

Enhancing Manufacturing Performance in Nigeria through Production Layout and Design

Needorn Richard Sorle

Department of Management, Faculty of Management Sciences, University of Port Harcourt, Nigeria

Abstract: All organizations work towards enhancing their operation given that it is a critical expectation of every firm. This is as a result of the importance of enhanced performance to the organization that ranges from increased output, better quality product, better production techniques etc. In the light of this, scholars in management discipline and business-related fields have made several postulations bordering on enhancing performance. From the volumes of reviewed works on the approaches and suggestion on how to enhance performance, it was observed that there exist variation in views and postulation, maybe due to differences in disciplinary background, standpoint and expected outcomes. XXXXXXXXXXXXXXXX The examined management literatures do not consider production layout and design as an option for enhanced performance. It is this observed lacuna that informed this study; thus, this study differs from every other study on the subject of performance enhancement because it postulates and approaches performance enhancement through production layout and design techniques. Thus, it attempts to seek explanation on how production layout and design techniques can be used to enhance performance in the manufacturing firms in Nigeria. Production layout and design was measured using product layout; process layout and group technology layout, while improving performance was measured using cost reduction; and improved quality production, the predictor and criterion variables were moderated Organizational Culture. To put the work in focus and proper perspective seven null Hypotheses was structured and tested using Structure Equation Modelling using Amos (version 3.34) and Scientific package for social science (version 3.26). The choice of these statistical tools and package is due to their adequacy and appropriateness to the research. Findings and analysis from the hypotheses reveal that hypothesis one to seven was rejected and thus the alternative one accepted since result did not support the positions of the hypotheses. Results of the one to six hypotheses show moderate impact and positive relationship between the examined dimensions of the predictor and the measures of the criterion variables with varying level of effect size and predictive accuracy. The hypothesis seven where the moderator was introduced show a further reduced impact even if it was still positive. Consequent on those findings six basic recommendations were advanced.

Keywords: Enhanced Performance, Production Layout and Design, Product Layout, Process Layout, Group Technology Layout, Reduced operational Cost, Quality Product, Structural Equation Modelling.

INTRODUCTION

Enhanced operation is the critical expectation of everything firm. Owners of organizations work towards enhancing their operation because of its importance. Scholars in management discipline and business-related fields have made several postulations bordering on enhance operation. The concept has been viewed differently by different scholars (Bititci et al., 2021; March & Sutton, 1997; Cook & Bala, 2007).

148	ISSN 2576-5973 (online), Published by "Global Research Network LLC" under Volume: 5 Issue: 8 in Aug-2022 https://www.grnjournals.us/index.php/AJEBM
	Copyright (c) 2022 Author (s). This is an open-access article distributed under the terms of Creative Commons Attribution License (CC BY).To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

It defines the outcome or result for organization was set up to achieve at a define period and to that extend serves as a bases of comparaison and assessment to examine if the desired outcome was achieved (Kyrgidou & Spyropoulou, 2013; Cook & Bala, 2007). There exist in management literatures volumes of perception and approaches on the definition of performance or enhanced operation due to variation and disciplinary background, standpoint and expected outcomes. Suffice therefore to allow this study to broadly compartmentalized this volumes of views based on standard operational variants of objective and subjective definition as proposed by (Dees & Robinson, 1984; Cook & Bala, 2007). Thus, all the overall activities that are undertaken in the organization that are measurable in terms of tangible results and outcome that reflect the true position of the firm such as profits, returns on assets, cash ratio or output volume are objective measures (Darwish & Singh, 2013; Hubbard, 2009; Kyrgidou & Spyropoulou, 2013; Brush et al., 2000, Hawawini, Subramanian & Verdin, 2003). The subjective measure views performance or operation from a perception-based angle (Singh et al., 2016). This study will adopt the both views. In the light of that enhanced, operation or performance is define here as the ability or efforts by organization to work towards reducing cost, efficient order time, improve effectiveness and all other efforts that guarantees increase output and operation (Heizer, Render & Weiss, 2008). It is the outcome of policies and principles that reduces operational cost, enhance quality, minimum operational time, increase output, flexibility, gains competitive advantage and customers and stakeholders satisfaction (Sharma & Modgil, 2020). As could be adduced from the direction of discussion, enhanced operation guarantees increase output, reduced operational time, reduced cost, operational flexibility, improved quality, increased patronage, stakeholder's satisfaction, and competitive edge.

Consequent on the numerous economic benefits and impact that enhanced operation or performance have on organizational growth and survival, lots of scholarly works have been undertaken, evident in management literatures suggesting and postulating on how to enhance performance of organization. Schoeder, Shah & Xiaosong-Peng, (2011) holds that organizational performance determines the competitiveness of the firm, thus, enhanced operation means having competitive edge. To have enhance operational performance, organizations should craft out strategies and principles that that increase output quality and reduce production cost to guarantee price advantage (Chavez, Yu, Gimenez. Fynes and Wiengarten, 2015). Sharma & Modgil (2020) argues that organizational focus on quality analysis and control can cause a redirection and paradigmic shift to enhancing operation. Harrington (1991) as cited in Olukade and Isichei (2021) argues that one of the ways of improving performance is through process improvement. Process improvement in the light of this discourse is seen as all the approaches that adopted some specific method to improve the operations and functional system of the firm. It is the systemic efforts that the apex management take to advance in its operation through changes in processes and operational procedures (Harrison, 1995). Experiential and empirical evidences has shown that enhance operation are critical to organizational and operational effectiveness, increase output, good quality product, better services and process quality, customer satisfaction, revenue, profit and returns on investment (Kaynak, 2008; Chavez, Gimenez, Fyne & Wiengarten, 2015; Olu, Liu, Hung & Yen, 2010; Lau, Lee & Jung, 2018; Santos, Lannelongue, Gonzalez-Banito, 2019).

Irrespective of the volumes of literatures on the subject of performance or enhanced operation where scholars advance several postulation and approach on how to improve performance given numerous contribution to all facet of organizational life one area that appear to have attracted not much attention is from the perspective of facility layout. The direction of interest of the cited scholars were merely procedural strategies and supposedly aggregate outcomes of the proposed action. While I do not contest the likely outcomes of the application of the proposed strategy, I am inclined to state here that empirical evidences and reviews show that much work is not document on the impact of location and enhanced operation. The closer attempts on discourse on the subject of location are those undertaken by Study of Wangari Muchiri and Onyancha (2018) were issues raised were that facility layout design has a major

impact on manufacturing cycle time hence throughput rate; Roslin *et al.* (2008) on facility planning in manufacturing process using witness. Comparing two alternative design of layout and works by operation scholars were the much work done is at best a mere review of the benefit of facility layout on the entire organizational operation. Nevertheless, suffice it be stated here that good facility layout and structures can contribute to better and enhance operation of the firm in terms of output level, safety etc. It is based on this line of thought that this work is structured to examine facility layout and enhanced operation in the manufacturing firm in Nigeria

The departure of this work from every other work is that it examines relationship between facility layout of the manufacturing firms and enhanced operation. Thus, the study conduct an empirical research into the impact of facility layout on enhanced operation of the manufacturing firms in Nigeria.

