DEVELOPMENT OF SUSTAINABLE PRODUCTION PLANNING AND CONTROL FRAMEWORK FOR GREEN INDUSTRIAL PRODUCTIVITY IN NIGERIA.

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ABSTRACT

Sustainable production planning and control is significantly effective in overall productive growth in every industrial processes that require cautious planning from conceptual stage to production of final product enabling control and effective delivery. Thus this research deals with development of sustainable production planning and control framework for green industrial productivity in Nigeria industries, a case study of Mario plastic limited, Owerri Imo state. The data for this research were collected from professionals responsible for production planning in the firm and were analyzed and subjected to statistical test using statistical Package for Social Sciences (SPSS). The research result shows that out of 75 respondents 38(50.7%) strongly agreed, 20(26.7%) Agreed and 17(22.7%) Disagree to the need for production planning and control for effective productivity in a firm, out of 75 respondents 54(72.0%) strongly agreed, 16(21.3%) Agreed and 5(6.6%) Disagree to the fact that Production planning and control have impact on cost minimization during production, out of 75 respondents 57(76.0%) strongly agreed, 14(18.7%) Agreed and 4(22.7%) Disagree, that most firms make a prior designation of time for adequate production planning. Furthermore, factors militating against good production planning practice were identified to include, limited time scheduled for preparation of the production plan, limited sufficient information and instability in labor and cost of material. Environmental strategies involved in industrial developmental revolution was also applied as supportive instrument to development of green production planning and control framework. It was finally recommended that adequate time should be scheduled for production planning while appropriate planning techniques should be applied during projects executions in industries.

Keywords: Planning, Production, Industrial productivity, Production control, sustainability.

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INTRODUCTION

Production planning and control (PPC) is the delineation of work processes that necessitates the efficient deployment of human resources, raw materials, facilities, and equipment / machine, [1] Jain and Aggarwal. Production planning and control, in layman's terms, aids producers in allocating materials, machinery, and human resources to satisfy customer expectations.

Production planning and control cannot be overstated in their importance. The conversion of raw materials into completed commodities is known as production. This conversion process entails several steps, including determining what to create and how to make it. Olusegun, and Adegbuyi, [2].

The hypothetical view of Production planning and control, has showcase that most firms trivialize the Planning and control aspect of storage of finished products. Most firms produce goods in mass, without making possible forecast of market situations, in relation to competing products, which makes them store their goods in the warehouse thereby incurring demurrages, this will reduce the company’s profit or possible return on investment. Lack of forecast will cause negative experiences for the firm such as; loss of goods longevity. Thus there is need for sustainable Production Planning and Control for efficient industrial productivity.

Sustainability is greatly discussed in science and industry. The motivators for sustainable development of production companies are, for example, various groups of stake-holders such as employees, environmental activists and government bodies. Furthermore, other factors such as the

finite availability of resources, rising energy costs or the shortage of skilled workers are leading to a greater importance of sustainability aspects, Bruzzone et al [3].

The process of controlling workflow, inventories, backlogs, and changing operations level in order to maximize outputs and locate a sustainable market for goods and services is known as production planning and control. Wilson and Albright, [4] Jain and Aggarwal, [5] Jain and Aggarwal.

Production planning (PP) also known as Manufacturing planning is defined as the predetermination of manufacturing requirements within the purview of the firm, such as available materials, specific equipment, production runs, order status, finance, manpower, and the manufacturing process. It's the process of establishing a link between market demands and manufacturing capability in order to satisfy a company's sales goals. Manufacturing planning can be achieved primarily through the management of aforementioned elements above, according to Clotet [6]. Winston [7]; Lockyer, K. G [8]; Jain and Aggarwal [9]. This instrument, according to Buffa [10], is required in each firm, regardless of size or complexity. Perhaps it is because industrialized countries grasped and applied this basic strategy that they were able to stave off a global depression that could have wreaked havoc on their economies. The manufacturing system is a term that refers to the process that transforms elements into usable products. A process, then, is a method for converting inputs into outputs that is well-organized. The fundamental goal of this research in the Nigerian manufacturing business is to better understanding, create, and implement this system. If the production sector of the National economy is contributing less to GDP, there is likely a problem with the economy's understanding, design, and implementation of production planning and control (PPC), especially in the real sector, where manufacturing is dominant.

With context to the definitions above and also relating the term to Industrial productivity, it is necessary to define Industrial productivity. Literally, this means that Productivity measures the relationship between the amount of output and the amount of inputs used to make the products.

