Volume 1(5), pages 292-301, October 2025
DOI: 10.65221/0068
eISSN: 3115-5898

https://reports.afjur.com

AFJUR
African Journals of Universities and Research

African Research Reports

Regular Research Paper

Production planning and capacity utilization in petrochemicals industry in Nigeria

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Received 10 September 2025, Accepted 29 September, 2025

This work investigated the impact of production planning on capacity utilization in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria. The work aims to determine the extent of the connection between inventory control and Labour Utilization Efficiency, Material Requirements Planning (MRP), and Output-to-Capacity Ratio in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria. The study was anchored on the Lean Production Theory, which emphasizes waste reduction and optimal resource use in production systems. A descriptive survey design was adopted. Data were collected using structured questionnaires distributed to 286 employees, determined through Taro Yamane's formula from a total population of approximately 1,000 staff. The data were analyzed utilizing both descriptive and inferential statistics. The findings showed a significant and positive connection between effective production planning practices and improved capacity utilization; effective production planning significantly and positively impacts capacity utilization. It is recommended that industrial firms adopt advanced forecasting tools, modern inventory systems, and lean scheduling techniques to improve their operational effectiveness.

Key words: Production planning, capacity utilization**,** Inventory control and efficiency, material requirements planning (MRP).

INTRODUCTION

In the petrochemical industry, particularly, Long-term profitability and operational efficiency depend heavily on production planning and capacity utilization. Effective production planning guarantees the efficient allocation of personnel, raw materials, and equipment to achieve both immediate and long-term production goals. In capital-intensive industries like petrochemicals, whose operations demand a high degree of accuracy and coordination, production planning becomes more than just a standard management task it becomes a strategic imperative. According to Ihim et al. (2024, businesses encounter different challenges in trying to compete in today's global market. Therefore, the importance of supply chain management practices must be identified by organizations to improve their performance and promote joint performance by coordinating with their supply chain partners (Ihim et al., 2024). These problems hinder firms from adopting innovative digital business models and efficient supply chain management strategies, undermining their competitiveness and ability to remain

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sustainable. Nwagbala et al. (2023) stated that poor decision-making, particularly the failure to consider critical factors, has caused some firms to face survival challenges, thereby hindering business growth (Katzenback and Smith, 2011; Nwagbala et al., 2023).

Elyasi et al. (2024) assert that production planning is a crucial component of manufacturing enterprises' success because it optimizes supply chain performance, minimizes waste, and aligns operations with market demand. Capacity utilization is an important indicator because of the requirement to reduce downtime, prevent overproduction, and guarantee the timely delivery of outputs. Underutilization of capacity results in resource waste, whereas overutilization raises the possibility of operational stress and compromised quality control. A major force in the African petrochemical scene is Indorama Eleme Petrochemicals Limited (IEPL), which is based in Rivers State, Nigeria. After going through significant expansion and change, IEPL, which was formerly state-owned before being privatized has established itself as a significant force in Nigeria's industrial and economic growth (Akintokunbo and Obom, 2021). Due to its size and strategic significance, efficient production planning and capacity utilization at IEPL significantly influence the creation of jobs, power security, and regional industrial growth. Nigerian manufacturing industries need to use data-driven approaches to capacity management and modern planning tools to be competitive in the face of infrastructure constraints (Igbokwe, 2024). Supply chain management (SCM) is crucial for the efficient running of businesses operation, comprising every aspect from the acquisition of raw resources to the delivery of the finished products. Efficient supply chain management helps firms to lower cost, improve customer satisfaction, and ensure a competitive advantage (Ihim et al., 2024).

Despite the crucial significance of these operational components, several Nigerian manufacturing companies struggle to achieve optimal capacity utilization because of supply chain interruptions, infrastructure constraints, and irregular energy supplies (Ekpudu et al.,2022). Therefore, firms must enhance the main supply chain strategies, which include procurement outsourcing, customer relationship management, information flow management, order process management, forecasting accuracy and customer satisfaction to address these challenges (Rutgers Business School, 2021; Obasi et al.,2024). Any departure from the production schedules can lead to substantial material and financial losses for petrochemical companies such as IEPL, which run continuous-process production systems. Thus, for long-term growth and profitability, production planning must align with real capacity utilization. However, a thorough grasp of the internal and external processes influencing capacity is necessary for the successful integration of such systems. This makes the case of Indorama Eleme Petrochemicals Limited not only important for academic inquiry but also highly relevant for policy direction and industrial best practices across Nigeria. To identify important obstacles, success factors, and development opportunities, this study will examine Indorama Eleme Petrochemicals Limited's production planning methodologies and capacity usage practices.