LITERATURE REVIEW

Theoretical Framework: Goal Approach Theory and Lean Manufacturing

Theory Goal Approach Theory

Propounded by Edwin A. Locke in (1968), the traditional way to study performance has been the goal approach (Price (1972) and Brown (2011)). Goal accomplishment is the most widely used effectiveness criterion for organisations (Beulens, Sinding, Waldstrom, Kreitner and Kinicki, 2011). Price (1972) and Brown (2011) state that the distinguishing characteristic of goal approach theory is that it defines performance in terms of the degree of goal achieved. The greater the degree to which an organisation achieves its goals, the greater its performance. In this approach the definition of goal is important. Etzioni (1964) defines organizational goal as a “desired state of affairs which the organization attempts to realize”. It is predicated on the assumption that an organisation is effective if it accomplishes its stated goals and that this model is preferred when goals are clear, time bound, consensual and measurable - Cameron (1986). According to Glunk and Wilderom (1999) the goal approach has its roots in the mechanistic view of the organisations. These authors explain that this approach centers on the degree to which organisations realize output goals such as profitability, growth and productivity. According to Martz (2008) the goal model defines performance as a complete or at least partial realization of the organisation’s goals. Regarding the identification of an organisation’s goals, Yuchtman and Seashore (1967) distinguish between two major doctrines. They refer to the first doctrine as the “prescribed goal approach”, characterized by a focus on the formal charter of the organisation, or on some category of its personnel (usually its top management) as the most valid source of information concerning organizational goals. They refer to the second doctrine as the “derived goal approach”. Here the investigator derives the ultimate goal of the organisation from his functional theory, thus arriving at goals which may be independent of the intentions and awareness of the members. Yuchtman and Seashore (1967) state that the “prescribed goal approach” is the most widely used by students of organisations. According to Martz (2008), the goal model presumes organisations are rational, deliberate and goal seeking. It also incorporates a number of presuppositions, such as that organizational goals do in fact exist. Martz (2008) explains that other assumptions inherent in the model are that organizational goals are specific and measureable, realistic, operative and not simply officially stated goals relevant to the organisation purpose. The goal approach has been supported by various authors. For example Cunningham (1977) states that the goal model gives feedback on the organisation’s effectiveness in achieving its goals. He further states that it focuses attention on the systematic relationship of each activity, role and function to the overall goals and objectives of the organisation. Steers (1977) also supports the goal model for evaluating organizational performance. He argues that the major advantage of the goal approach is that organisation success is measured against organizational intentions instead of against an investigator’s value judgments. This theory is pertinent to this study because it presumes organisations are rational, deliberate and goal seeking.

Lean Manufacturing Theory

Lean production is a prominent manufacturing philosophy that is based on customer-focused process improvements and has its roots based on foundational ideas that date back to W. F. Taylor (1911) and to H. Ford. The key idea is to increase value to customers while reducing the number of resources consumed and cycle times via waste elimination. It is concerned with implementing some ideas like dimensioning the manufacturing resources according to actual demand (rightsizing), improving the self-monitoring capabilities of equipment to ensure quality, designing the process layout to facilitate the sequence of the operations, studying and improving quick setups to enable rapid changeovers and the use of Kanbans to coordinate the production pull from and link one workstation to its predecessors and successors, and also to link the company with its suppliers and enable Just-in-time supply (Womack, 2002). These processing improvements made possible to offer a wide variety of products in a sequence that reflected more closely the market’s demands, reducing lead times and eliminating the need for large volumes of inventory. Lean is a philosophy of manufacturing that incorporates a collection of principles, tools and techniques into the business processes to optimize time, human resources, assets, and productivity, while improving the quality level of products and services to their customers (Ronald, 2001). Lean manufacturing is a multi-dimensional management practice including just in time, quality systems, work teams, cellular manufacturing, supplier management, etc. in an integrated system (Singh et al., 2011).

This theory is related to the present study in the sense that the focus of facility layout is to plan, coordinate and organize material for production purposes in such a manner that would be cost effective and zero waste.

Performance or Enhanced Operation

Performance has become a relevant concept in strategic and other management literature and research due to the importance on the totality of organizational operation. Research and postulations are made on how to enhance operations of firm to make them more productive and successful. Successful firms represent a key ingredient for developing nations. To survive in a competitive business environment, every firm should work to enhance their operation and become very productive. operate in conditions of performance In the 50s, firm performance was considered as the equivalent of organizational efficiency, which represents the degree to which an organization, as a social system with some limited resources and means, achieves its goals without an excessive effort from its members. The criteria used for assessing performance are productivity, flexibility, and inter-organizational tensions (Georgopoulos & Tannenbaum, 1957). Later in the 60s and 70s, organizations began to explore new ways to evaluate their performance. During this time, performance was defined as an organization's ability to exploit its environment for accessing and using the limited resources (Yuchtman & Seashore, 1967). In the 1980s, the firm performance depended on its ability to create value for its clients (Porter, 1986). Robbins (1987) defined performance as the extent to which an organization, as a social system, could consider both its means and ends. Cherrington (1989) considered performance as a concept of success or effectiveness of an organization, and as an indication of the organizational manner that it is working effectively to achieve its goals successfully. During the following decade, Adam (1994) considered organizational performance as deeply dependent on the employees’ input quality. He believed that in order to guarantee a high-quality organizational performance, it is essential to have regular exposure of the workers of the company to new and up-to-date knowledge and skills, which would, in turn, help them keep up with the new changes happening in the market, and, ultimately, increase the quality of organizational performance. In the first decade of the twenty-first century, the definition of organizational performance principally focused on the capability and ability of an organization to efficiently exploit the available resources to achieve accomplishments consistent with the set objectives of the company, as well as considering their relevance to its users (Peterson, Gijsbers, & Wilks, 2003). Verboncu and Zalman (2005) appreciated that performance is a

particular result obtained in management, economics, and marketing that gives characteristics of competitiveness, efficiency, and effectiveness to the organization and its structural and procedural components, thus, performance acts as the basis of organization improvement

However (David et al., 2016) identified the major two benefits namely, increased customer loyalty resulting from quick response to customers’ order and an opportunity to charge premium prices again speedy delivery. Schoeder, Shah & Xiaosong-Peng, (2011) holds that organizational performance determines the competitiveness of the firm, thus, enhanced operation means having competitive edge. To have enhance operational performance, organizations should craft out strategies and principles that that increase output quality and reduce production cost to guarantee price advantage (Chavez, Yu, Gimenez. Fynes and Wiengarten, 2015). Sharma & Modgil (2020) argues that organizational focus on quality analysis and control can cause a redirection and paradigmic shift to enhancing operation. Harrington (1991) as cited in Olukade and Isichei (2021) argues that one of the ways of improving performance is through process improvement. Process improvement in the light of this discourse is seen as all the approaches that adopted some specific method to improve the operations and functional system of the firm. It is the systemic efforts that the apex management take to advance in its operation through changes in processes and operational procedures (Harrison, 1995). Experiential and empirical evidences has shown that enhance operation are critical to organizational and operational effectiveness, increase output, good quality product, better services and process quality, customer satisfaction, revenue, profit and returns on investment (Kaynak, 2008; Chavez, Gimenez, Fyne & Wiengarten, 2015; Olu, Liu, Hung & Yen, 2010; Lau, Lee & Jung, 2018; Santos, Lannelongue, Gonzalez-Banito, 2019).

The increase in the number of concepts used in the definition of performance is sometimes confusing as it has been used to imply productivity, increased output, reduced operational cost, increased revenue, increase sales volume, profitability, competitiveness, efficiency, to organizational and operational effectiveness, increase output, good quality product, better services and process quality, customer satisfaction, revenue, profit and returns on investment (Kaynak, 2008; Chavez, Gimenez, Fyne & Wiengarten, 2015; Olu, Liu, Hung & Yen, 2010; Lau, Lee & Jung, 2018; Santos, Lannelongue, Gonzalez-Banito, 2019; Elena-Iuliana & Maria, 2016). A firm that desire success should work to enhance its operation and thus achieve the highlighted outcomes. The chosen dimension of enhanced operation or performance in this study is cost reduction and improved quality product.

Cost Reduction

Cost is said to be reduced if the prices of all the elements of production fall as output expands. An industry is said to be reducing cost if its long run supply is negative signifying that output will rise as prices drops. The increased demand for factors inspires their suppliers to improve their skills, so that factor costs become lower per unit of output. The decline in factor prices shifts the cost of individual firms downwards. The manufacturing supply shift so that fee in the long run falls beneath the early level (Koutsoyiannis, 1979).

The cost emphasis focuses on the efficiency of the firm’s processes. General cost reduction efforts (downsizing) do not necessarily improve efficiency, but quality efforts that reduce costs always do. Every successful program should tend to accelerate the productivity of quality efforts by reducing the input required to produce a unit of output. Customer satisfaction improvements and increase patronage can be sought indirectly, through such results as increased reliability and lower prices. Cost reduction programs thus transfer their savings to the bottom line directly. Methods of quantifying cost reductions are referred to as “cost of quality” programs (Bohan & Horney 1991; Campanella 1990; Carr 1992; Gryna 1988). All organizational programmes and activities should be geared towards improve quality at reduced operational cost to manifest in increase profit. All efforts and organizational activities that guarantee this

is strategic and thus, encouraged. Effective facility layout does not only guarantees efficient and smooth operation but save cost, reduced operational time and organizational safety.