The enormous and most challenging task faced today by any firm is productivity. It is obvious that productivity in the traditional meaning of, "relation between quantities of output in relation to amount of input" Dheeraj, Nimawat & Ashish [11]. It is therefore, a necessity to provide a summary of literatures on production plans and control, as well as its imperatives towards achieving productivity on industries. For better understanding of the impact of manufacturing planning and control, intense assessment of the elements in manufacturing planning and control will be examined in other to buttress the impact on industrial productivity.

As a result, the highest production efficiency is accomplished by providing the needed number and quality of items in the required time and using the least expensive way possible Kia, R., Javadian, N., & Baboli, A, [12]. To attain this goal, management uses production planning as a tool to coordinate and speed up industry productivity. While this research has studied that adequate production planning and control has profound impact on the industrial productivity, it will be necessary to succinctly converse the elements of Production planning and control that give rise to positive impact to industrial productivity as opined by some prolific researchers who support the notion with their theories. Nieminen, [13] Forecasting is a strategy for projecting future expectations based on existing knowledge. Forecasting is a structural projection of prior knowledge rather than a prediction. Every planning for production, forecasting is most emphasized because it entails short-term projections for particular product demand utilized for scheduling and initiating production, while others are long-term, integrated models that are used to plan things like fundamental capacity needs, strategic plans, and long-term strategic decisions, purchasing decisions, Englewood Cliffs, NJ: Prentice Hall, [14]. The sales and operations planning is barely used for the actual production activity scheduling. Instead, the primary goal is to organize and coordinate resources, such as type, amount, and timing. More specifically, the sales and operations

planning tends to plan for inventory levels, cash flow, Human resources needs, Capital needs, Production outputs, Ling, Richard C [15], Forgarty et al [16].

The purpose of Production and Planning Control is to create what the market want on a continuous basis at the predicted quality, volume, time, and cost, as well as to adjust to system interruptions when necessary. The Production and Planning Control system contains all of the tools and processes needed to achieve that goal, according to Wiendahl et al [17]. Production and Planning Control is an important function for manufacturing managers. The fit of the Manufacturing and Planning Control system to the manufacturing system is one of the most important aspects of operations management research, as the amount of fit often determines a production enterprises Effectiveness, productivity, and lengthy viability. In practice, however, Manufacturing and Planning Control managers must contend with a slew of issues, including shifting global warming, government regulations, and other global events, all of which keep the universe in a condition of near-constant upheaval. Production managers are constantly attempting to increase product and process flexibility to handle increasing complicacy and contemporary purchase needs, resulting in deeper list of materials and higher variance in manufacturing routings, Vollman et al [18]. This makes Production and Planning Control more difficult, As a result of queueing or waiting time, manufacturing lead time is still squandered. Arnold [19].

Additionally, recent advancements in the telecommunications (ICT) model—as part of the industry 4.0 concept, point out the ability to transform all levels of a product's lifecycle (Development, acquisition, manufacture, dissemination, consumption, and regeneration are all part of the process.) by allowing plant and supply chain processes to be planned and controlled in real time, thereby mitigating wastage, Ivanov et al [20]. While there have been a number of artificial intelligent manufacturing conceptual studies, most of which have focused on the configuration and features of manufacturing systems, there have been very few empirical in-depth case studies that

explicitly concentrate on the systems' administration processes, Moeuf, et al [21]. Furthermore, only a few of these studies have included a discussion of the imperative of manufacturing planning, Sun et al [22]. It is necessary to speculate that this is a missed opportunity, as the Production and Planning Control process is the most important “smartness” component a green factory, acting as a heart for the manufacturing process. Furthermore, approaching the problem from the perspective of Production and Planning Control, it allows businesses to gradually progress toward smart and sustainable manufacturing.