Aligning production planning with capacity utilization is a crucial factor in determining operational efficiency and profitability in the fiercely competitive and capital-intensive petrochemical sector. Many Nigerian manufacturing companies, notably those in the petrochemical sub-sector struggle with underutilized capacity, production bottlenecks, and operational inefficiencies despite large expenditures in production infrastructure and process automation. Despite being seen as an example of industrial revitalization in Nigeria, Indorama Eleme Petrochemicals Limited (IEPL) is not immune to the structural issues affecting the nation's production efficiency. These challenges include unreliable energy supply, inadequate infrastructure, supply chain disruptions, and limited access to real-time data for effective decision-making. Consequently, even with sophisticated facilities, firms may struggle to fully utilize their installed capacity or optimize their production schedules to meet market demands. Production planning and capacity utilization are still difficult for Indorama Eleme Petrochemicals Limited (IEPL) to coordinate, even with large investments in technology and equipment. Resources are frequently underutilized, production is delayed, and operating costs rise as a result of unpredictable power supplies, inefficient supply chains, and poor forecasting techniques. These make the company unable to meet market demand and attain sustained productivity. Therefore, it is necessary to look at IEPL's capacity usage and production planning methodologies to find any gaps and suggest workable fixes for better operational performance.

This work mainly aim to assess production planning and capacity utilization in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria. Precisely, it aims to: 1) Investigate the extent of the connection between Inventory Control and Labour Utilization Efficiency in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria. 2) Explore the extent of the relationship between Material Requirements Planning (MRP) and Output-to-Capacity Ratio in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria. The study aims to answer the following: **1**) How does Inventory Control relate to Labour Utilization Efficiency in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria? And **2)** What is the connection between Material Requirements Planning (MRP) and Output-to-Capacity Ratio in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria?

This study makes valuable contributions to both academic literature and industrial practice in the areas of production management and operations strategy.

Specifically, the study expands the understanding of how production planning components such as inventory control and material requirements planning directly influence capacity utilization metrics, including machine utilization rate and output-to-capacity ratio, within a developing economy. The study creates a framework of capacity utilization indicators and production planning proxies that may be used as a standard for later studies and managerial evaluation. This study provides a useful paradigm for assessing and enhancing plant performance by decomposing production planning into quantifiable components and connecting them to operational results. The study reinforces the relevance and applicability of Lean Production Theory in the Nigerian industrial setting. The research supports the theory's global applicability by aligning lean principles such as waste reduction, just-in-time inventory, and continuous process improvement with observed production practices at Indorama Eleme Petrochemicals. It offers evidence for its adaptation in large-scale petrochemical operations in emerging markets.

THEORETICAL REVIEW

This study is anchored on the Lean Production theory that was developed over many decades ago, with significant breakthroughs occurring in the 1950s and 1980s. The theory emphasizes the elimination of waste (muda), continuous improvement (kaizen), and just-in-time (JIT) production. It suggests that production planning efficiency is achieved by maximizing output and minimizing non-value-adding activities. For Indorama, where processes are capital- and material-intensive, lean principles guide the reduction of overproduction, waiting time, inventory build-up, and process inefficiencies. The lean theory thus serves as a strategic approach to improve production scheduling, material handling, and machine utilization all of which contribute to better capacity utilization (Yang et al., 2025).

Implications of lean production theory

Lean production theory suggests a significant focus on efficiency by getting rid of waste in all its manifestations, including extra inventory, waiting times, motion that is not needed, faults, and overproduction. To prevent expensive overproduction or resource shortages, a petrochemical company like Indorama must have accurate production planning that closely matches demand projections. Using lean concepts to streamline operations lowers production costs and makes better use of capital-intensive resources by increasing machine utilization rates and assisting in maintaining optimal output-to-capacity ratios (Singh et al., 2025).

Relevance of the theory to the present study

In the dynamic business world of today, organizations need to react swiftly to shifting consumer demands, supply chain interruptions, and technology breakthroughs. Lean production theory is very relevant because it encourages adaptability and responsiveness through continuous improvement (Kaizen) and Just-In-Time (JIT) production. In a post-COVID, demand-volatile market, these concepts allow businesses to cut lead times, create only what is required, and limit excess inventory, all of which are vital competencies. Margherita and Braccini (2024) posit that companies that implement lean strategies are better able to change course, scale their operations up or down, and maintain their competitiveness in ever-changing global marketplaces.