Improved Quality Product

Quality product signify that a product satisfy or exceed customer’s expectations (Waters & Waters, 2008). The most known and general operational definition postulates quality as the customer's perception of product and service excellence. In today’s competitive world, quality is prime to an organization’s success as well as survival. Intense worldwide rivalry over price determination, market share, growth rate and product quality has accelerate the increasing significance of quality. Superior quality no longer distinguishes participants; instead, it authenticates the earnestness of a business organization to compete (Giffi et al., 1990). Business organizations worldwide whether involved in the manufacturing of physical goods or the provision of services or both recognize quality as a foremost competitive instrument for improvement or maintainers of their market share as well as sale growth. Thus, business organization continuously nurture innovative ways using quality management principles with a vision to design continuous techniques as well as procedures in order for effective control and sustainability of quality in the pursuit of excellence.

Quality is critical to corporate success as it demonstrate a significance role in improving organizational productivity and patronage. This is evidenced in the work of Aremu, Ekpo, and Mustapha (2013) who asserted that a quality product leads to a good consequence. Kotler and Armstrong (2012) stipulated that product quality is the distinctness of a product or service in fulfilling customer needs. While Ehsani (2015) said that quality of product is the customer's perception of the overall quality or superiority of the product or service, with respect to its intended purpose, relative to alternatives. Kotler and Armstrong (2012) assumed that product quality is the characteristic of a product or service that bear on its ability to satisfy stated or implied customer needs. Quality thus is a deciding factor by how much offerings are valued by the consumers. According to Palmer (2005) quality can only be expressed by customers and occurs where an organisation supplies goods or services in the specifications that satisfy their implied customer’s needs. Quality thus is synonymous with the high expectations of customers towards a product. Similarly, Cooper (2002) opined that quality is the degree to which an object (e.g., process, product, or service) satisfies a specified set of attributes or requirements.

Facility Layout and Design

Facility layout refers to the configuration of departments, work center, and equipment, with particular emphasis on movement of work (customers or materials) through the system (Stevenson, 2009). It’s the physical arrangement of the workplace, that is, assignment of departments to specific locations on the production floor (Heragu, 2006). Facility planning is concerned with the design, layout, and accommodation of people, machines and activities of a system or enterprise within a physical spatial environment (Stevenson. 2009). Furthermore, Huang (2002) states that facility layout design determines how to arrange, locate, and distribute the equipment and support services in a manufacturing facility to achieve minimization of overall production time, maximization of operational and arrangement flexibility, maximization of turnover of work-in process (WIP) and maximization of factory output in conformance with production schedules. It is the spatial disposition of equipment and machinery in a firm (Mac’Odo, 2001)

Factory or facility layout is a procedure for managing factory physical facilities to support the smooth production process (Wignjosobroto, 2000). Facility layout is a function that involves analysis (synthesis), planning and design of the interrelationships between physical facility arrangements, material movements, activities associated with personnel and the flow of information needed to achieve optimum performance in the range of related activities (Apple, 1990, cited in Bintang, Lina, Lamto & Daywin, 2019).

Significance of Facility Layout and Design

According to Stevenson, facility layout facilitate smooth flow of work, material and information through the system (Stevenson, 2009). Heragu further explains that an effective physical arrangement of departments minimizes the movement of personnel and material between departments, and thereby decreasing material handling costs, increasing a systems’ efficiency and productivity (Heragu, 2006). It likewise facilitates the entry, exit, as well as placement of materials and products whilst eliminating bottlenecks (Gupta, Gopalakrisnan, & Turuvekere, 2004). Besides, proper layout design directly and indirectly minimizes the overall cost of products while increasing productivity and performance. Cost reduction due to facility layout mainly is as a result of decreased material handling costs (Naqvi, Fahad, Atir, Zubair, & Shehzad, 2016). Between 20 and 50% of the total operating costs within manufacturing is attributed to material handling. Effective facilities planning can reduce these costs by at least 10% to 30% and thus increase productivity (Tompkins, White, Bozer, & Tanchoco, 2010). The indirect cost reduction is as a result of effective utilization of space, workers and infrastructure, increased wellbeing and morale of the workers (Eida & Siti , 2008), attainment of product or service quality as well as increased safety of the plant (Stevenson, 2009).

Facility layout planning is likewise required for providing a cost benefit to the organisation. It help in reducing the transportation cost for the organisation. This ultimately helps in decreasing the cost of production and generating cost advantage for the organisation. It is also needed to identify proximity to the sources of raw materials and transportation facilities. The determinants of facility layout decision are availability of power; transportation; suitability of climate, space, job flow, available amenities, supervision and safety policies. There are four basic known layout type which include product, process, group technology and fixed position layout. In manufacturing systems, the three main types of facility layout are product layout, process layout, and group layout, which is further categorized into flow line, cell, and center. According to Tompkins (2003) the distinction between these types of layout is made based on system characteristics such as production volume and product variety. Hessen (2018) stated that product layout (flow shop) is associated with high volume production and low product variety, while process layout (job shop) is associated with low-volume production and high product variety. I will however in this study adopt the three highlighted ones as the dimension.

Product Layout

Product layout is generally used for factories that produce one kind or group of products in large numbers and for a long time. With a layout based on production flow, machines and other production facilities will be arranged according to the principle of the machine after the machine. Here machines are arranged according to the production flow of the product. Machines are arranged in the order in which the process is determined in order of production, no matter the type of machine used. Each component runs from one machine to the next through the entire operating cycle required. With this type of layout, a product will be done until finished within the department without needing to be moved to another department. Here raw materials will be moved directly from one operation to the next so that it can be concluded

In this type of layout, machines and auxiliary services are located according to the processing sequence of the product. If the volume of production of one or more products is large, the facilities can be arranged to achieve efficient flow of materials and lower cost per unit. Special purpose machines are used which perform the required function quickly and reliably. The product layout is selected when the volume of production of a product is high such that a separate production line to manufacture it can be justified. In a strict product layout, machines are not shared by different products. Therefore, the production volume must be sufficient to achieve satisfactory utilization of the equipment. Thus, the product layout definition explains that a product layout is a systematic approach of arranging different machines in a sequential order to provide products.

Process Layout

It is a method of regulating and placing all production machines and equipment that have the same type/type or perform same task into one department. So machines are grouped according to the similarity of processes or work functions. This layout is suitable for the production of products with high product variations and low production volumes (Wignjosobroto, 2000). Process layout is recommended for batch production. All machines performing similar type of operations are grouped at one location in the process layout e.g., all lathes, milling machines, etc. are grouped in the shop will be clustered in like groups. Thus, in process layout the arrangement of facilities are grouped together according to their functions. The flow paths of material through the facilities from one functional area to another vary from product to product. Usually, the paths are long and there will be possibility of backtracking. Process layout is normally used when the production volume is not sufficient to justify a product layout. Typically, job shops employ process layouts due to the variety of products manufactured and their low production volumes.

Group Technology Layout

It is a layout based on grouping of products or components to be made. In this case the grouping is not based on the similarity of types of end products, but is grouped according to the processing step, shape, machine, or equipment used or product to be produced. A grouping of equipment for performing a sequence of operations on family of similar components or products is the foundation of this type of layout. Group Technology (GT) is the analysis and comparisons of items to group them into families with similar characteristics. GT can be used to develop a hybrid between pure process layout and pure flow line (product) layout. This technique is very useful for companies that produce variety of parts in small batches to enable them to take advantage and economics of flow line layout. The application of group technology involves two basic steps: first step is to determine component families or groups. The second step in applying group technology is to arrange the plants equipment used to process a particular family of components. This represents small plants within the plants. The group technology reduces production planning time for jobs. It reduces the set-up time. Thus group layout is a combination of the product layout and process layout. It combines the advantages of both layout systems. If there are M machines and N components in a group layout (Group-Technology Layout), the M machines and N components will be divided into distinct number of machine-component cells (group) such that all the components assigned to a cell are almost processed within that cell itself. Here, the objective is to minimize the inter-cell movements. In-group technology layout, the objective is to minimize the sum of the cost of transportation and the cost of equipment. So, this is called as multi-objective layout.