As a result, this research focuses on how to implement a "smarter" or "machine-intelligent" Production and Planning Control system (hence, smart Production and Planning Control), as well as the long-term ramifications of a system like this and its processes. New age Production and Planning Control combines emerging industry advanced technologies and capabilities with Production and Planning Control processes to improve production system performance by using actual, statistics, and continuous improvement from a broader set of data sources than typical. The possibilities for artificial intelligent Production and Planning Control are endless: to use actual requirement and production system data to mitigate forecast instability; to be constantly moving, thus modifying regularly and reactive to actual data; to use an elaborated set of factors and data, including telemetry data; to be able to precisely predict short-term requirements and support increased flexibility. If these objectives are met, it will result in more exact planning, reduction or removal of various wastes generated, and, in the end, a competitive edge Manufacturing Planning and Control is commonly expressed using hierarchical models, which depict the various aspects of the process at various levels of complexity and time limits. A framework was created to enable a better accounting of the process of Production Planning and Control. The strategic (long-term), tactical (medium-term), and operational (short-term) stages are described in the framework as the standard stages of planning that exist within a common enterprise resource planning (ERP) system,

irrespective of the type of industry in issue. However, there are various different Production Planning and Control frameworks, such as Bonney's [23], which takes a fresh look at the Production Planning and Control process and emphasizes the imperative of feedback loops. In the tactical and operational levels of Production Planning and Control, these loops appear to be quite common and crucial.

The different environmental strategies used in the process of industrial revolution include, Passive stage, where we experienced lack of recognition for the problem until mid-20th century, Re-active: End-of-pipe treatment (the 1970s), Constructive stage that involved recycling and energy recovery (the1980s) and pro-active strategy that concentrated on Cleaner production and sustainable entrepreneurship (the 1990s) leading to presently suggested sustainable green production planning and control for green industrial operational processes strategy that would not compromise the industrial need and development of the future generation. Cleaner production manual [24].

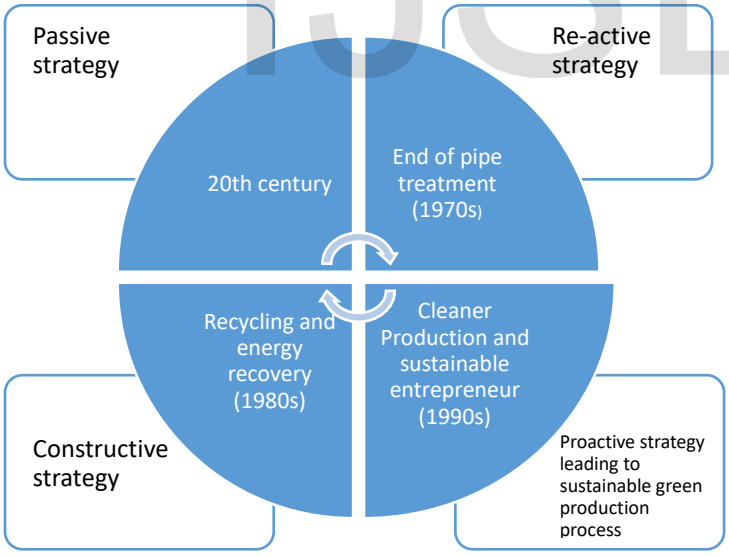

Figure 1: Environmental strategies involved in industrial developmental revolution

The strategic level takes a long-term, trend-oriented approach to production. Sales and operations planning are the first steps in the process, with the goal of balancing total demand with available capacity. Sales and operations planning get demand data (volumes by product family per planning

period) and, in some cases, meta data (such as prediction uncertainty) from demand management (DM) and future usable aggregate capacity from resource planning (RP). This level's aggregated plan is then disaggregated into individual commodities from the product family. It is not always accurate because the plan is clustered and has a proportionally longer time limit than others.

Demand projection data, which can be obtained from past demand data, approximated from past knowledge by the sales and marketing team, or a combination of the two, is the most relevant data for this stage. The master production scheduling (MPS) is the principal outcome, which comprises purchase and manufacturing plans for individual products by time period, often weeks. The input to the tactical level comes from this level. At the tactical level, master production schedule records are merged with bill of materials data and inventory data to compute component and part demands and indicate when replenishing material orders should be released, a process known as materials requirements planning (MRP). Based on the production system's capabilities and lead times, which define the capacity needs planning (CRP) process, it is possible to provide technical material and capacity plans with a short time horizon (typically weekly). These plans are reviewed on a regular basis, and the stage's result is production plans and refilled material orders, which are then used to feed the operational stage.

Finally, the key focus at the operational level is on how to carry out the firm's manufacturing system using the resources and capacity plans established by the Master production scheduling and capacity requirements planning. The methods entail meticulous daily transition work schedules, the alignment of actual manufacturing processes (shop floor control, SFC), and the provision of buying schedules to the purchasing function or supplier systems for the efficient supply of materials needed to carry out daily operations. At this stage, the papers are purchase orders at the component level and work orders and job lists at the work center level.