Conceptual clarifications

Production planning

Production planning, which involves the strategic arrangement of resources, schedules, and procedures to effectively satisfy customer needs, is a crucial function in manufacturing and service operations. It includes the methodical planning of production processes, making sure that workers, supplies, and machinery are efficiently synchronized to reach target production levels. Stella et al. (2024) stated that capacity building seeks to empower and enable communities to identify, prioritize, and address their own development needs. This may include improving the capabilities of community-based organizations, making local leadership and decision-making processes stronger, getting more people involved in the community, and encouraging partnerships and collaborations among different stakeholders (Modibbo et al., 2021; Stella et al., 2024).

In essence, production planning is vital for ensuring that resources are used efficiently, customer expectations are met, and organizations remain competitive. It reduces uncertainty, prevents overproduction or stockouts, and contributes to a leaner, more agile operation (Das and Sen, 2025). The timely delivery of goods and services is made possible by this planning process, which is essential for matching production capacities with market demands (Ikechukwu et al., 2023). To guarantee smooth operations, it also addresses the daily scheduling of tasks, shifts, and machine utilization at the operational level (Madume et al., 2024).

Inventory control

Inventory control is the methodical process of controlling and monitoring stock levels to make sure a company keeps just enough inventory on hand to satisfy consumer

demand while lowering holding costs. Inventory control is crucial for production and operations management to maximize space, minimize waste, achieve operational efficiency, and guarantee a smooth production flow (Nsowah et al., 2025). It involves various activities, including the monitoring of stock levels, setting reorder points, determining safety stock, classifying inventory (e.g., raw materials, work-in-progress, finished goods), and using inventory valuation methods such as FIFO (First-In, First-Out) or LIFO (Last-In, First-Out). Effective inventory control helps organizations avoid stockouts that can halt production and damage customer relationships, as well as overstocking that can lead to increased holding costs, obsolescence, or spoilage (Ajibola et al., 2025). By ensuring that raw materials are available for ongoing production and that completed goods are distributed and kept effectively, effective inventory control helps to reduce expenses and operational disturbances (Oyetade et al., 2024).

Furthermore, inventory control helps firms achieve more general objectives like supply chain optimization and working capital management. Supply chain management is the ratio of average inventory value to the cost of goods sold (Ihim et al., 2024). Inventory turnover is an accounting concept that shows how effective an organization is in managing its stock, showing the rapid rate at which products are sold and replaced. It describes the rates at which inventory moves the supply chain in logistics (Nasution, 2020; Ihim et al., 2024). Businesses can enhance their financial performance and free up funds for other strategic expenditures by maintaining optimal inventory levels. Strong inventory control skills are a source of customer satisfaction and operational agility in cutthroat sectors (Olaide and Omodero, 2023).

Material requirements planning (MRP)

Material requirements planning (MRP) is a methodical approach to scheduling, production planning, and inventory management that guarantees the supply of components and materials required to manufacture. MRP helps manufacturers coordinate material availability with production schedules, reduce waste, and improve delivery performance. Nwagbala et al. (2024) assert that the efficient utilization of resources is essential for attaining sustainable development, enhancing economic growth, and mitigating environmental impacts. It refers to utilizing resources in an efficient way that reduces waste, minimizes problems with the environment, and fosters sustainable growth (Hut, 2012; Nwagbala et al., 2024). Companies may maintain excellent service levels while operating with little inventory using this technique, which is particularly crucial in sectors with intricate supply chains (Adeosun, 2023). Given the volatile pricing and hazardous handling of petrochemical materials, an efficient MRP system also helps in optimizing procurement costs and maintaining safety standards (Edike, 2023). Darmawan et al. (2025) posit that materials planning is essential to contemporary production management because it enables businesses to effectively plan and coordinate the flow of materials. For a major petrochemical company like Indorama, where production needs to be accurate, efficient, and economical, MRP makes sure that everything runs smoothly and competitively.