Organizational Culture

This is the collection of values, expectations and all practices that is exhibited and thus guide how members of and organization do things. It is the collection of traits that differentiate the practices of one organization from others (Wong, 2020). It is the underlying beliefs, philosophy, values, interactions and assumptions exhibited that makes a particular organization unique and different from others. It is shared attitude, beliefs, customs and written or unwritten rules that develop over time in the daily interaction that differentiate one firm from other (www.gothamculture.com). It includes the organizational vision, values, norm, system, symbols, language, assumptions, beliefs and habits (Needle, 2004). It is the way things are done around here (Deal & Kennedy, 2000). It is the set of shared assumptions that guide what happens in organization by difing appropriate behaviour for various situation (Ravasi & Schultz, 2006)

Fig 1: Conceptual Frameworks of Facility Layout and Enhanced Performance



Deducing from the reviewed literature on the measures and dimension of the criterion and predictor variable which is the subject matter of the research, the following hypotheses were formulated to be tested statistically

- H₀₁: There is no significant association between product layout and cost reduction of manufacturing firms in Nigeria.*
- H₀₂: There is no significant association between product layout and quality product of manufacturing firms in Nigeria.*
- H₀₃: There is no significant correlation between process layout and cost reduction of manufacturing firms in Nigeria.*
- H₀₄: There is no significant association between process layout and quality product of manufacturing firms in Nigeria.*
- H₀₅: There is no significant association between group layout and cost reduction of manufacturing firms in Nigeria.*
- H₀₆: There is no significant association between group layout and quality product of manufacturing firms in Nigeria.*
- H₀₇: Organizational Culture does not significant moderate association between product layout and design and enhanced performance of manufacturing firms in Nigeria.*

Methodology

This study adopted a descriptive and cross sectional survey. The target population of the study comprised all 814 registered manufacturing firms in Nigeria – www.dnb.com . Out of this lot, 37 firms operating in 7 different sector of Cement; Food/Beverages/Tobacco; Chemical/Pharmaceuticals; Plastic/Rubber; Textile/Apparel/Footwear; Oil/Gas Refining; Wood/Wood Product were selected for adequate representation - www.selectglobal.com. Manufacturing firms have a very significant impact on any economy. In the Nigerian economy, the sub-sector accounts for 10% of the total GDP annually and provide job opportunity to about 12% of the labour force.

The study is at the organizational level, so all inquiry and investigations are to the management staff. Choices of companies were through judgmental sampling technique based on accessibility and convenience. Facility Layout is the independent variable, and it is measured using product layout; process layout and group technology layout. Enhanced Performance being the dependent variable was measured using Cost Reduction and Improved Quality Product. The data analysis techniques for hypothesis testing is Structural Equation Modelling due to the nature of the study and the structure of the hypotheses. Decision criteria for validation and test of significance is at 95% confidence level. Descriptive Statistics were measured using the mean and standard deviation, used to capture the characteristics of the variables under study via Statistical Package for Social Sciences (SPSS) software version 25. Inferential Statistics were tested using the Structural Equation Modelling (SEM). Structural

Equation Modelling (SEM) comprises of both a measurement model and a structural model. The measurement model is based on the common factor model (Thurstone as cited in Dimitris, George, Malvina, & Demosthenes 2017).

Details of Sub-Sectors and study firms are as below:

Table 1: Sub-Sector classification and Names of Firms

1	MANUFACTURING FIRMS	Adm	Ret.
S/N	SELECTED ORGANIZATION		
A	CEMENT		
1	Dangote Cement	10	7
2.	BUA Cement	10	5
3	Lafarge Cement	10	5
B	FOODS/BEVERAGES/TOBACCO		
1.	Dufil Prima Foods PLC	10	7
2.	Dangote Pasta	10	7
3.	Golden Penny	10	5
4	Nestle Nigeria	10	7
5	Unilever Nigeria	10	7
6	Cadbury Nig	10	7
7	Nigerian Bottling Co. PLC	10	7
8	7Up bottling company	10	5
9	Nigerian Breweries	10	6
10	Guinness Breweries	10	6
11	British American Tobacco, Nig	10	5
12	Great Brands Nig. Ltd	10	4
C	CHEMICAL/PHARMACEUTICALS		
1.	Procter & Gamble, Nig Ltd	10	7
2.	PZ Cussons Nig Ltd	10	6
3.	Reckitt Benkiser Nig Ltd	10	5
4	Indorama Eleme Petrochemical, Nig Ltd	10	6
5	Avon Basson Nig Ltd	10	5
6	Chemical and Allied Product, Nig Ltd	10	5
D	PLASTIC/ RUBBER		
1.	Dana Plast, Nig Ltd	10	5
2.	Black Horse Plastic Nig Ltd	10	6
3.	Leoplast Nig	10	5
E	TEXTILE/APPAREL/FOOT WEAR		
1.	Afriar Textile Man Ltd	10	6
2.	United Nig Textile Ltd	10	6
3	Da Viva Fashion Ltd	10	5
4	K. Aspen Nig Ltd	10	5
5	HOM Shoes	10	6
F	OIL AND GAS REFINING		
1	SHELL Nig	10	7
2.	TOTALFINA EFF Nigeria	10	6
3.	Chevron PLC	10	7

4.	Agip Oil	10	7
G	WOOD/WOOD PRODUCTS		
1	The Wood Factory Ltd	10	4
2.	IBWAS Nig Ltd	10	5
3	Corporate Planks	10	4
4	Brothersoft Furniture Accessories	10	5
	TOTAL	370	208

Source: Info from different firms

To ascertain if the theoretical LV hypothetical model fits the sample data the following guidelines are used.

Table 2: General Guidelines for interpreting some Goodness-of-Fit indices

Measurement Category	Fit Indices	Range/Value	Inferences	Authors
Absolute Fit	Chi-Square	3.8416	Critical value (statistically significant)	Marsh, Ballaand McDonald, (1988)
Absolute Fit	SRMR	Close to 0.08	Acceptable model fit	Hu and Bentler (1999)
		0.0	Perfect fit	
Parsimony Correction	RMSEA	Close to 0.06 and below.	Reasonably good fit	Hu and Bentler (1999)
		< 0.08	Suggest adequate model fit And reasonable error of approximation.	Brown and Cudeck (1993)
		< 0.05	Suggest good model fit.	Brown and Cudeck (1993)
		>= 0.1	Should be rejected	Brown and Cudeck (1993)
		0.08 – 0.10	Suggest “Mediocre” fit.	Brown and Cudeck (1993)
Parsimony Correction	NCP	=0	Fit of the model is perfect	MacCallum, Browne, & Sugawara, (1996)
		>0	Fit of the model is not perfect	
Comperative Fit	CFI	0.90 – 0.95	Acceptable model fit	Benter (1990)
	TLI	0.90 – 0.95	Acceptable model fit	Benter (1990)

Source: Hooper, Coughlan and Mullen (2008).

Multivariate Analysis (Inferential)

In this section, the study hypotheses were tested statistically using Partial Least Square- Structural Equation Modeling (SEM). This Inferential statistical technique was chosen based on the fact that the study

is about relationship, causal effect and explanation of target constructs (Lowry & Gaskin, 2014; Hair, Ringle, Hult & Sarstedt, 2014). The SEM technique also can substitute for non-parametric approaches based on it's fewer restrictions on normality distribution of data and minimum sample size (Esposito Vinzi, Amato & Trinchera, 2010). This section also contains analysis of output, presentation of results and interpretation of same results from SEM test on the relationship between the independent variable, dependent variable and the moderating variable

Model Specification for Partial Least Square-Structural Equation Modeling (PLS- SEM)

Generally, Structural Equation Modeling seeks to determine relationships based on examining correlations among three or more variables. Presently, the literature has two general approaches to Structural Equation Modelling: Covariance-based structural equation modeling (CB-SEM) e.g LISREL, AMOS and EQS, and b). Variance-based structural equation modeling, known as Partial Least Squares (SEM).

