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PRODUCTION SCHEDULING AND MANUFACTURING EFFECTIVENESS OF SELECTED MANUFACTURING FIRMS IN PORT HARCOURT

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ABSTRACT
This study examines production scheduling and manufacturing effectiveness of Selected Manufacturing Firms in Port Harcourt. 9 research questions and 9 hypotheses were raised to guide the study. This study adopted a correlational research design. The population of the study was 10 selected manufacturing firms in Port Harcourt. The study adopted the census sampling technique which implies that the sample size was 10 selected manufacturing firms in Port Harcourt. 4 respondents were selected from each of the firm which give us a total of 40 respondents. The data collection instrument for this study is a structured questionnaire titled "production scheduling and manufacturing effectiveness". The univariate analysis was analyzed with mean and standard deviation and bivariate analysis were evaluated using the Spearman Rank Order Correlation Coefficient at a 0.01 significance level using SPSS version 22. The study revealed that there is a significant relationship between production scheduling in terms of production planning, production routing, production dispatching and manufacturing effectiveness in terms of quality, delivery and cost of selected manufacturing firms in port Harcourt. The study concluded that production scheduling in terms of production planning, production routing, production dispatching is imperative and essential to manufacturing effectiveness in terms of quality, delivery and cost of selected manufacturing firms in port Harcourt. The study recommended that Manufacturing firms should Implement an integrated information system that facilitates real-time data sharing across departments, enabling accurate demand forecasting and resource allocation among others.

INTRODUCTION
Production scheduling is a crucial aspect of production management that involves the allocation of resources, determination of production sequences, and coordination of activities to ensure efficient and timely production. It encompasses various interconnected processes such as production planning, production routing, production dispatching, and manufacturing effectiveness in terms of quality, delivery, and cost. In the context of selected manufacturing firms in Port Harcourt, Nigeria, this study aims to investigate and analyze these aspects to enhance their operational efficiency. Production planning is the process of determining the objectives, strategies, and policies for production activities. It involves forecasting demand, setting production targets, and developing plans to meet those targets. Effective production planning ensures that the right quantity of products is produced at the right time while optimizing resource utilization. It considers factors such as available resources, capacity constraints, lead times, and market demand (Kumar & van Dissel, 2017).

Production routing refers to the determination of the most efficient sequence of operations required to produce a product. It involves identifying the specific machines, workstations, or departments involved in each step of the production process. The routing decision considers factors such as machine capabilities, material flow, tooling requirements, and skill levels. Optimizing production routing can minimize bottlenecks, reduce idle time, and improve overall productivity. Production dispatching involves assigning specific jobs or tasks to available resources based on priority and capacity considerations. It includes releasing work orders to the shop floor, monitoring progress, and ensuring that operations are executed according to plan. Effective dispatching ensures that resources are utilized efficiently and that production schedules are adhered to. It requires real-time coordination between different departments and effective communication channels (Srinivasan & Suresh, 2016).

Manufacturing effectiveness refers to the ability of a manufacturing firm to achieve its production goals in terms of quality, delivery, and cost. Quality refers to meeting customer specifications and expectations while minimizing defects or rework. Delivery relates to the ability to meet customer demand within the agreed-upon time frame. Cost encompasses various factors such as material costs, labor costs, overhead expenses, and waste reduction. Enhancing manufacturing effectiveness requires continuous improvement efforts, process optimization, and the adoption of best practices (Boyer & Lewis, 2019). The study on production scheduling and manufacturing effectiveness in selected manufacturing firms in Port Harcourt aims to provide insights into the current practices, challenges, and opportunities for improvement. It may involve data collection through surveys, interviews, and observations to gather information on production planning processes, routing decisions, dispatching practices, and performance metrics related to quality, delivery, and cost .The findings of the study can help identify areas for improvement, propose strategies for enhancing operational efficiency, and contribute to the overall competitiveness of the manufacturing firms in Port Harcourt.

Statement of the Problem

Production planning is the first step in the production scheduling process, and it involves determining the quantity and type of goods to be produced, as well as the resources required to produce them. However, several problems can arise during production planning, including: Inaccurate Demand Forecasting: Inaccurate demand forecasting can lead to overproduction or underproduction, resulting in wasted resources and lost sales. Lack of Clear Objectives: Without clear objectives, production planning may not align with the company's overall strategy, leading to inefficient use of resources and poor product quality. Inadequate Resource Planning: Failure to plan for adequate resources, such as labor, materials, and equipment, can result in delays, increased costs, and poor product quality. Poor Communication: Poor communication between departments can lead to misunderstandings, misinterpretations, and delays in the production planning process.

Production routing involves the allocation of tasks and activities to specific workstations or machines to optimize production efficiency and minimize waste. However, several problems can arise during production routing, including: Inefficient Workstation Layout: An inefficient workstation layout can lead to increased travel times, reduced productivity, and higher costs. Inadequate Tooling and Equipment: Insufficient tooling and equipment can result in delays, reduced productivity, and poor product quality. Lack of Standardized Work Procedures: The lack of standardized work procedures can lead to variability in production processes, reduced productivity, and poor product quality. Poor Quality Control: Poor quality control can result in defective products, increased rework, and reduced customer satisfaction.

Production dispatching involves the allocation of tasks and activities to specific workstations or machines to optimize production efficiency and minimize waste. However, several problems can arise during production dispatching, including: Inadequate Production Capacity: Insufficient production capacity can result in delays, increased costs, and poor product quality. Poor Resource Allocation: Poor resource allocation can result in delays, increased costs, and poor product quality. Lack of Flexibility: Inflexible production schedules can make it difficult to respond to changes in demand or unexpected disruptions. Poor Communication: Poor communication between departments can lead to misunderstandings, misinterpretations, and delays in the production dispatching process.

Manufacturing effectiveness involves measuring and improving the efficiency and effectiveness of production processes to achieve optimal performance. However, several problems can arise during manufacturing effectiveness, including: Poor Quality Control: Poor quality control can result in defective products, increased rework, and reduced customer satisfaction. Inefficient Production

Processes: Inefficient production processes can result in increased costs, reduced productivity, and poor product quality. Lack of Continuous Improvement: The lack of continuous improvement can result in stagnant production processes and reduced competitiveness. Inadequate Training and Development: Inadequate training and development can result in reduced productivity, poor product quality, and high employee turnover.