Utilization efficiency

Utilization efficiency is a critical performance metric that evaluates how effectively an organization uses its available resources, such as land, machinery, labour, materials, and time to achieve its production goals. It is the efficient use of resources, such as land, water, energy and materials to attain desired results while reducing waste and minimizing environmental adverse effects (Miller, 2021; Stella et al., 2024). Utilization efficiency is essential in the petrochemical sector since complicated processing systems need large capital investments and activities frequently run around the clock. Polymerization reactors, packaging systems, and ethylene plants are examples of continuous process units operated by Indorama Eleme Petrochemicals Limited that require close coordination. Any inefficiency, whether brought on by labour delays, equipment failures, or a poorly integrated process, can result in missed production goals, material losses, and safety risks. By tracking and enhancing utilization efficiency, the business can lower operating expenses, uphold quality standards, and consistently satisfy customer requests (Ameh and Lee, 2022). By facilitating proactive decision-making and quicker reaction to disturbances, digital technologies such as IoT-enabled sensors, real-time dashboards, and predictive analytics further improve efficiency. Predictive maintenance, for example, can save an expensive shutdown if a pump in Indorama's polymerization process exhibits early indications of performance decline (Esheya, 2022).

Output-to-capacity ratio

Output-to-Capacity Ratio is a critical performance metric used to evaluate how effectively a production facility is utilizing its available capacity to generate output. It measures the proportion of actual production output compared to the maximum potential output (or installed capacity) within a given period. This ratio provides a clear picture of a company’s operational efficiency and production effectiveness. In capital-intensive industries such as the petrochemical sector, including Indorama Eleme Petrochemicals Limited in Rivers State, Nigeria, the output-to-capacity ratio is instrumental in tracking how

well physical resources are being translated into productive work (Wijayanto et al., 2025). The output-to-capacity ratio is a planning tool as well as an operating benchmark for a complex industrial operation like Indorama. It serves as a reference for choices regarding market development, labour planning, raw material procurement, and capacity expansion. It assists managers in locating production bottlenecks, modifying operating plans, and more successfully matching production levels with market demand when examined in conjunction with other metrics, including downtime frequency, machine utilization rate, and utilization efficiency (Morjaria,2022). Many businesses use techniques like lean manufacturing, capacity balancing, preventative maintenance, and automation technologies to increase the output-to-capacity ratio. In contemporary factories, Manufacturing Execution Systems (MES) and Enterprise Resource Planning (ERP) systems are essential for tracking production in real-time against capacity, allowing for prompt correction of inefficiencies.

Empirical studies

Chien et al. (2024) investigated strategies for effective production planning within the textile sector. Their study introduced a green production planning framework aimed at reducing wastewater generation and increasing the recycling of defective dyed products. To test this framework, martingale forecast evolution models were employed to address yield uncertainty, and a simulation model was constructed using data from a leading textile company in Taiwan. The findings demonstrated that the proposed approach is practically feasible, capable of managing yield variability, and effective in lowering production risks while enhancing the robustness of both circular supply chains and overall resource management.

Esteso et al. (2023) explored how reinforcement learning (RL) methods have been applied within production planning and control (PPC), focusing on areas such as facility resource allocation, capacity planning, procurement and supply management, production scheduling, and inventory control. The study reviewed RL characteristics including methodology, context, states, actions, rewards, and key insights. It also examined the number of agents used, application areas, and RL software tools, such as programming languages, platforms, application programming interfaces, and frameworks. In total, 181 articles were analyzed. Findings indicated that RL has been most frequently applied to production scheduling, followed by procurement and supply management.

Rossini et al. (2023) investigated the integration of Lean Supply Chain Management (LSCM) with Industry 4.0 (I4.0) technologies, a topic that has gained increasing attention in recent years. Given the novelty of this field and the rapid growth of related studies, there is a need for regular updates on current perspectives. The study therefore reviewed how LSCM and I4.0 intersect, examining their relationship across operational, tactical, and strategic levels.

Elyasi et al. (2024) examined the effects of the ongoing global crisis on supply chain resilience and proposed measures to mitigate disruptions arising from prevailing uncertainties. Although economic activity has begun to recover after the pandemic and demand has increased, many firms have yet to reach their pre-pandemic performance levels. The study suggested that adopting flexible or hybrid manufacturing systems is a viable strategy for strengthening supply chain resilience and managing disruptions effectively. Motivated by the needs of Vestal Electronics, a household appliance manufacturer, the research focused on a hybrid production system combining dedicated machinery to meet regular demand with a flexible manufacturing system (FMS) to handle demand surges. A scenario-based approach was applied to model demand uncertainty, allowing the company to make adaptive decisions that balance the cost-efficiency of standard production with the responsiveness of FMS. To address this problem, the authors proposed a heuristic algorithm based on column generation. Numerical results indicated that the optimization model achieved solutions with an average optimality gap below 6% while reducing the average cost of traditional production schemes without FMS by more than 12%.