MATERIALS AND METHODS

The methods of this research will include; research design, study population and sample size, technique for selecting the samples the instrument used for selecting samples, primary data collection, secondary data collection and the techniques for data analysis. Hypothetical statements such as **H0**$_1$: Effective production planning and control does not have impact on industrial productivity and **H0**$_2$ Effective production planning and control has impact on industrial productivity were adopted. Research design adopted by the study was descriptive, combined with a quantitative research approach. This was aimed at collecting information to investigate the influence of production planning and control on industrial productivity using a case study result style which was focused on Mario plastic limited Owerri, Imo state as a case study. A total of seventy five (75) personnel were selected at random. The data collected was analyzed using the Statistical Package for Social Sciences (SPSS). Tables were used to present the findings, as seen below.

RESULTS AND DISCUSSION

This research considered the development of sustainable green production planning and control strategy for the enhancement of green production process that would take care of our present production needs without interfering negatively on the production needs of the future generation. Figure 2 below shows a diagrammatic display of sustainable green production planning and control framework for efficient industrial process performance that considered to follow a pattern that would motivate green industrial production and development process. Green production planning considered the use of experts with very good knowledge of green planning concepts that would involve green efficient energy consideration and green raw material input while sustainable green control strategy considers waste minimization, waste treatment and waste recycling. Furthermore, sustainable green production involves green production implementation, green production output, green production packaging and green product distribution while Green sustainable production

planning and control monitoring would involve assessment, evaluation, Audit, Enforcement and Punishment for defaulters.

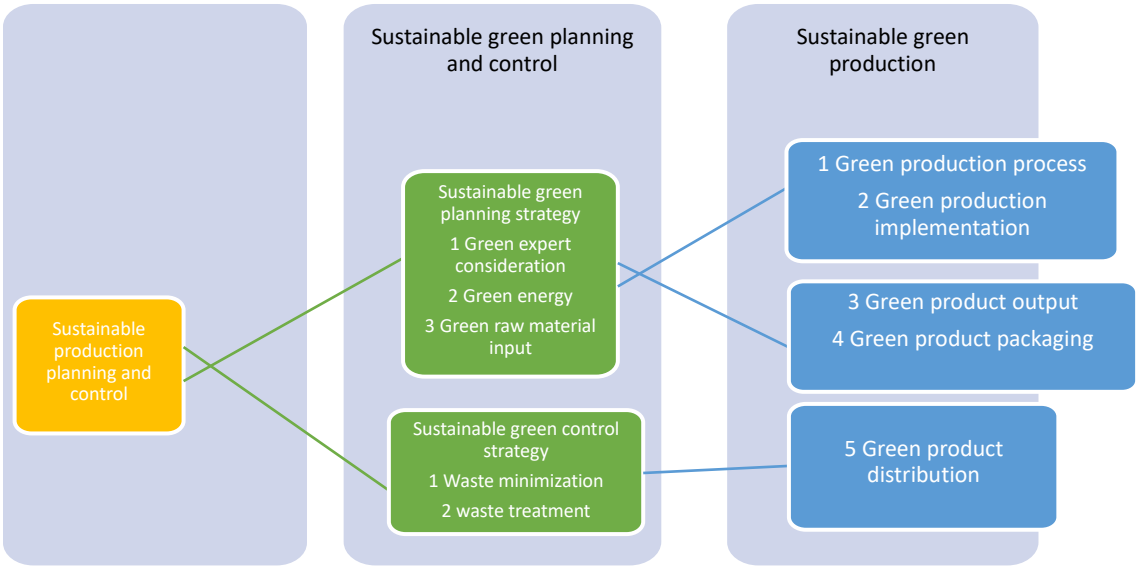

Figure 2: Sustainable green production planning and control framework

Table 1: There is need for production planning and control for effective productivity in a firm?

	Frequency	Percent	Valid percent	Cumulative percent
Disagree	17	22.7	22.7	22.7
Agree	20	26.7	26.7	49.3
Strongly Agree	38	50.7	50.7	100.0
Total	75	100.0	100.0	

From table 4.1 above it shows that out of 75 respondents 38(50.7%) strongly agreed, 20(26.7%) Agreed and 17(22.7%) Disagree. From the results, it shows that most firms embrace production planning and control for effective productivity. Below is the graphical representation of Table 1.