Conceptual Framework

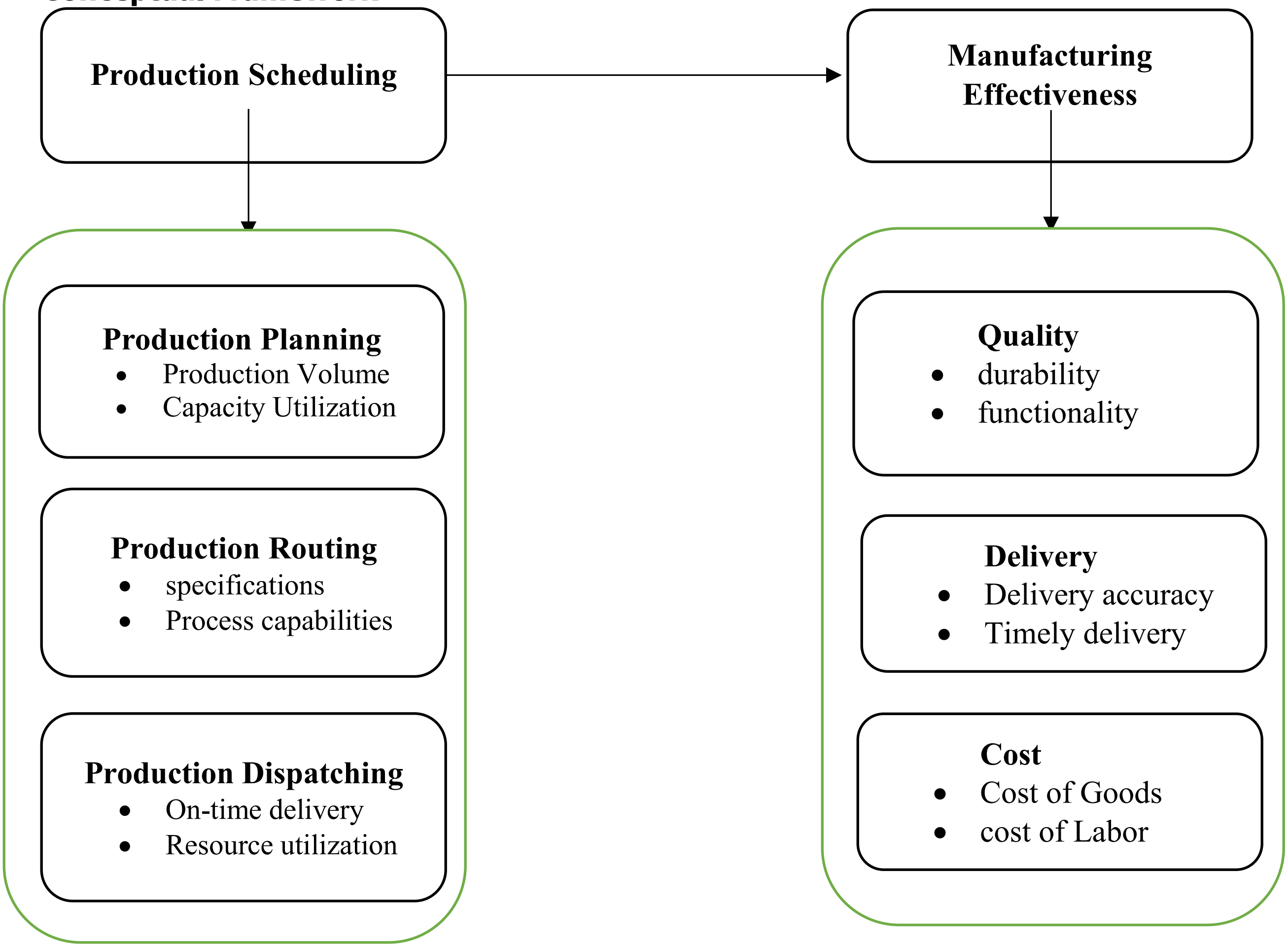

Figure 1: conceptual framework of Production Scheduling and Manufacturing Effectiveness
Source: Stevenson (2018), Krajewski, Ritzman, and Malhotra, (2018)and Smith, (2007)

Aim & Objectives

The aim of this study is to determine the relationship between production scheduling and manufacturer effectiveness of selected manufacturing firms in Port Harcourt. The specific objectives are to:

1) determine the relationship between production planning and quality of selected manufacturing firms in Port Harcourt.
2) determine the relationship between production planning and delivery of selected manufacturing firms in Port Harcourt.
3) determine the relationship between production planning and cost of selected manufacturing firms in Port Harcourt.
4) determine the relationship between production routing and quality of selected manufacturing firms in Port Harcourt.
5) determine the relationship between production routing and delivery of selected manufacturing firms in Port Harcourt.

6) determine the relationship between production routing and cost of selected manufacturing firms in Port Harcourt.
7) determine the relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt.
8) determine the relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt.
9) determine the relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt.

Research Questions

The following research questions were raised to guide the study

1) What is the relationship between production planning and quality of selected manufacturing firms in Port Harcourt?
2) What is the relationship between production planning and delivery of selected manufacturing firms in Port Harcourt?
3) What is the relationship between production planning and cost of selected manufacturing firms in Port Harcourt?
4) What is the relationship between production routing and quality of selected manufacturing firms in Port Harcourt?
5) What is the relationship between production routing and delivery of selected manufacturing firms in Port Harcourt?
6) What is the relationship between production routing and cost of selected manufacturing firms in Port Harcourt?
7) What is the relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt?
8) What is the relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt?
9) What is the relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt?

Hypotheses

The following hypotheses were formulated and will be tested at a significant level of 0.01.

HO_1: There is no significant relationship between production planning and quality of selected manufacturing firms in Port Harcourt.

HO_2: There is no significant relationship between production planning and delivery of selected manufacturing firms in Port Harcourt.

HO_3: There is no significant relationship between production planning and cost of selected manufacturing firms in Port Harcourt.

HO_4: There is no significant relationship between production routing and quality of selected manufacturing firms in Port Harcourt.

HO_5: There is no significant relationship between production routing and delivery of selected manufacturing firms in Port Harcourt.

HO_6: There is no significant relationship between production routing and cost of selected manufacturing firms in Port Harcourt.

HO_7: There is no significant relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt.

HO_8: There is no significant relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt.

HO_9: There is no significant relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt.

Review of Related Literature

Production Scheduling

Production scheduling is a crucial aspect of operations management that involves planning and organizing the production process to optimize resource utilization, meet customer demands, and minimize costs. It refers to the allocation of resources, such as labor, machines, and materials, over time to complete production tasks efficiently. Effective production scheduling ensures that production activities are coordinated in a way that maximizes productivity and minimizes idle time and bottlenecks (Kumar & van Dissel, 2017).

The primary goal of production scheduling is to create a feasible and efficient plan that meets customer demands while considering various constraints, such as limited resources, capacity limitations, and lead times. It involves determining the order and timing of production activities, including the start and end times for each task, as well as the sequence in which they should be performed. Production scheduling also takes into account factors like setup times, changeovers between different products or processes, and the availability of raw materials (Srinivasan & Suresh, 2016).