Igbokwe (2024) noted that production planning and profit maximization remain challenging tasks for small and medium-sized manufacturing enterprises (SMEs). Since many SMEs struggle to adopt advanced Industry 4.0 technologies, they often rely heavily on expert guidance. The study therefore developed a linear programming model to determine optimal product quantities for profit maximization. Using forty-five months of data from a plastic manufacturing SME, the optimization showed that producing 12,000 cups yielded the highest profit of ₦456,000. This model offers practical insights for enhancing production planning in similar enterprises.

Similarly, Okoroafor and Iwuji (2024) analyzed production planning as a complex process requiring collaboration across multiple functional units within organizations. Their study collected data from the production and sales departments of a bakery, including the quantity of raw materials (flour, sugar, salt, milk, nutmeg, water, butter, yeast, preserver, and improver) required per unit of bread, profit per unit, production time, and target output levels for various bread types (burger, sardine, banana, hot dog roll, coconut, and mixed fruit). The researchers set eight goals covering profit, machine time, and production targets for each bread type. Results obtained with LINGO optimization software revealed that six of the eight goals were achieved: production targets for all bread types were met, while the machine time and

Table 1. Population structure.

Block	Department (unit)	Number of businesses
A	Administration	100
B	Production	180
C	Engineering	80
D	Logistics	75
E	Maintenance	60
F	Procurement	55
G	Human Resources	30
H	Quality Control	45
I	Finance	55
J	Security and safety	110
K	Sales and Marketing	210
	Total	1000

Source: public records and the company's bulletin (2025).

profit goals were not attained

Ekpudu et al. (2022) examined the effect of production planning and control on organizational performance in the Nigerian cement manufacturing industry. Production planning and control were measured using material requirement planning, quality control, just-in-time production, and inventory management, while organizational performance was assessed through productivity, quality delivery, profitability, and cost minimization. The study population comprised 768 employees across the production, quality, procurement, and sales/marketing departments of Dangote Cement Plc and Lafarge Cement Nigeria Plc. From this, a sample of 263 employees was selected using a judgmental sampling technique, and data were collected through structured questionnaires. To validate the research instrument, a pooled confirmatory factor analysis was conducted. Data analysis involved both descriptive statistics (mean, frequency distribution, percentage) and inferential statistics, with structural equation modeling (SEM) employed to test the hypotheses. The path analysis revealed positive causal effects of production planning and control constructs—material requirement planning, quality control, just-in-time production, and inventory management—on organizational performance. The study therefore recommends that manufacturing firms adopt effective material requirement planning to enhance manufacturing efficiency.

Gap in literature

To the best of the researchers' knowledge, none of the reviewed studies explored the relationship between Production Planning and Capacity Utilization in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria, using the following decomposed proxies: Inventory Control and Labour Utilization Efficiency, Material requirements planning (MRP) and Output-to-Capacity Ratio. This research explored these variables in depth and provided Petrochemical companies with actionable insights to navigate production advancements and stay ahead of the competition.

METHODOLOGY

This work employed a descriptive survey design. This involves the use of questionnaires, distributed to staff and stakeholders of Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria, to obtain relevant data. This survey provided first-hand primary data that were collected and analyzed. Judgmental sampling technique was used to approach the target audience directly. The sample size of 286 was drawn from the population of 1000 staff according to information available in the public records and the company bulletin. The estimated staff strength of **IEPL** is categorized into 11 separate departments, also called Blocks (**A-K**). Table 1 shows the population structure.

Method of data analysis

The data were analyzed using descriptive statistics, while the study's hypotheses were tested through simple linear regression with the aid of SPSS (version 23) at a 5% significance level. In determining decisions during the analysis, responses were rated on a five-point Likert scale: Strongly Agree (5), Agree (4), Disagree (3), Strongly Disagree (2), and Undecided (1). The mean of the responses served as the basis for interpretation:

$$\frac{(5 + 4 + 3 + 2 + 1)}{5} = 3.0$$

Accordingly, mean scores below 3.0 were regarded as rejected, whereas mean scores of 3.0 or above were considered accepted.