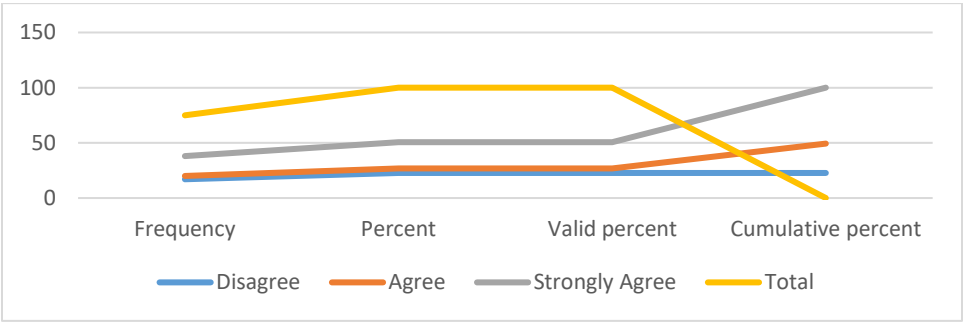

Figure 1: **There is need for production planning and control for effective productivity in a firm?**

Table 2: Does production planning and control have impact on cost minimization during production?

	Frequency	Percent	Valid percent	Cumulative percent
Disagree	5	6.7	6.7	6.7
Agree	16	21.3	21.3	27.9
Strongly Agree	54	72.0	72.0	100
Total	75	100.0	100.0	

From table 4.2 above it shows that out of 75 respondents 54(72.0%) strongly agreed, 16(21.3%) Agreed and 5(6.6%) Disagree to the fact that PPC have impact on cost minimization during production. Below is the graphical representation of Table 2.

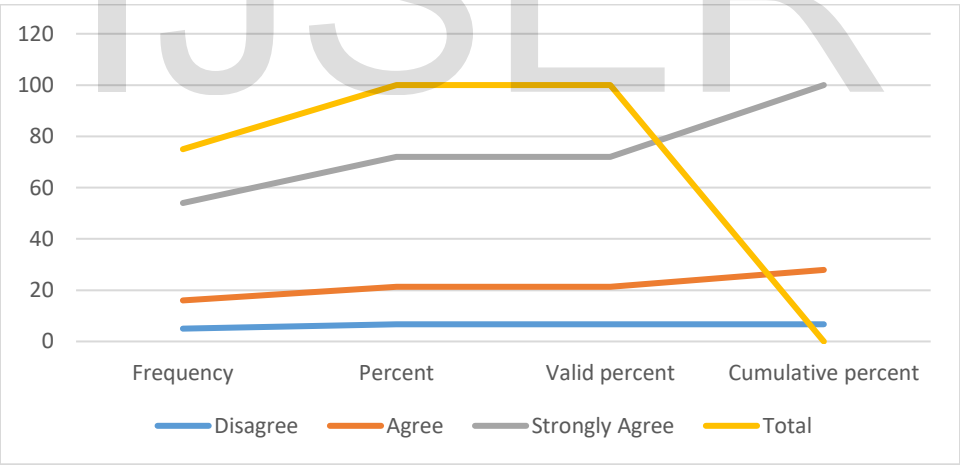

Figure 2: **Does production planning and control have impact on cost minimization during production?**

Table 3: There should be prompt provision of time for adequate production planning

	Frequency	Percent	Valid percent	Cumulative percent
Disagree	4	5.3	5.3	5.3
Agree	14	18.7	18.7	24.0

Strongly Agree	57	76.0	76.0	100.0
Total	75	100.0	100.0	

From table 4.3 above it shows that out of 75 respondents 57(76.0%) strongly agreed, 14(18.7%) Agreed and 4(22.7%) Disagree. This indicates that most firms make a prior designation of time for adequate production planning. Below is the graphical representation of Table 3.

