is typically slightly higher than the safety stock level to account for delivery time and the number of items already in the warehouse when the materials are expected to arrive. Therefore, considering lead time is essential in determining the reorder quantity, ensuring an optimal amount of stock is ordered while considering cost, storage space, and demand patterns.

The tenth hypothesis (H010) aimed to examine the moderating effect of technology on the relationship between material management practices and operational efficiency in manufacturing firms in Nigeria. The data analysis results indicate that technology significantly moderates the effect of material management on operational efficiency, with a coefficient of 0.74 and a probability value less than the significance threshold of 0.05 ($p = 0.000$). Consequently, the null hypothesis of no moderating effect is rejected, and H010 is not supported. Therefore, the study concludes that technology plays a substantial role in moderating the effect of material management on the operational efficiency of manufacturing firms in Nigeria.

Based on the findings and conclusion above, the following recommendations are proposed:

i. Managers in the Nigerian manufacturing industry should consistently determine the reorder level for their inventory. This refers to the threshold at which a new order should be placed to replenish the stock. It is crucial in preventing stockouts and disruptions in the supply chain. The reorder level is typically based on lead time, average demand, and safety stock requirements. Its purpose is to trigger the replenishment process and maintain sufficient stock levels, thereby facilitating uninterrupted operations and a smooth flow of goods. Reorder level and reorder quantity are vital in effective inventory management, helping businesses proactively manage their inventory, meet customer demand, and avoid stockouts.

ii. By calculating the reorder quantity, Nigerian manufacturing organisations can minimise the total inventory costs while effectively meeting customer demand. This allows businesses to optimise inventory levels by determining the most cost-effective quantity to order. By minimising holding and ordering costs, businesses can balance meeting customer demand and avoiding excess inventory that ties up capital and incurs additional expenses.

iii. Managers in the Nigerian manufacturing industry should determine the reorder quantity, also known as just-in-time inventory, for each input used in the organisation. This practical approach ensures that sufficient inventory is maintained without excessive capital tied up. The reorder quantity should neither be too high, leading to additional carrying costs, nor too low, risking stockouts. By calculating or monitoring the reorder quantity, organisations can reduce costs, enhance efficiency, decrease waste, and receive goods when they are required. This study's findings demonstrate that implementing this approach can improve organisational profitability, enhance outputs, and ensure timely delivery of ordered inputs, providing a practical and effective solution to inventory management.

iv. Managers in the Nigerian manufacturing industry typically determine the reorder level based on factors such as lead time, demand variability, and desired service level to ensure stock availability when needed.

v. Managers in the Nigerian manufacturing industry usually determine the reorder quantity based on demand forecast, economic order quantity (EOQ), storage capacity, and supplier constraints.

vi. Due to the significance of materials management, managers play a crucial role in providing training programmes to enhance operational efficiency. These programmes involve enrolling employees and fostering collaboration, which is vital

to promoting materials and inventory management. Practical training led by materials managers for operational managers within the firm should be emphasised, highlighting the integral role of managers in implementing these strategies and improving operational efficiency.

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