Research question 1: What is the effect of inventory control on labour utilization efficiency in Indorama Eleme petrochemicals limited, Rivers State, Nigeria?

Table 2 displays the results of Research Question 1, which probed the effect of Labour Utilization Efficiency on Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria. A significant majority of items (1, 3, 4, 6 and 8) surpassed the 3.0 criterion mean, while items 2, 5and 7 did not. These results confirm that Inventory Control significantly affects Utilization Efficiency in the industry and location studied.

Research question 2: What is the relationship between material requirements planning (MRP) and output-to-capacity ratio in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria?

In Table 3, all the items addressed the fourth research question which is "What is the relationship between Material Requirements Planning (MRP) and Output-to-Capacity Ratio in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria" From the data analysis, items 10,11,13, and 14 obtained a mean rating above the criterion mean of 3.0 (indicating acceptance) and items 8, 9, 12, and 15 obtained a mean rating below the criterion mean of 3.0 (indicating rejection). The result of the analysis revealed that the majority of the respondents supported Material Requirements

Table 2. Inventory control.

S/N	Items	N	Mean	Remark
1	Inventory control has negatively influenced the production of my company.	181	3.58	Accepted
2	I have noticed wrong inventory control within my company.	181	2.34	Rejected
3	Inventory controlling my company are paid lesser attention in my company.	181	4.02	Accepted
4	My experience leads me to believe that the Petrochemical companies have poor inventory control.	181	3.60	Accepted
	Utilization efficiency			
5	Efficient utilization of inventory is top-notch in my company	181	1.98	Rejected
6	I will contribute seriously to the adoption police Utilization efficiency.	181	4.27	Accepted
7	My company provides opportunities for the efficient utilization of inventory.	181	2.01	Rejected
8	My company provides me with opportunities to learn about the utilization efficiency.	181	3.66	Accepted

Source: Field survey (2025).

Table 3. Material requirements planning (MRP).

S/N	Items	N	Mean	Remark
8	There is an improvement in the availability of material for production in the company	181	2.22	Accepted
9	The required material for production is always available in the factory.	181	1.28	Rejected
10	Workers are always ready to work in the factory but sometimes there is a delay in production processes.	181	3.27	Accepted
11	Inputs are available in sufficient quantity without disrupting the production schedule.	181	3.42	Rejected
	Output-to-capacity ratio			
12	Was there a clear picture of production efficiency in the company	181	1.90	Rejected
13	Resources are being translated into productive work as soon as the materials are available	181	3.44	Accepted
14	My company's output is always very high compared with its input.	181	3.12	Accepted
15	High output has been maintained consistently over a period	181	2.07	Rejected

Source: Field survey (2025).

Planning (MRP) and Output-to-Capacity Ratio in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria.

Test of hypotheses

Hypothesis one

H_0: Inventory control does not significantly relate to Labour Utilization Efficiency in Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria.

The test of hypothesis one reveals a significant positive relationship between inventory controls and labour utilization efficiency ($p < 0.05$). INCO explains 26.2% of labour utilization efficiency variation. Each unit increase in INCO yields a 0.378-unit increase in labour utilization efficiency. The moderate-to-strong positive relationship (Beta = 0.512) underscores INCO analytics' substantial relationship. Companies prioritizing INCO tend to achieve superior customer service. Thus, the null hypothesis is rejected. INCO significantly relates to labour utilization efficiency in Indorama Eleme Petrochemicals Limited. This highlights INCO's critical role in driving customer service excellence. Businesses seeking improved customer satisfaction and loyalty must prioritize INCO in informing customer service strategies and enhancing market performance. Table 4 shows the model summary for hypothesis one.

Hypothesis two

H_0: There is no significant relationship between Material Requirements Planning (MRP) and Output-to-Capacity Ratio in

Table 4. Model summary for hypothesis one.

Model	R	R Square	Adjusted R Square	Std. error of the estimate
1	0.512[a]	0.262	0.258	3.895

a. Predictors: (Constant), INCO.

Table 5. F-statistics output for hypothesis two.

ANOVA[a] model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2011.235	1	2011.235	83.119	0.000[b]
	Residual	2205.765	279	26.567		
	Total	4217.000	280			

a) Dependent Variable: LUE, b) Predictors: (Constant), INCO.

Table 6. Regression analysis coefficients.

Model		Unstandardized coefficients		Standardised coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	15.678	3.567		4.395	0.000
	Inventory control	0.378	0.041	0.512	9.154	0.000

a. Dependent Variable: Labour utilization efficiency.