CB-SEM centres on giving estimates to the set of model parameters so as to close the covariance matrix between the theoretical covariance matrix implied by the system of structural equations and the empirical covariance matrix observed within the fitted model. CB-SEM estimation requires a set of assumptions to be fulfilled, such as a multivariate normal distribution of the observed indicators and sufficient sample size. If these assumptions are violated, SEM (Hair et al., 2005; Wold, 1975) would be a suitable option for researchers. Unlike CB-SEM, a SEM analysis does not require any distributional assumptions to be fulfilled (Wold, 1975), the SEM algorithm minimizes the variance of all the dependent variables instead of explaining the covariance and is able to provide robust and accurate fits for relatively small sample sizes (Tenenhaus et al., 2005). The inferential statistical data analysis in this study was carried out using the Partial Least Square – Structural Equation Modeling. This was done through the aid of the AMOS software.

Conditions under which SEM became appropriate for this study is that (a) there are no stringent rule placed on the minimum sample size (Chin et al., 2003, Ryans, 1990; Yoo and Alavi 2001). (b) SEM accommodates the presence of a large number of variables and complex relationships - Graham et al. (1994). This study has 3 latent variables, 6 subconstructs and 43 indicators. (c) SEM approach does not have normal distributional requirements (Singh et al. 2006). Therefore, due to the mild-normality of the field data for this study, CB-SEM was considered to be inappropriate, hence SEM was used for the research (Urbach & Ahlemann, 2010). Johansson and Yip (1994) using a partial least squares causal model maintained that SEM was chosen, rather than CB-SEM, due to its ability to model latent constructs under conditions of non-normality and with a small sample size. Hajipour (2010) asserts that SEM can handle a mix of both types of measurement models, reflective and formative.

SEM is properly defined by two sets of linear equations: the inner model (or structural model) and the outer model (or measurement model). The inner model specifies the relationships between latent variables (constructs), whereas the outer model specifies the relationships between a latent variable and its manifest variables (indicator variables). The combination of inner and outer models leads to a complete partial least squares model. In this study, the exogenous variable is Production layout and design, having its referents as Product, Process and Group technology layout. The endogenous variable or construct is Organizational performance (OGR) and having measures as Reduced production cost; and increased output. The model also tested the moderating effect of Organizational culture after the inner direct relationships were tested.

The SEM Algorithm Model Evaluation.

There are several criteria for assessing model structures. In general, a systematic application of the different criteria is carried out in a two-step process, (1) the assessment of the measurement model and (2) the assessment of the structural model. This study SEM analysis was carried out in three stages, which

include: (i) assessment of measurement model, (ii) assessment of structural model or direct effect and (iii) assessment of moderating effect (Ringle, Wende, & Becker, 2015)

The measurement model is the same as the outer model and it is concerned with the assessment of the Reliability and convergent validity of the constructs (the psychometric qualities of the data generated from the questionnaire given to the respondents), using Factor loadings of the manifest variables, indicator Reliability and the Average Variance Extracted (AVE).

Factor Loadings of the Manifest Variables.

To analyze the collected data, the bootstrapping method was conducted to determine the significance levels for the loadings, path coefficients and weights. The essence of the measurement model is to help to establish Reliability (indicator and construct) and validity (convergent and discriminant) of the instrument (Hair et al., 2017). Items that scores above 0.70, explains more than 50% of the variance, thereby having an acceptable level of reliability (Hulland, 1999).

Figure 1 shows the SEM output for outer loadings (l_k) of the manifest variables (dimensions) of Production layout and design, manifest variables (measures) of Organizational performance and statement items of Organizational culture.

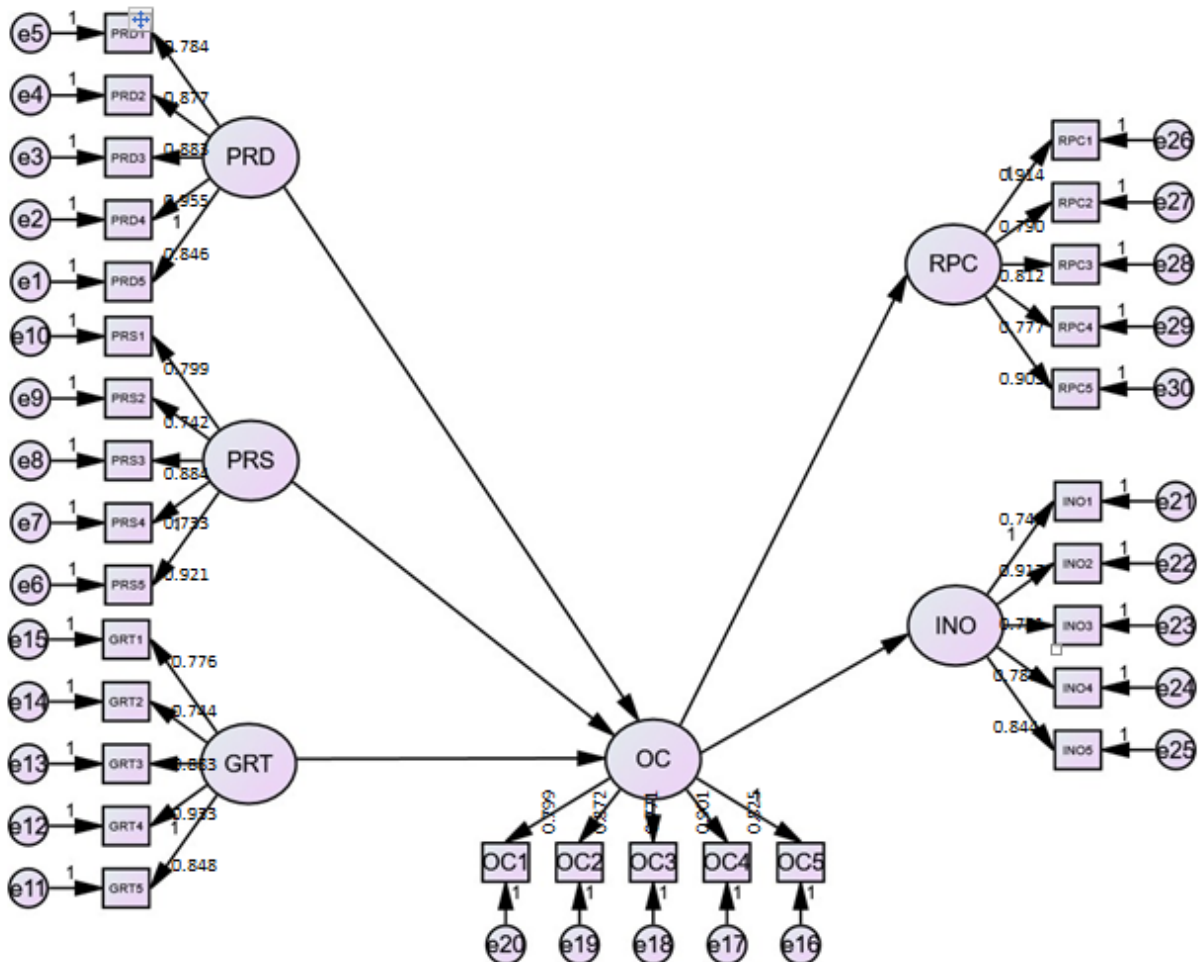


Figure 1: AMOS output for outer loadings of indicators

With respect to the dimensions of production layout and design, all the indicators for product development loaded above the benchmark of 0.70, with PRD₁ as the lowest ($l_k = 0.784$) and PRD₄ as the highest ($l_k =$

0.955). Also, all the indicators for process loaded above the benchmark of 0.70, with PRS₄ as the lowest ($l_k = 0.733$) and PRS₅ as the highest ($l_k = 0.921$). Furthermore, all the indicators for group technology loaded above the benchmark of 0.70, with GRT₂ as the lowest ($l_k = 0.744$) and GRT₄ as the highest ($l_k = 0.933$).

For organizational performance, all the referents pertaining to reduced production cost in loaded above the benchmark of 0.70, with RPC₁ being the highest ($l_k = 0.914$). Also, all the items for increased output loaded above the benchmark of 0.70, with INO₂ being the highest ($l_k = 0.917$). Furthermore, all the statement items for organizational culture scored above 0.70, with INO₃ as the lowest ($l_k = 0.771$) and INO₄ as the highest ($l_k = 0.901$).