There are several different approaches to production scheduling, depending on the nature of the production process and the specific requirements of the organization. Some common techniques include: Forward Scheduling: This approach starts from the current time and schedules tasks in chronological order based on their estimated duration. It is suitable for situations where meeting delivery deadlines is critical. Backward Scheduling: In this method, the scheduling starts from the desired completion date and works backward to determine when each task should start. Backward scheduling is useful when there are fixed due dates or when tasks have dependencies (Stevenson, 2018). Finite Capacity Scheduling: This technique considers the capacity constraints of resources like machines or labor when creating a schedule. It ensures that the workload assigned to each resource does not exceed its capacity. Just-in-Time (JIT) Scheduling: JIT scheduling aims to minimize inventory levels by synchronizing production with customer demand. It focuses on producing items only when they are needed, reducing waste and improving efficiency (Smith,2007).

Advanced Planning and Scheduling (APS): APS systems use sophisticated algorithms and optimization techniques to create production schedules that consider multiple factors, such as demand forecasts, resource availability, and production constraints. These systems can handle complex scheduling problems and provide real-time updates. Effective production scheduling offers several benefits to organizations, including improved productivity, reduced lead times, increased customer satisfaction, and cost savings. It helps minimize idle time and bottlenecks, ensures efficient resource allocation, and enables better coordination between different departments or production stages (Krajewski et al.,2018).

Dimensions of Production Scheduling

Production Planning

Production planning is a crucial aspect of production scheduling that involves the systematic organization and coordination of resources, materials, and activities to ensure efficient and effective production processes. It encompasses various activities such as forecasting, capacity planning, material requirement planning, scheduling, and control (Chase et al.,2018). The primary goal of production planning is to optimize the utilization of resources while meeting customer demands and minimizing costs. Forecasting plays a vital role in production planning as it involves estimating future demand for products or services. By analyzing historical data, market trends, and other relevant factors, organizations can make informed decisions regarding production levels, inventory management, and resource allocation. Accurate forecasting helps in avoiding stockouts or excess inventory, thereby improving customer satisfaction and reducing costs (Vollmann et al.,2017).

Capacity planning is another critical component of production planning. It involves determining the optimal level of resources required to meet the anticipated demand. This includes evaluating the available production facilities, labor force, machinery, equipment, and technology. Capacity planning ensures that the production process operates at an optimal level without any bottlenecks or underutilization of resources. Material requirement planning (MRP) is an essential part of production planning that focuses on managing the availability and procurement of raw materials, components, and sub-assemblies required for production. MRP systems use information from the sales forecast to calculate the quantity and timing of material orders. By ensuring timely availability of materials, MRP helps in avoiding delays in production and maintaining smooth operations (Nahmias & Olsen, 2015).

Scheduling is a crucial activity in production planning that involves determining the sequence and timing of operations required to complete a product or service. It includes allocating resources, setting up workstations, defining task durations, and establishing dependencies between tasks. Effective scheduling helps in optimizing resource utilization, reducing lead times, and improving overall productivity (Vollmann et al.,2017).

Production Routing

Production routing is a crucial aspect of production scheduling that involves determining the most efficient and effective sequence of operations required to manufacture a product. It is a detailed plan that outlines the specific steps, resources, and time required to complete each task in the production process. By optimizing production routing, companies can minimize costs, reduce lead times, improve quality, and enhance overall productivity. The primary goal of production routing is to ensure that materials, equipment, and labor are allocated in the most efficient manner possible. This involves identifying the optimal sequence of operations, determining the appropriate work centers or machines for each task, and estimating the time required for completion. Production routing also considers factors such as material availability, machine capacity, skill requirements, and any constraints or limitations that may impact the production process (Chase et al.,2018).

To create an effective production routing plan, several key steps need to be followed. These steps include: Analyzing the product: The first step in production routing is to thoroughly analyze the product design and specifications. This involves understanding the required materials, components, and processes involved in manufacturing the product. Sequencing operations: Once the product analysis is complete, the next step is to determine the optimal sequence of operations. This involves identifying the order in which tasks should be performed to minimize setup times, reduce material handling, and maximize efficiency. Identifying work centers: After sequencing operations, it is important to identify the appropriate work centers or machines for each task. This includes considering factors such as machine capabilities, availability, and capacity. Estimating task times: Accurate estimation of task times is crucial for effective production routing. This involves considering factors such as machine speeds, operator skill levels, material handling times, and any other relevant variables (Vollmann, et al.,2017).

Considering constraints: Production routing also takes into account any constraints or limitations that may impact the production process. This includes factors such as machine maintenance schedules, material availability, labor availability, and any other constraints that may affect the production timeline. Optimizing the plan: Once all the above steps are completed, the production routing plan can be optimized to ensure maximum efficiency and productivity. This may involve making adjustments to the sequence of operations, reallocating resources, or considering alternative approaches to improve overall performance. In summary, production routing is a critical aspect of production scheduling that involves determining the most efficient sequence of operations required to manufacture a product. By carefully analyzing the product design, sequencing operations, identifying work centers, estimating task times, considering constraints, and optimizing the plan, companies can enhance their production processes and achieve better outcomes (Nahmias & Olsen, 2015).

Production Dispatching

Production dispatching is an essential aspect of production scheduling that involves the allocation and coordination of resources to ensure the smooth flow of production activities. It plays a crucial role in optimizing production processes, minimizing delays, and maximizing efficiency. This comprehensive explanation will delve into the concept of production dispatching, its objectives, key functions, challenges, and strategies for effective implementation. Production dispatching can be defined as the process of assigning tasks, allocating resources, and coordinating activities to execute the production plan effectively. It involves making decisions regarding which jobs should be processed next, determining the sequence of operations, and ensuring that all necessary resources are available at the right time and place. The primary objective of production dispatching is to achieve efficient utilization of resources while meeting customer demands within specified timeframes (Gaither & Frazier, 2018).

The key functions of production dispatching include: Job sequencing: Production dispatchers determine the order in which jobs are processed based on various factors such as due dates, priority levels, resource availability, and production constraints. By establishing an optimal job sequence, they aim to minimize idle time, reduce setup costs, and improve overall productivity. Resource allocation: Dispatchers allocate resources such as labor, machines, tools, and materials to specific jobs based on their requirements and availability. They consider factors like skill levels, equipment capabilities, and capacity constraints to ensure that resources are utilized effectively and efficiently (Nahmias & Olsen, 2015).

Coordination: Dispatchers play a crucial role in coordinating activities between different departments or workstations involved in the production process. They communicate instructions, provide necessary information, and resolve any conflicts or bottlenecks that may arise during production. Monitoring and control: Dispatchers continuously monitor the progress of jobs on the shop floor to ensure that they are executed according to plan. They track key performance indicators (KPIs) such as cycle time, throughput, and quality metrics to identify deviations from expected outcomes. If any issues or delays occur, they take corrective actions to minimize disruptions and maintain production schedules (Vollmann, et al.,2017).