Table 7. Model summary for hypothesis two.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.671[a]	0.450	0.446	2.871

a. Predictors: (Constant), MRP.

Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria.

The results indicate a significant positive relationship ($p \leq 0.001$), with material requirements planning explaining approximately 45% of the variation in Output-to-Capacity Ratio. For every 1-unit increase in material requirement, the Output-to-Capacity Ratio increases by 0.583 units. The strong positive effect size (Beta = 0.671) confirms the substantial relationship between material requirement planning and Output-to-Capacity Ratio. This provides evidence supporting the significant relationship between material requirement planning and Output-to-Capacity Ratio in Rivers State, Nigeria. Indorama is prioritizing material requirement planning, which would bring development and capacity utilization. Tables 5 and 8 show the F-statistics output for hypothesis two. Tables 6 and 9 show the regression analysis coefficients. Table 7 shows the model summary for hypothesis two.

SUMMARY OF FINDINGS

This study investigated the relationship between production planning and capacity utilization in Indorama Eleme Petrochemicals Limited, Rivers State. The key variables of production planning explored in this study included forecasting accuracy, inventory control, and production. The findings revealed that effective production planning significantly and positively impacts capacity utilization. Production scheduling was found to play a crucial role in ensuring optimal use of machines and labour, reducing idle time and enhancing overall productivity. Similarly, material requirements planning ensured that raw materials were available in the right quantities at the right time, thereby avoiding disruptions in the production process.

Conclusion

Based on the empirical findings of this study, it is concluded that production planning is a critical determinant of capacity utilization in capital-intensive industries such as the petrochemical sector. At Indorama Eleme Petrochemicals Limited, the application of structured planning methods significantly enhances equipment performance and improves production outcomes. The results further underscore the relevance of lean production theory, which emphasizes waste

Table 8. F-Statistics output for hypothesis two.

ANOVA[a] model		Sum of squares	Df	Mean square	F	Sig.
1	Regression	3214.552	1	3214.552	133.119	0.001[b]
	Residual	1002.448	279	7.591		
	Total	4217.000	280			

a) Dependent Variable: OCR, b) Predictors: (Constant), MRP.

Table 9. Regression analysis coefficients.

Model		Unstandardized coefficients		Standardised coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.039	2.153		5.591	0.001
	Material requirements planning	0 .583	0.051	0.671	11.459	0.001

a) Dependent Variable: Output-to-capacity ratio.

minimization, process efficiency, and continuous improvement. By adhering to sound production planning principles, organizations can fully harness their installed capacities and maximize output without incurring excessive operational costs. This is especially vital in a competitive industrial landscape where efficiency and responsiveness to market demand are key success factors.

Limitations of the study

The applicability of this study may be limited by some factors. Firstly, its geographical scope is confined to Indorama Eleme Petrochemicals Limited, Rivers State, Nigeria, which might not be representative of other industries or regions. The unique cultural, economic, and infrastructural characteristics of this company may not be generalizable to other settings or industries. Furthermore, the study's focus on the Petrochemical industry might limit its applicability to other sectors. The findings may not be relevant to companies that are not in the petrochemical sector. Additionally, the study's methodology and sampling frame may also limit its generalizability. Therefore, caution should be exercised when applying the findings of this study to other contexts. This research was limited to Indorama Eleme Petrochemicals in Rivers State. Further research could involve firms in other regions of Nigeria or West Africa to assess regional differences in production efficiency and resource utilization. A cross-country comparison could also reveal how infrastructural, regulatory, or cultural factors affect production planning outcomes.

RECOMMENDATIONS

In line with the findings and conclusions drawn from this study, the following recommendations are made:

Strengthen forecasting techniques

The Company should adopt advanced forecasting tools such as predictive analytics and machine learning algorithms to improve demand prediction accuracy and resource alignment.

Enhance inventory management systems

Implementing automated inventory systems with real-time tracking will reduce overstocking and understocking, thereby improving production flow.

Adopt lean production practices

The organization should integrate lean tools such as Kaizen, 5S, and value stream mapping to eliminate waste and improve efficiency. By following these recommendations, Indorama Eleme Petrochemicals Limited and similar firms can significantly boost their production efficiency and achieve sustainable capacity utilization outcomes.

ACKNOWLEDGEMENTS

From the conception and design of the study, all authors contributed equally to improve the research work.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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