Indicator Reliability and Convergent Validity

Indicator Reliability: This measure how much of the indicators’ variance is explained by the corresponding latent variable. The researcher monitored the loadings of reflective indicators to assess indicator Reliability. Generally, it is postulated that a latent variable should explain at least 50 per cent of each indicator’s variance. Accordingly, indicator loadings should be significantly different from zero, at least at the 0.05 level, and greater than 0.7 (Chin, 2010). Also, Hulland, (1999) supported that loadings above 0.70 demonstrates that the construct explains more than 50% of the indicator's variance, showing a satisfactory degree of Reliability.

Cronbach’s alpha assumes that all indicators are equally reliable; therefore, it tends to severely underestimate the internal consistency Reliability of latent variables in PLS-SEM. An internal consistency Reliability value above 0.7 is considered satisfactory (Nunnally & Bernstein, 1994), Composite Reliability takes into account that indicators have different loadings (Henseler, 2010). Also, a value above 0.7 is a satisfactory degree of Reliability.

No matter which Reliability coefficient is used, an internal consistency Reliability value above 0.7 in the early stages of research, and values above 0.8 in more advanced stages, is considered satisfactory (Nunnally & Bernstein, 1994), whereas a value below 0.6 indicates a weak contribution to the construct. This study meets up all those highlighted conditions.

Composite Reliability refers to the proportion of the total combined variance that provide an estimate of the true-score variance of each latent variable. Threshold is 0.70 (Wang & Stanley, 1970; Henseler, 2010).

Convergent validity (communality) refers to the degree to which individual items load onto their designated construct. According to Campbell and Fiske (1959), convergent validity refers to all items measuring a construct and actually loading on a single construct. Convergent validity is established when all items fall into one factor as theorized. A commonly applied criterion for convergent validity is the average variance extracted (AVE) proposed by Fornell & Larcker (1981). It is assessed by the AVE across all items connected to a particular construct. An AVE value of at least 0.5 indicates sufficient convergent validity, meaning that a latent variable is able to explain at least half of the variance of its indicators on average.

It is imperative to note that the validity and Reliability analysis below is independent of the previous one reported in previous sections. The values of standardized factor loadings, indicator Reliability, internal consistency Reliability (composite Reliability, Reliability coefficients, Cronbach’s alpha) and convergent validity (Average Variance Extracted) are shown in Table 3 as the PLS-SEM assessment of measurement (outer) model.

Table 3: First Order SEM Assessment Results of the Measurement Model

Latent Variable	Indicators	Convergent validity			Internal consistency Reliability		
		Loadings	Indicator group technology	AVE	Composite group technology ρ_c	Group technology Coefficient ρ_A	Cronbach's alpha (CA)
		>0.70	>0.50	>0.50	>0.70	>0.70	0.70 - 0.90
PLD	PLD ₁	0.784	0.615	0.715	0.802	0.716	0.706
	PLD ₂	0.877	0.769				
	PLD ₃	0.883	0.677				
	PLD ₄	0.955	0.800				
	PLD ₅	0.846	0.716				
PRS	PRS ₁	0.799	0.638	0.671	0.817	0.730	0.717
	PRS ₂	0.742	0.551				
	PRS ₃	0.884	0.782				
	PRS ₄	0.733	0.537				
	PRS ₅	0.921	0.848				
GRT	GRT ₁	0.776	0.602	0.707	0.876	0.793	0.782
	GRT ₂	0.744	0.554				
	GRT ₃	0.888	0.789				
	GRT ₄	0.933	0.871				
	GRT ₅	0.848	0.719				
OC	INO ₁	0.799	0.638	0.697	0.892	0.717	0.702
	INO ₂	0.872	0.760				
	INO ₃	0.771	0.594				
	INO ₄	0.901	0.812				
	INO ₅	0.825	0.681				
Latent Variable	Indicators	Convergent validity			Internal consistency Reliability		
		Loadings	Indicator group technology	AVE	Composite group technology ρ_c	Group technology Coefficient ρ_A	Cronbach's alpha (CA)
		>0.70	>0.50	>0.50	>0.70	>0.70	0.70 - 0.90
RPC	RPC ₁	0.914	0.835	0.681	0.927	0.878	0.826
	RPC ₂	0.790	0.624				
	RPC ₃	0.812	0.659				
	RPC ₄	0.777	0.604				
	RPC ₅	0.903	0.815				
INO	INO ₁	0.740	0.548	0.664	0.846	0.712	0.701
	INO ₂	0.917	0.841				
	INO ₃	0.751	0.564				
	INO ₄	0.787	0.619				
	INO ₅	0.844	0.712				

Note: PLD = Product Layout, PRS = Process Layout, GRT = Group technology, OC = Organizational culture, RPC =Reduced production cost, INO = Quality Product,

Source:AMOS output on research Data, 2022

Table 3 reveals that when the factor loadings in the model were squared, all response items of the model explained more than 50% of the indicator’s variance. This table also reveals that all the latent variables

show satisfactory levels of internal consistency greater than 0.70 as recommended by Nunnally and Bernstein (1994) and Wang & Stanley (1970). In terms of composite Reliability, Reliability coefficient and Cronbach’s alpha values, product layout recorded the lowest score ($\rho_c= 0.802$, $\rho_A = 0.716$, alpha = 0.706), while reduced production cost scored the highest ($\rho_c= 0.927$, $\rho_A = 0.878$, alpha = 0.826). Furthermore, the table shows that all the latent indicators satisfied the threshold criterion for convergent validity (AVEs >50%) as prescribed by Fornell and Larcker (1981). The highest AVE is scored by product layout (71.5%). Thus, the model satisfied the conditions for convergent validity.

Having seen that all items under their corresponding latent variables met the factor loading threshold of 0.70 and above, it was not important to proceed to the second order computation. Therefore, no item was redundant or regarded as free parameter estimate.

Discriminant (Divergent) Validity

Discriminant validity refers to the extent to which measures of two different constructs are relatively distinctive, that their correlation values are neither an absolute value of 0 nor 1 (Campbell and Fiske, 1959). Discriminant validity explains the magnitude of empirical difference between a construct and other constructs. If the square root of a construct’s AVE exceeds its correlation with all other constructs in the model, then the instrument has discriminant validity (Fornell & Larcker, 1981; Chin, 1998).

Table 4 shows the output for discriminant validity of a correlation analysis on all the latent variables.

	AVE	PLD	PRS	GRT	OC	RPC	INO
PLD	0.715	0.846					
PRS	0.671	0.377	0.819				
GRT	0.707	0.329	0.323	0.841			
OC	0.697	0.075	0.024	0.082	0.835		
RPC	0.681	0.084	0.158	0.179	0.016	0.825	
INO	0.664	0.071	0.102	0.105	0.033	0.296	0.815

Note: AVE = Average Variance Extracted. PLD = Product Layout, PRS = Process Layout, GRT = Group technology Layout, OC = Organizational culture, RPC = Reduced production cost, INO = Product Quality. The off-diagonal values are the correlations between latent variables, while **the diagonal values (in bold) denote the square roots of AVEs.**

Source: AMOS output on research Data, 2022

The result on table 4 shows that all latent variables are not perfectly correlated where their correlation coefficients range between 0 - 1. It was further revealed that all the diagonal values (SQR of AVEs) exceed 0.70; and are far greater than the off-diagonal values, thereby suggesting that each construct distinguishes itself from others by sharing more variance in its own block of indicators than with other latent variables in their own block of indicators. Therefore, the model and its instrument possess discriminant validity. Hence, we can conclude that discriminant validity has been established.

Assessing the Structural Model (Direct Effect)

Having validated and confirmed the measurement model, this section is the assessment of the structural model, which has to do with testing the hypotheses through bootstrapping procedure. The outputs derived from this process are: (i) the path coefficients (β) and their corresponding values of significance, (ii) the

coefficients of determination (R^2) also known as predictive accuracy, and (iii) the predictive relevance (Q^2) (Tenenhaus et al. 2005; Hair et al., 2014).

Another statistics derived from the structural analysis (for main effect) is the evaluation of Cohen’s f^2 effect size (Cohen, 1988), which measures the relative impact of each of the dimensions of the independent variable on each of the measures of the dependent variable. Values for f^2 between 0.020 and 0.150, between 0.150 and 0.350, and exceeding 0.350 represent small, medium, or large effect, respectively (Chin 1998; Cohen 1988; Gefen et al. 2000). The third phase of SEM algorithm which is the assessment of Moderation or Interaction effect

Tests of Hypotheses and Evaluation of Structural Path Significance

The hypotheses were tested using SEM via the bootstrapping of 370 samples. Bootstrapping is an estimate of “the shape, spread, and bias of the sampling distribution of a specific statistic by creating and treating “a large, pre- specified number of samples as a representation of the population” (Henseler et al., 2009:305).