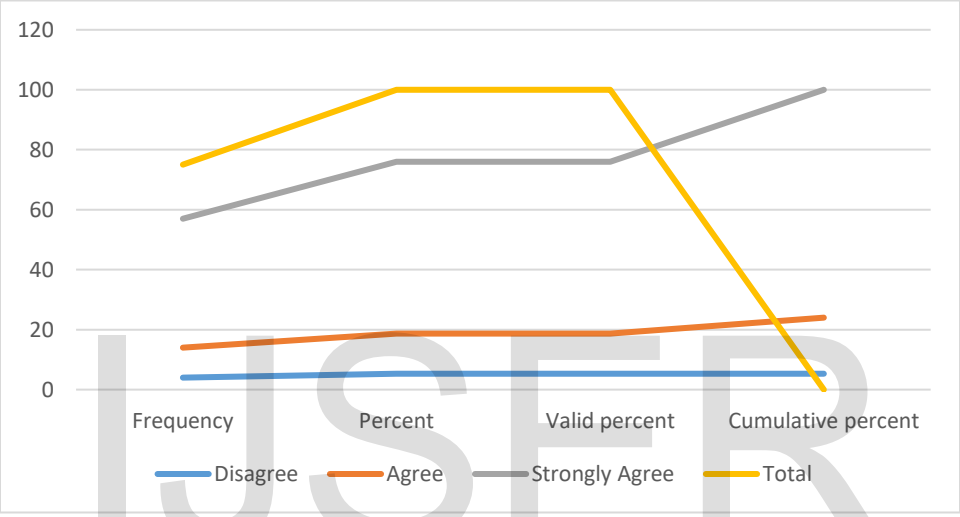

Figure 3: There should be prompt provision of time for adequate production planning

Table 4: Does production planning & control have negative impact on cost minimization during production?

	Frequency	Percent	Valid percent	Cumulative percent
Disagree	50	66.7	66.7	100
Agree	18	24	24	33.3
Strongly Agree	7.0	9.3	9.3	9.3
Total	75	100.0	100.0	

From table 4.4 above it shows that out of 75 respondents 7(9.3%) strongly agreed, 18(24.0%) Agreed and 50(66.7%) Disagree to the fact that PPC have negative impact on the flexibility to change in plants working. Below is the graphical representation of Table 4.

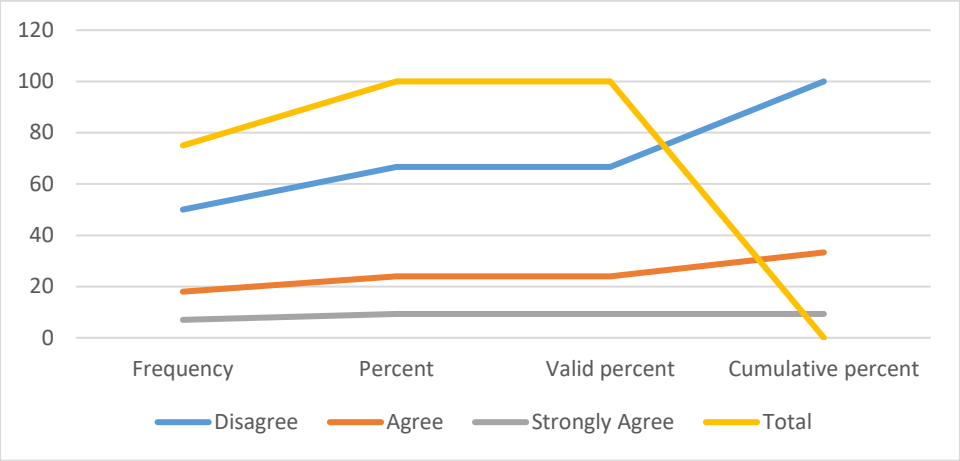

Figure 4: **Does production planning & control have negative impact on cost minimization during production?**

CONCLUSIONS AND RECOMMENDATIONS

The discussion set out to examine the impact of production planning and control on industrial productivity, which was successfully actualized with a case study of Mario plastic limited, Owerri Imo state. The results point to major stakeholders in the firm, with majority having industrial experience not less than six years. Findings also show that a good number of firms start production planning before execution of the manufacturing process. None of the departments start manufacturing planning during production stage. Majority of the respondent agreed to all the questions that prove positivity to production planning and control.

The productivity performance of a company is a key indicator of its success; as a result, business executives work tirelessly to achieve this goal. One of the most common ways to do this is to reduce costs. We discovered that production planning had a considerable impact on cost minimization in this study. Cost reduction is a boon for industrial production, according to 93.3 percent of respondents.

The following suggestions were made based on these observations.

Because production planning and control improves industrial efficiency, Nigerian industries must work diligently to design and conduct effective and formal production activities, Regardless of the company's size or age. Nigerian industry should use advanced technologies, computer assisted design and manufacture (CAD/CAM), robotics, and flexible production processes. In addition, there is a formal tie between Nigeria's industrial industry and tertiary institutions. Regardless of the company's size or age. Advanced technology, computer assisted design and manufacturing (CAD/CAM), robotics, and flexible production methods should all be adopted by Nigerian industry. In addition, there is a formal tie between Nigeria's industrial industry and tertiary institutions.

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