Communication: Effective communication is vital in production dispatching. Dispatchers need to liaise with various stakeholders, including production supervisors, operators, maintenance personnel, and customer service representatives. Clear and timely communication helps in conveying instructions, sharing updates, addressing concerns, and maintaining a smooth flow of information throughout the production process. Despite its importance, production dispatching faces several challenges that can impact its effectiveness. Some of these challenges include: Uncertainty: Production environments are often characterized by uncertainties such as machine breakdowns, material shortages, or unexpected changes in customer demands. Dispatchers must be able to adapt quickly to such uncertainties and make necessary adjustments to the production schedule (Vollmann, et al.,2017).

Complexity: Production processes can be complex, involving multiple operations, workstations, and dependencies. Dispatchers need to consider various factors like setup times, processing times, and resource availability while sequencing jobs and allocating resources. Limited resources: The availability of resources such as labor, machines, and materials may be limited or constrained. Dispatchers must optimize the utilization of these resources to ensure efficient production without overburdening any particular resource. Time constraints: Production schedules are often time-sensitive due to customer demands or market requirements. Dispatchers must balance the need

for timely delivery with other considerations like resource availability and operational constraints (Nahmias & Olsen, 2015).
Production dispatching is a critical aspect of production scheduling that involves the allocation and coordination of resources to ensure efficient execution of the production plan. It encompasses functions such as job sequencing, resource allocation, coordination, monitoring, and communication. Despite challenges like uncertainty, complexity, limited resources, and time constraints, organizations can adopt strategies such as advanced planning systems, real-time monitoring, cross-functional collaboration, continuous improvement, and training to enhance the effectiveness of production dispatching (Nahmias & Olsen, 2015).

Manufacturer Effectiveness
Manufacturer effectiveness refers to the ability of a manufacturer to efficiently and successfully produce goods or provide services that meet customer expectations. It encompasses various aspects such as production efficiency, product quality, customer satisfaction, innovation, and overall business performance. A manufacturer's effectiveness is crucial for its long-term success and competitiveness in the market. To achieve manufacturer effectiveness, several key factors need to be considered: Production Efficiency: This refers to the ability of a manufacturer to produce goods or deliver services in a timely manner while minimizing waste and maximizing resource utilization. Efficient production processes can help reduce costs, improve productivity, and enhance overall operational performance (Chase, et al.,2021).
Product Quality: High-quality products are essential for customer satisfaction and loyalty. Manufacturers need to ensure that their products meet or exceed customer expectations in terms of durability, reliability, functionality, and aesthetics. Quality control measures and continuous improvement efforts are necessary to maintain consistent product quality. Customer Satisfaction: Understanding and meeting customer needs is crucial for manufacturer effectiveness. Manufacturers should strive to provide excellent customer service, address customer complaints promptly, and continuously gather feedback to improve their products and services (Chase, et al.,2021).

Measures of Manufacturer Effectiveness
Manufacturer effectiveness refers to the ability of a company to achieve its goals and objectives in terms of quality, delivery, and cost. It encompasses various aspects of a manufacturer's operations, including production processes, supply chain management, and overall efficiency. In this discussion, we will explore each of these dimensions in detail.

Quality
Quality is a critical aspect of manufacturer effectiveness. It refers to the degree to which a product meets or exceeds customer expectations and specifications. A manufacturer must ensure that its products consistently meet high-quality standards to maintain customer satisfaction and loyalty. This involves implementing robust quality control measures throughout the production process, from raw material sourcing to final product inspection. Effective manufacturers invest in quality management systems, such as ISO 9001 certification, to ensure adherence to quality standards and continuous improvement (Slack, 2018).

Delivery
Delivery is another crucial dimension of manufacturer effectiveness. It pertains to the ability of a manufacturer to deliver products to customers on time and in the desired quantities. Timely delivery is essential for meeting customer demand and maintaining a competitive edge in the market. Effective manufacturers employ efficient production planning and scheduling techniques to optimize their delivery processes. They also establish strong relationships with suppliers and logistics partners to ensure a smooth flow of materials and finished goods(Slack, 2018).

Cost

Cost is a fundamental aspect of manufacturer effectiveness as it directly impacts profitability. Effective manufacturers strive to minimize costs while maintaining product quality and delivery performance. They employ various cost reduction strategies, such as lean manufacturing principles, process optimization, and supply chain efficiency improvements. By eliminating waste, streamlining operations, and negotiating favorable contracts with suppliers, manufacturers can achieve cost savings without compromising on other dimensions of effectiveness(Slack, 2018).

Theoretical Review

Just-in-Time (JIT) Theory

Just-in-Time (JIT) Theory, also known as the Toyota Production System, was propounded by Taiichi Ohno, an industrial engineer at Toyota Motor Corporation in Japan. Ohno developed this theory in the 1950s and 1960s as a response to the inefficiencies he observed in traditional manufacturing systems. The assumptions of JIT theory are as follows: Waste reduction: JIT assumes that waste can be minimized or eliminated through efficient production processes. This includes reducing inventory levels, eliminating unnecessary transportation and movement, and minimizing defects and rework. Continuous improvement: JIT emphasizes the importance of continuously improving processes and systems. It assumes that there is always room for improvement and encourages employees to identify and implement changes that lead to increased efficiency. Just-in-time delivery: The theory assumes that materials and components should be delivered to the production line just in time for their use. This reduces the need for large inventories and minimizes storage costs (Ohno, 1988).

Pull system: JIT operates on a pull system rather than a push system. Instead of producing goods based on forecasts or predetermined schedules, production is triggered by customer demand. This helps to avoid overproduction and reduces the risk of excess inventory. Employee involvement: JIT theory assumes that employees should be actively involved in the production process. It encourages teamwork, empowerment, and participation in decision-making to improve overall efficiency.

The relevance of JIT theory to the study of production scheduling and manufacturing effectiveness is significant. By implementing JIT principles, organizations can achieve several benefits: Reduced inventory costs: JIT minimizes the need for large inventories by delivering materials just in time for production. This reduces storage costs, obsolescence risks, and capital tied up in inventory. Improved quality: JIT emphasizes defect prevention rather than detection. By focusing on continuous improvement and waste reduction, organizations can improve product quality and reduce defects. Increased productivity: JIT eliminates waste and streamlines production processes, leading to increased productivity. By reducing setup times, eliminating bottlenecks, and improving workflow, organizations can produce more with the same resources (Liker, 2004).