The distribution from the bootstrapped samples was regarded as close to normal distribution, and the path coefficients as well as the t -values were assessed. Path coefficients (β) within the ranges of 0.10 - 0.29, 0.30 - 0.49 and 0.50 - 1.0 are weak, moderate and strong correlations, respectively (Cohen, 1988). Considering a two tailed test, t values > 1.96 means significant, whereas t values < 1.96 means non-significant (Hair et al., 2014).

Results of Hypotheses Testing

Table 5: Summary of Results on the Tests of Hypotheses $H_{O:1}$ to $H_{O:6}$

Null Hypothesis	Path (Relationship)	Path Coefficient (β), (t –value)	Predictive Accuracy R^2	Effect Size- f^2	Predictive Relevance - Q^2	Decision
H_{O1} :	PLD -> RPC	0.243(3.032) Significant	0.557 Moderate	0.041 Small	0.147 Relevant	Not supported
H_{O2} :	PLD -> INO	0.278(2.171) Significant	0.557 Moderate	0.194 Medium	0.147 Relevant	Not supported
H_{O3} :	PRS -> RPC	0.515(2.020) Significant	0.557 Moderate	0.205 Medium	0.147 Relevant	Not supported
H_{O4} :	PRS -> INO	0.370 (2.752) Significant	0.391 Moderate	0.169 Medium	0.108 Relevant	Not supported
H_{O5} :	GRT -> RPC	0.447(3.004) Significant	0.391 Moderate	0.293 Medium	0.108 Relevant	Not supported
H_{O6} :	GRT -> INO	0.586(1.971) Significant	0.391 Moderate	0.371 Large	0.108 Relevant	Not supported

Source: AMOS output on research Data, 2022.

Table 6: Summary of Results on the Test of Hypothesis H_{0:7}: Moderating Effect of Organizational culture on the relationship between Production layout and design and Organizational performance

Null Hypothesis - H _{0:7}	Path (Relationship)	Path Coefficient(β), (t-value)	Predictive Accuracy R ²	f ² - effect size	Decision
Hypothesis Testing without moderating variable	PLD -> INO	0.546(2.093) Significant	0.465 Moderate	-0.147 Medium (Negative)	Not supported
Hypothesis Testing with moderating variable	PLD -> INO	0.479 (2.006) Significant	0.373 Weak		
	OC -> INO	-0.182(9.015) Significant	0.197 Weak		
	Moderating Effect 1 -> INO	0.072(1.989) Significant	NIL		

Source: AMOS output on research Data, 2022 The path diagramme is shown below

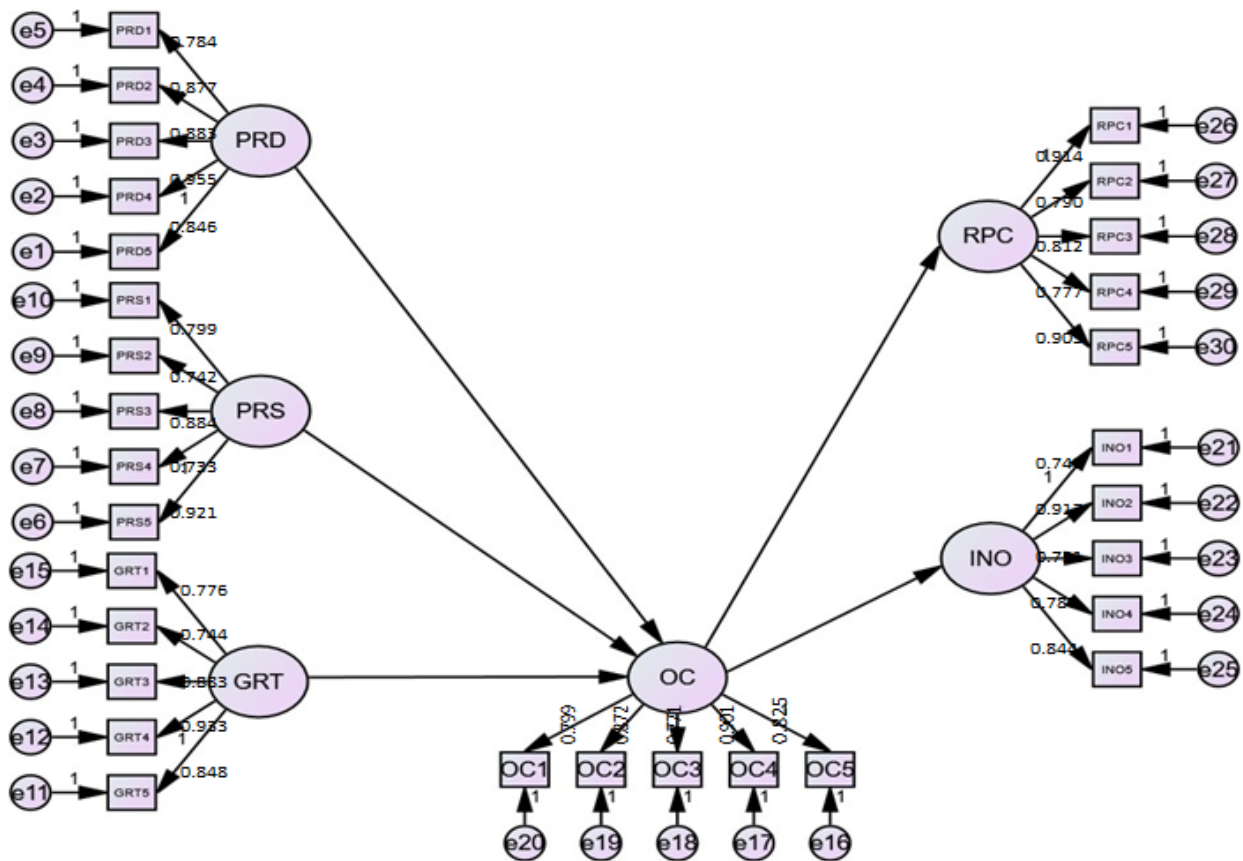


Figure 2: Specific path model of organizational culture and organizational performance.

Discussion of Findings

The result of the first hypothesized ($H_{0.1}$) reveals that product development has a moderate level relationship with reduced production cost, and thus, positively enhance reduced production cost. The null hypothesis was not supported and so refuted. The effect size is small with about 14.7% predictive relevance. I am inclined therefore to hold that there is a significant and positive relationship between product layout and reduced production cost. There is correlation between product layout and cost reduction. The correlation statistic ($r = .0.680, p < 0.001$) signifies that product layout can explain 68.0% of variation in cost reduction. This is an indication of a positive relationship between the variables. This is very instructive to management of manufacturing firms that, a unit proper product layout has potential to enhance cost reduction.

The second Hypothesis ($H_{0.2}$) also show a moderate impact. The result is assessed to be positive and significant. The result of the study did not support the position of the hypothesis. The effect size is medium with a 14.7 % predictive relevance. Given the position of the result, I am inclined to reject the null hypothesis and thus accept the alternative hypothesis which holds that there is a positive and significant relationship between product layout and quality product of manufacturing firms. There is correlation between product layout and improved quality product. The correlation statistic ($r = .0.432, p < 0.001$) signifies that product layout can explain 43.2% of variation in improved quality product. This is very instructive to management of manufacturing firms that, a unit proper product layout has potential to enhance quality product.

The result of the third Hypothesis ($H_{0.3}$) show a moderate impact, medium effect size and a 14.7% predictive relevance. The relationship between Process Layout and cost reduction is positive and significant. The findings of this study did not support the position of the null hypothesis; thus, I rejected the null hypothesis and accepted the alternative one. With the result therefore I hold that there is a positive and significant relationship between Process layout and reduced production cost. The correlation statistic ($r = .0.710, p < 0.001$) signifies that process layout can explain 71.0% of variation in cost reduction. This is very instructive to management of manufacturing firms that, a unit proper process layout has potential to enhance cost reduction and improved quality product.