Shorter lead times: JIT reduces the time required to fulfill customer orders by eliminating unnecessary waiting times and delays. This improves customer satisfaction and enables organizations to respond quickly to changing market demands. Enhanced flexibility: JIT allows organizations to quickly adapt to changes in customer demand or product specifications. By maintaining a lean and agile production system, organizations can easily introduce new products or modify existing ones. JIT theory provides a framework for optimizing production scheduling and improving manufacturing effectiveness by minimizing waste, increasing efficiency, and enhancing customer satisfaction (Liker, 2004).

JIT is a production scheduling theory that aims to minimize inventory levels by producing goods only when they are needed. This theory emphasizes the importance of synchronizing production with demand, reducing waste, and improving efficiency. JIT promotes a pull-based system where materials are delivered just in time for production, eliminating excess inventory and associated costs.

Theory of Constraints (TOC)
The Theory of Constraints (TOC) was propounded by Eliyahu M. Goldratt, an Israeli physicist, and management consultant. Goldratt introduced the theory in his book "The Goal" published in 1984. The Theory of Constraints is a management philosophy that aims to improve the performance of organizations by identifying and managing the constraints that limit their ability to achieve their goals. The theory is based on several assumptions: Every system has at least one constraint: A constraint is any factor that limits the system from achieving higher performance. It can be a physical limitation, such as a machine with limited capacity, or a policy or rule that restricts the system's ability to operate efficiently (Goldratt, 1984).
The performance of the system is determined by its constraints: The output or performance of a system is determined by its weakest link or constraint. Improving non-constraints does not necessarily improve the overall performance of the system. Exploiting the constraint maximizes system performance: To improve the overall performance of a system, it is essential to identify and exploit the constraint fully. This involves ensuring that the constraint is always working at full capacity and removing any obstacles that hinder its productivity (Gupta, & Starr, 2018).
Subordinate everything else to the constraint: In order to maximize the performance of the system, all other activities and processes should be aligned with and subordinate to the constraint. This means that decisions regarding production scheduling, resource allocation, and process improvement should be made with the constraint in mind. Elevate the constraint if necessary: If exploiting the existing constraint does not lead to significant improvements in system performance, it may be necessary to elevate or remove the constraint altogether. This can involve investing in additional resources, upgrading equipment, or redesigning processes to eliminate bottlenecks
The Theory of Constraints is highly relevant to the study of production scheduling and manufacturing effectiveness. By identifying and managing constraints within a production system, organizations can optimize their production schedules, improve throughput, reduce lead times, and enhance overall manufacturing effectiveness. The theory provides a systematic approach to identifying and resolving bottlenecks, allowing organizations to make informed decisions about resource allocation, process improvement, and capacity planning. The TOC approach focuses on identifying and managing bottlenecks or constraints that limit the overall performance of a manufacturing system. By identifying the most critical constraint, resources can be allocated effectively to maximize throughput. TOC emphasizes the need for continuous improvement and highlights the importance of managing constraints to optimize production scheduling (Gupta, & Starr, 2018).

Empirical Review
Empirical studies on production scheduling and manufacturer effectiveness in Nigeria have been conducted to understand the factors that influence production scheduling and its impact on the overall effectiveness of manufacturers in the country. These studies provide valuable insights into the strategies, challenges, and outcomes related to production scheduling in Nigeria. Here is a comprehensive overview of some of these empirical studies, including the author, year, title, population, sample size, method of data analysis, findings, conclusion, and recommendations.
Okeke (2015) undertook a study on Production Scheduling and Manufacturer Effectiveness: A Case Study of Nigerian Manufacturing Firms. Population of the study consisted of Nigerian manufacturing firms. Sample Size of the study was 100 manufacturing firms. Method of Data Analysis was Descriptive statistics and regression analysis. The study found that effective production scheduling positively influences the overall effectiveness of Nigerian manufacturing firms. It also identified several challenges faced by manufacturers in implementing efficient production scheduling practices. The study concludes that improving production scheduling practices can enhance the effectiveness and competitiveness of Nigerian manufacturing firms. The study recommends that manufacturers should invest in advanced production scheduling techniques and technologies to optimize their operations.

Adekunle (2018) carried out a study on An Empirical Analysis of Production Scheduling Practices in Nigerian Manufacturing Companies. Population of the study was Nigerian manufacturing companies. Sample Size of the study was 50 manufacturing companies. Method of Data Analysis was Survey questionnaire and statistical analysis. The study revealed that a significant number of Nigerian manufacturing companies still rely on manual production scheduling methods. It also identified factors such as inadequate resources, poor information systems, and lack of skilled personnel as barriers to effective production scheduling. The study concludes that there is a need for Nigerian manufacturing companies to adopt modern production scheduling techniques to improve efficiency and competitiveness. The study recommends that manufacturers should invest in training programs to enhance the skills of their production scheduling personnel. It also suggests the adoption of advanced production scheduling software.
Okoro, (2016) undertook a study on Impact of Production Scheduling on Manufacturing Performance: Evidence from Nigerian Food Processing Firms. Population of the study was Nigerian food processing firms. Sample Size was 80 food processing firms. Method of Data Analysis was Structural equation modeling. The study found a positive relationship between effective production scheduling and manufacturing performance in Nigerian food processing firms. It also highlighted the importance of aligning production scheduling with customer demand and optimizing resource allocation. The study concludes that improving production scheduling practices can lead to enhanced manufacturing performance in Nigerian food processing firms. The study recommends that food processing firms should adopt flexible production scheduling approaches to accommodate changing customer demands. It also suggests the implementation of integrated information systems for better coordination and communication.
Ibrahim (2017) carried out a study on Optimizing Production Scheduling for Enhanced Manufacturer Effectiveness: A Study of Nigerian Textile Industry. Population of the study was Nigerian textile industry. Sample Size was 60 textile manufacturing firms. Method of Data Analysis was Case study analysis and statistical techniques. The study revealed that optimizing production scheduling can significantly improve the effectiveness of Nigerian textile manufacturing firms by reducing lead times, minimizing inventory costs, and enhancing customer satisfaction. The study concludes that adopting advanced production scheduling techniques can help Nigerian textile manufacturers gain a competitive advantage in the global market. The study recommends that textile manufacturers should invest in advanced planning and scheduling software to optimize their production processes. It also suggests the establishment of collaborative relationships with suppliers and customers to improve overall supply chain efficiency.
Nwankwo (2019) carried out a study on Challenges and Strategies for Effective Production Scheduling in Nigerian Manufacturing Sector. Population of the study was Nigerian manufacturing sector. Sample Size was150 manufacturing firms. Method of Data Analysis was Qualitative analysis and content analysis. The study identified various challenges faced by Nigerian manufacturing firms in implementing effective production scheduling, including inadequate infrastructure, unreliable power supply, and limited access to finance. It also highlighted strategies such as capacity planning, demand forecasting, and lean manufacturing principles as potential solutions. The study concludes that addressing the challenges associated with production scheduling can contribute to the growth and competitiveness of the Nigerian manufacturing sector. The study recommends that the government should provide necessary infrastructure support and create an enabling environment for manufacturers to adopt modern production scheduling practices. It also suggests the establishment of industry-wide collaborations to share best practices and knowledge.

METHODOLOGY

Research Design

This study adopted a correlational research design. Correctional research design refers to a type of research methodology that focuses on studying and evaluating the effectiveness of correctional programs, policies, and interventions within the criminal justice system. It aims to understand the impact of these interventions on various outcomes such as recidivism rates, inmate behavior, and overall institutional functioning. Correctional research design typically involves conducting experiments or quasi-experiments in correctional settings to assess the causal relationship between an intervention and its outcomes.

Population of the study

The population of the study was 10 selected manufacturing firms in Port Harcourt.

Table 1: List of manufacturing companies in port Harcourt

S/n	Man reg. No	Company name	Address
1	MAN/GML/00017	Berger paints nig. plc	70, Ordinance Road, Trans-Amadi Industrial Layout, Port Harcourt, Rivers State
2	MAN/GML/00068	Kabelmetal Nigeria plc	6, Bori Road, Rumuibekwe Port Harcourt, River State, Nigeria
3	MAN/GML/00197	Nigerian ropes plc	129/132, Trans Amadi Industrial Layout, Port Harcourt, Rivers, Nigeria
4	MAN/GML/00224	International breweries limited	186 187 Trans-Amadi, Elelenwo Street, Old Port Harcourt, Port Harcourt
5	MAN/GML/00379	First aluminium Nigeria plc	19/21 Onitsha Street, Trans Amadi Industrial Layout, Port Harcourt, Rivers State, Nigeria
6	MAN/GML/00384	Eastern enamelware factory limited	Plot 47, Trans Amadi Layout
7	MAN/GML/00385	Air Liquide Nigeria plc	Plot 108, Trans Amadi Layout, Port Harcourt
8	MAN/GML/00428	United Plastic Industries limited	Plot 96, Trans- Amadi Ind. Estate, Port Harcourt, Rivers State.
9	MAN/GML/00534	Almarine limited	Plot 108, trans Amadi layout, port Harcourt
10	MAN/GML/00670	Eastern Bulkcem company limited	Rumuolumeni, Port Harcourt

source: MAN Membership Directory
https://www.manufacturersnigeria.org/MembersDirectory

Sample Size and sampling technique

The study adopted the census sampling technique which implies that the sample size was 10 selected manufacturing firms in Port Harcourt. 4 respondents were selected from each of the firm which give us a total of 4o respondents.

Data Collection

The data collection instrument for this study is a structured questionnaire titled "production scheduling and manufacturing effectiveness". The questionnaire is divided into two sections. Section A collects demographic information of the respondents, while Section B includes statements derived from the research variables. Respondents are asked to respond to these items using a four-point modified Likert scale: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1).

Data Analysis

The univariate analysis were analyze with mean and standard deviation and bivariate analysis were evaluated using the Spearman Rank Order Correlation Coefficient at a 0.01 significance level. This method was chosen because the hypotheses involve two ranked variables, and it's necessary to understand their relationship, specifically whether an increase in one variable corresponds to an increase or decrease in the other using SPSS version 22.

Table 2: Descriptive Statistics on production scheduling and Manufacturer effectiveness

Production planning	N	Min	Max	Sum	Mean	Std. Dev
Our firm often determine the volume of product to produce	40	2	4	128	3.20	.758
Our firm often ensure that there is effective capacity utilization of our production	40	1	4	112	2.80	1.181
Production Routing						
Our firm often ensure that there is effective routing specification	40	1	4	112	2.80	1.181
Our firm often determine the most efficient sequence of operations required to produce a product	40	2	4	120	3.00	.906
Production Dispatching						
Our firm often specified workstations or machines to optimize production efficiency and minimize waste	40	2	4	120	3.00	.641
Quality						
Our product quality is durable	40	2	4	128	3.20	.758
Our product quality serves its functionality	40	1	4	112	2.80	1.181
Delivery						
There is timely delivery of our product	40	2	4	120	3.00	.906
Our product is delivery adequately and accurately	40	1	4	112	2.80	1.181
Cost						
Our firm ensure that cost of goods used in the production processing is minimize and quality	40	2	4	128	3.20	.758
Our firm ensure that cost of labour is minimize	40	2	4	128	3.20	.758
Valid N (listwise)	40					

Source: Researcher computation (2023) via SPSS output version 22

T[illegible]ufacturer effectiveness. The respective item mean score was above 2.5 which is an indicator that the respondents agreed on the items of production scheduling and manufactures effectiveness.

Testing of Hypotheses

The following hypotheses were formulated and will be tested at a significant level of 0.01.

HO_1: There is no significant relationship between production planning and quality of selected manufacturing firms in Port Harcourt.

Correlations 1

			production planning	quality
Spearman's rho	production planning	Correlation Coefficient	1.000	.506**
		Sig. (2-tailed)	.	.001
		N	40	40
	Quality	Correlation Coefficient	.506**	1.000
		Sig. (2-tailed)	.001	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Ho1: There is no significant relationship between production planning and quality of selected manufacturing firms in Port Harcourt.(correlation. 1) reveals there is a significant relationship between production planning and quality of selected manufacturing firms in Port Harcourt (where rho = .506 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production planning and quality of selected manufacturing firms in Port Harcourt.*

HO2: There is no significant relationship between production planning and delivery of selected manufacturing firms in Port Harcourt.

Correlations 2

			production planning	delivery
Spearman's rho	production planning	Correlation Coefficient	1.000	.571**
		Sig. (2-tailed)	.	.000
		N	40	40
	Delivery	Correlation Coefficient	.571**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Ho2: There is no significant relationship between production planning and delivery of selected manufacturing firms in Port Harcourt.(correlation. 2) reveals there is a significant relationship between production planning and delivery of selected manufacturing firms in Port Harcourt (where rho = .571 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production planning and delivery of selected manufacturing firms in Port Harcourt.*

HO3: There is no significant relationship between production planning and cost of selected manufacturing firms in Port Harcourt.

Correlations 3

			production planning	cost
Spearman's rho	production planning	Correlation Coefficient	1.000	.448**

		Sig. (2-tailed)	.	.004
		N	40	40
	Cost	Correlation Coefficient	.448**	1.000
		Sig. (2-tailed)	.004	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

HO_3: There is no significant relationship between production planning and cost of selected manufacturing firms in Port Harcourt.(correlation. 3) reveals there is a significant relationship between production planning and cost of selected manufacturing firms in Port Harcourt (where rho = .488 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production planning and cost of selected manufacturing firms in Port Harcourt.*

HO_4: There is no significant relationship between production routing and quality of selected manufacturing firms in Port Harcourt.

Correlations 4

			production routing	quality
Spearman's rho	production routing	Correlation Coefficient	1.000	.596**
		Sig. (2-tailed)	.	.000
		N	40	40
	quality	Correlation Coefficient	.596**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

HO_4: There is no significant relationship between production routing and quality of selected manufacturing firms in Port Harcourt.(correlation. 4) reveals there is a significant relationship between production routing and quality of selected manufacturing firms in Port Harcourt (where rho = .596 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production routing and quality of selected manufacturing firms in Port Harcourt.*

HO_5: There is no significant relationship between production routing and delivery of selected manufacturing firms in Port Harcourt.

Correlations 5

			production routing	delivery
Spearman's rho	production routing	Correlation Coefficient	1.000	.813**
		Sig. (2-tailed)	.	.000
		N	40	40
	delivery	Correlation Coefficient	.813**	1.000
		Sig. (2-tailed)	.000	.

		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Ho5: There is no significant relationship between production routing and delivery of selected manufacturing firms in Port Harcourt.(correlation. 5) reveals there is a significant relationship between production routing and delivery of selected manufacturing firms in Port Harcourt (where rho = .813 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production routing and delivery of selected manufacturing firms in Port Harcourt.*

HO$_6$: There is no significant relationship between production routing and cost of selected manufacturing firms in Port Harcourt.

Correlations 6

			production routing	cost
Spearman's rho	production routing	Correlation Coefficient	1.000	.794**
		Sig. (2-tailed)	.	.000
		N	40	40
	cost	Correlation Coefficient	.794**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Ho6: There is no significant relationship between production routing and cost of selected manufacturing firms in Port Harcourt.(correlation 6) reveals there is a significant relationship between production routing and cost of selected manufacturing firms in Port Harcourt (where rho = .794 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production routing and cost of selected manufacturing firms in Port Harcourt.*

HO$_7$: There is no significant relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt.

Correlations 7

			production Dispatching	Quality
Spearman's rho	production Dispatching	Correlation Coefficient	1.000	.871**
		Sig. (2-tailed)	.	.000
		N	40	40
	Quality	Correlation Coefficient	.871**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Ho7: There is no significant relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt. (Correlation 7) reveals there is a significant relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt. (Where rho = .871 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt.*

HO_8: There is no significant relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt.

Correlations

			production Dispatching	delivery
Spearman's rho	production Dispatching	Correlation Coefficient	1.000	.797**
		Sig. (2-tailed)	.	.000
		N	40	40
	delivery	Correlation Coefficient	.797**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Ho8: There is no significant relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt. (Correlation 8) reveals there is a significant relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt. (Where rho = .797 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt.*

HO_9: There is no significant relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt.

Correlations

			production Dispatching	cost
Spearman's rho	production Dispatching	Correlation Coefficient	1.000	.553**
		Sig. (2-tailed)	.	.000
		N	40	40
	cost	Correlation Coefficient	.553**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Ho9: There is no significant relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt. (Correlation 9) reveals there is a significant relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt. (Where rho = .553 and p =0.000) and based on the decision rule of $p < 0.05$ for null rejection; we reject the null hypothesis and restate *that there is a significant relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt.*

Summary of findings

1. There is a significant relationship between production planning and quality of selected manufacturing firms in Port Harcourt.
2. There is a significant relationship between production planning and delivery of selected manufacturing firms in Port Harcourt.
3. There is a significant relationship between production planning and cost of selected manufacturing firms in Port Harcourt
4. There is a significant relationship between production routing and quality of selected manufacturing firms in Port Harcourt.
5. There is a significant relationship between production routing and delivery of selected manufacturing firms in Port Harcourt.
6. There is a significant relationship between production routing and cost of selected manufacturing firms in Port Harcourt.
7. There is a significant relationship between production dispatching and quality of selected manufacturing firms in Port Harcourt.
8. There is a significant relationship between production dispatching and delivery of selected manufacturing firms in Port Harcourt.
9. There is a significant relationship between production dispatching and cost of selected manufacturing firms in Port Harcourt.

CONCLUSION

Production scheduling is a crucial aspect of production management that involves the allocation of resources, time, and tasks to ensure efficient and timely production. It encompasses production planning, production routing, and production dispatching, which are interconnected processes aimed at optimizing manufacturing effectiveness in terms of quality, delivery, and cost. This comprehensive explanation will delve into each of these components and provide recommendations for improving production scheduling in selected manufacturing firms in Port Harcourt. The study concluded that production scheduling in terms of production planning, production routing, production dispatching is imperative and essential to manufacturing effectiveness in terms of quality, delivery and cost of selected manufacturing firms in port Harcourt.

RECOMMENDATIONS

The following recommendation were drawn from the study:

1) Manufacturing firms should Implement an integrated information system that facilitates real-time data sharing across departments, enabling accurate demand forecasting and resource allocation.
2) Manufacturing firms should Conduct regular capacity analysis to identify potential bottlenecks or underutilized resources and adjust production plans accordingly.
3) Manufacturing firms should train employees on efficient work methods and provide them with clear instructions on routing procedures.
4) Manufacturing firms should continuously review and update dispatching rules and procedures based on feedback from shop floor personnel and performance data.
5) Manufacturing firms should implement a robust quality management system based on international standards such as ISO 9001.
6) Manufacturing firms should conduct regular inspections and audits to identify potential quality issues at various stages of production.
7) Manufacturing firms should adopt lean manufacturing principles such as just-in-time (JIT) production or kanban systems to reduce lead times and inventory holding costs.
8) Manufacturing firms should continuously monitor and analyze key performance indicators (KPIs) related to delivery performance and production costs to identify areas for improvement.

9) Manufacturing firms should foster collaboration with suppliers and customers to streamline supply chain processes, reduce lead times, and optimize costs

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APPENDIX A
Letter of Introduction

I am a MSc student in Ignatius Ajuru university of Education , faculty of management sciences, Department of management. I am carrying out a study on **production scheduling and manufacturing effectiveness.** I will appreciate your honest response as it will be confidential and strictly for academic purposes only.

NOTE: *strongly agree (SA) =4; agree (A) = 3; disagree (D) =2; strongly disagree (SD) =1*

SECTION B:

S/N	Production planning	SA	A	SD	D
1.	Our firm often determine the volume of product to produce				
2.	Our firm often ensure that there is effective capacity utilization of our production				
	Production Routing				
3.	Our firm often ensure that there is effective routing specification				
4.	Our firm often determine the most efficient sequence of operations required to produce a product				
	Production dispatching				
5.	Our firm often specified workstations or machines to optimize production efficiency and minimize waste				
6.	Our firm often ensure that there are effective utilizations of resources used in production				
	Quality				
7.	Our product quality is durable				
8.	Our product quality serves its functionality				
	Delivery				
9.	There is timely delivery of our product				
10.	Our product is delivery adequately and accurately				
	Cost				
11.	Our firm ensure that cost of goods used in the production processing is minimize and quality				
12	Our firm ensure that cost of labour is minimize				

APPENDIX B
SPSS output

Descriptives

Notes

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Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Our firm often determine the volume of product to produce	40	2	4	128	3.20	.758
Our firm often ensure that there is effective capacity utilization of our production	40	1	4	112	2.80	1.181
Our firm often ensure that there is effective routing specification	40	1	4	112	2.80	1.181
Our firm often determine the most efficient sequence of operations required to produce a product	40	2	4	120	3.00	.906
Our firm often specified workstations or machines to optimize production efficiency and minimize waste	40	2	4	120	3.00	.641
Our product quality is durable	40	2	4	128	3.20	.758
Our product quality serves its functionality	40	1	4	112	2.80	1.181

There is timely delivery of our product	40	2	4	120	3.00	.906
Our product is delivery adequately and accurately	40	1	4	112	2.80	1.181
Our firm ensure that cost of goods used in the production processing is minimize and quality	40	2	4	128	3.20	.758
Our firm ensure that cost of labour is minimize	40	2	4	128	3.20	.758
Valid N (listwise)	40					

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Frequencies

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Frequency Table

Our firm often determine the volume of product to produce

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	8	20.0	20.0	20.0
	3	16	40.0	40.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our firm often ensure that there is effective capacity utilization of our production

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	8	20.0	20.0	20.0
	2	8	20.0	20.0	40.0
	3	8	20.0	20.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our firm often ensure that there is effective routing specification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	8	20.0	20.0	20.0
	2	8	20.0	20.0	40.0
	3	8	20.0	20.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our firm often determine the most efficient sequence of operations required to produce a product

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	16	40.0	40.0	40.0
	3	8	20.0	20.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our firm often specified workstations or machines to optimize production efficiency and minimize waste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	8	20.0	20.0	20.0
	3	24	60.0	60.0	80.0
	4	8	20.0	20.0	100.0
	Total	40	100.0	100.0	

Our firm often ensure that there are effective utilizations of resources used in production

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	8	20.0	20.0	20.0
	3	8	20.0	20.0	40.0
	4	24	60.0	60.0	100.0
	Total	40	100.0	100.0	

Our product quality is durable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	8	20.0	20.0	20.0
	3	16	40.0	40.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our product quality serves its functionality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	8	20.0	20.0	20.0
	2	8	20.0	20.0	40.0
	3	8	20.0	20.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

There is timely delivery of our product

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	16	40.0	40.0	40.0
	3	8	20.0	20.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our product is delivery adequately and accurately

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	8	20.0	20.0	20.0
	2	8	20.0	20.0	40.0
	3	8	20.0	20.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our firm ensure that cost of goods used in the production processing is minimize and quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	8	20.0	20.0	20.0
	3	16	40.0	40.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Our firm ensure that cost of labour is minimize

	Frequency	Percent	Valid Percent	Cumulative

					Percent
Valid	2	8	20.0	20.0	20.0
	3	16	40.0	40.0	60.0
	4	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

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a. Based on availability of workspace memory

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a. Based on availability of workspace memory

Correlations

			production planning	quality
Spearman's rho	production planning	Correlation Coefficient	1.000	.506**
		Sig. (2-tailed)	.	.001
		N	40	40
	quality	Correlation Coefficient	.506**	1.000
		Sig. (2-tailed)	.001	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Notes

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a. Based on availability of workspace memory

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Nonparametric Correlation

Notes

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a. Based on availability of workspace memory

Correlations

			production planning	delivery
Spearman's rho	production planning	Correlation Coefficient	1.000	.571**
		Sig. (2-tailed)	.	.000
		N	40	40
	delivery	Correlation Coefficient	.571**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

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Nonparametric Correlations

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	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
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Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	157286 cases[a]

a. Based on availability of workspace memory

Correlations

			production planning	cost
Spearman's rho	production planning	Correlation Coefficient	1.000	.448**
		Sig. (2-tailed)	.	.004
		N	40	40
	cost	Correlation Coefficient	.448**	1.000
		Sig. (2-tailed)	.004	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=VAR00001 VAR00002
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		08-SEP-2023 04:10:02
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working	40

	Data File	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=VAR00001 VAR00002 /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01
	Number of Cases Allowed	157286 cases[a]

a. Based on availability of workspace memory

Correlations

			production routing	quality
Spearman's rho	production routing	Correlation Coefficient	1.000	.596**
		Sig. (2-tailed)	.	.000
		N	40	40
	quality	Correlation Coefficient	.596**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=VAR00001 VAR00002
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		08-SEP-2023 04:18:36
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	40
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR

		/VARIABLES=VAR00001 VAR00002 /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	157286 cases[a]

a. Based on availability of workspace memory

Correlations

			production routing	delivery
Spearman's rho	production routing	Correlation Coefficient	1.000	.813**
		Sig. (2-tailed)	.	.000
		N	40	40
	delivery	Correlation Coefficient	.813**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=VAR00001 VAR00002
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		08-SEP-2023 04:20:24
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	40
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=VAR00001 VAR00002 /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

	Number of Cases Allowed	157286 cases[a]

a. Based on availability of workspace memory

Correlations

			production routing	cost
Spearman's rho	production routing	Correlation Coefficient	1.000	.794**
		Sig. (2-tailed)	.	.000
		N	40	40
	cost	Correlation Coefficient	.794**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=VAR00001 VAR00002
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		08-SEP-2023 04:22:41
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	40
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=VAR00001 VAR00002 /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	157286 cases[a]

a. Based on availability of workspace memory

Correlations

			production Dispatching	Quality
Spearman's rho	production Dispatching	Correlation Coefficient	1.000	.871**
		Sig. (2-tailed)	.	.000
		N	40	40
	Quality	Correlation Coefficient	.871**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=VAR00001 VAR00002
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Correlations

			production Dispatching	delivery
Spearman's rho	production Dispatching	Correlation Coefficient	1.000	.797**
		Sig. (2-tailed)	.	.000
		N	40	40
	Delivery	Correlation Coefficient	.797**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=VAR00001 VAR00002
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE
```

Nonparametric Correlations

Notes

Output Created		08-SEP-2023 04:28:18
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	40
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=VAR00001 VAR00002 /PRINT=SPEARMAN TWOTAIL

		NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	157286 cases[a]

a. Based on availability of workspace memory

Correlations

			production Dispatching	cost
Spearman's rho	production Dispatching	Correlation Coefficient	1.000	.553**
		Sig. (2-tailed)	.	.000
		N	40	40
	Cost	Correlation Coefficient	.553**	1.000
		Sig. (2-tailed)	.000	.
		N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).