The result of the fourth hypothesis ($H_{0.4}$) reveal a moderate impact, medium effect size and about 10.8% predictive relevance. The result further shows a positive and significant relationship. The correlation statistic ($r = .0.540, p < 0.001$) signifies that process layout can explain 54.0% of variation in improved quality product.

This is an indication of a positive relationship between the variables. Evidence from the analysis did not show support to the null hypothesis. In the light of this therefore, the null hypothesis is rejected the alternative one accepted; thus, I am inclined to hold, given the result that process Layout positively and significantly relate with improve product quality. It is instructive to management of manufacturing firms that, a unit process layout has potential to enhance quality product Results of the fifth hypothesis ($H_{0.5}$) reveal a moderate impact, medium effect size and 10.8% predictive relevance. The correlation statistic ($r = .0.840, p < 0.001$) signifies that group technology layout can explain 84.0% of variation in cost reduction. This is an indication of a positive relationship between the variables. Given this result, it shows that the null hypothesis is not supported and thus, rejected. I therefore accept the alternative hypothesis to be true and thus conclude that there is a positive and significant relationship between group technology layout and cost reduction. This is very instructive to management of manufacturing firms that, a unit change in group technology layout has potential to enhance cost reduction.

The six Hypothesis ($H_{0.6}$) also show a moderate impact. The result is assessed to be positive and significant. The result of the study did not support the position of the hypothesis. The effect size is

medium with a 10.8 % predictive relevance. Given the position of the result, I am inclined to reject the null hypothesis and thus accept the alternative hypothesis which states that there is a positive and significant relationship between group technology layout and quality product of manufacturing firms. There is correlation between group technology layout and improved product quality. The correlation statistic ($r = .0.956$, $p < 0.001$) signify that process layout can explain 95.6% of variation in improved quality product. This is an indication of a positive relationship between the variables. This is very instructive to management of manufacturing firms that, a unit change in group technology layout has potential to enhance quality product.

Organisations do not exist in a vacuum, hence the researcher proposed that the organizations were bounded by Organizational culture. This informed how our seventh hypothesis was structured. Thus I captured the moderating effect of Organizational culture on the relationship between Production layout and design and Organizational performance. The result of this hypothesis ($H_{0.7}$) show a weak impact medium effect size. Given the result the position of the null hypothesis was not supported. It moderated negatively and weakens the positive relationship between Production layout and design and Organizational performance (OGR). This finding goes against the apriori that organizational culture is an important determinant of corporate finance and management effectiveness and goes against the observation of Armstrong (2008) who opined that organizational culture confirms the strong and significant relationship between the variables. The finding is therefore against the study and confirms the findings above. Our finding therefore means that production layout and design effect will wane in the presence of an improper organizational culture.

The hypothesis show that production layout and design is important because it boosts the efficiency of an organization's decision-making ability via creation, sharing and utilization of knowledge.

These findings tally to those of Wangari Muchiri and Onyancha (2018) which asserted that, facility layout design has a major impact on manufacturing cycle time hence throughput rate. Its critical objective is to minimize material handling thus decrease manufacturing cycle time and increase throughput rate resulting to improved productivity. The findings of this study collaborate the findings of Roslin *et al.* (2008) on facility planning in manufacturing process using. This work also further affirms the studies of Kibira *et al.* (2002) on virtual reality simulation of as a precondition for machine layout in mechanical assembly production line, for modelling the production line operation presenting workstation and material handling system. The findings further validate the study of Zuhdy *et al.* (2008) on simulation model for production line layout.

Recommendation

Consequent on the findings of this research some recommendations are made:

- Before siting any equipment or machines, location analysis should be conducted with regards to the availability and accessibility of labour/staff, other stakeholders, market and raw material.
- It should be designed in such away that it will be flexible in event of periodic review and expansion.
- It should be designed in such a way that it will minimize travelling distance, handling and discomfort.
- Space, maintenance and security must be considered when designing good layout. These factors if effectively considered will enhance performance of staff and equipment.

167	ISSN 2576-5973 (online), Published by "Global Research Network LLC" under Volume: 5 Issue: 8 in Aug-2022 https://www.grnjournals.us/index.php/AJEBM
	Copyright (c) 2022 Author (s). This is an open-access article distributed under the terms of Creative Commons Attribution License (CC BY).To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

There must be a comprehensive review and consideration when cited equipment and machineries sinceadequate and good layout enhances performance.

- Manu facturing firms should continuously train their personnel in the area of facility layout so that itcan enhance performance.

References

1. Bottani, E. (2009). A fuzzy QFD approach to achieve agility, *International Journal of Production Economics* 119(2009) 380–391.
2. Chen, S. (2016). The influencing factors of sustainable enterprise innovation: an empirical study. *International Journal of Management*, 8(5), 425.
3. Cole, R. (2002). *From continuous improvement to continuous innovation: Total Quality Management*, 13(8), 101-1056.
4. Crabb, A, W. (2014). *Business growth versus organisational development reflected in strategic management of Polish small, medium and large enterprises*. Wroclaw, Poland: Elsevier
5. Desouza, K. (2007). *Agile information systems: conceptualization, construction and management*. Oxford, Uk:Elsevier.
6. Downes, J. Goodman, J. E (2003). *Dictionary of Finance & Investment Terms*, Barron's Financial Guides.
7. Doz, Y., & Kossonen, M. (2010). *Embedding strategic agility: A leadership agenda for accelerating businessmodel renewal*. Elsevier
8. Filley, A., & Aldag, S. (1980). *Organisational growth and types: Lessons from small institutions*. JAI Press Inc. Flamholtz, E., & Hua, W. (2003). Searching for competitive advantage in the black box. *European Management Journal*, 21(2), 222–236.
9. Garnsey, E., Stam, E., & Hefferman, P. (2006). New firm growth: Exploring processes and paths. *Industry and innovation*, 13(1), 1-20.
10. Georgopoulos, B.S. & Tannenbaum, A.S. (1957). A study of organizational effectiveness. *American Sociological Review* (534- 540).
11. Glaister, K. W., & Buckley, P. J. (1998). Measures of performance in UK international alliance. *OrganizationStudies*, 19(1), 89-118.
12. Gupta, Gopalakrisnan, & Turuvekere. (2004). Computer integrated facilities planning and design. *Journal of Facilities*, 199-209.
13. Heizer, J., & Render, B. (2014). *Operations Management*. England: Pearson Education, Inc.Heizer, J., & Render, B. (2014). *Operations Management*. England: Pearson Education, Inc Heragu, S. (2006). *Facilities Design*, 2nd edition. Louisville: Universe, Inc.
14. Hillman, G. P (1994). Making self-assessment successful. *The TQM magazine*, vol. 6, no. 3, pp. 29-3.
15. Iqbal, N., Ahmad, N., Ateeq, M., Javaid, K. (2013). The role of creativity on organisational growth: A case study of Al-ghazi tractor limited. *Arabian journal of business management review (Nigerian chapter)*. Vol. 1, No. 9.
16. Karlsson, M. (2015). *Has anything changed in strategic thinking since Porter?* Tampere, Finland.

17. Macpherson, A., & Holt, R. (2007). *Knowledge, learning and small firm growth: A systematic review of the evidence*. Elsevier.
18. Madhok, A., & Marques, R. (2014). *Towards an action-based perspective on firm competitiveness*. York University, Canada: Elsevier.
19. McGrath, R. (2013a). *Transient advantage: Spotlight on strategy for turbulent times*. Harvard business review.
20. Harvard Business School Publishing Corporation.
21. McGrath, R. (2013b). *The end of competitive advantage: How to keep your strategy moving as fast as your business*. Boston, MA: Harvard business press.
22. Nisula, A., & Kianto, A. (2013). Evaluating and developing innovation capabilities with a structured method.
23. *Interdisciplinary Journal of Information, Knowledge and Management*, 8, 59-82.
24. Peranginangin, J. (2015). A conceptual mapping resource advantage theory: Competitive advantage theory and transient competitive advantage. *Expert Journal of Business Management*, 3, 140-149.
25. Rindova, V., & Kotha, S. (2001). Continuous morphing: Competing through dynamic capabilities, form and function. *Academy of management journal* 44(6), 1263-1280.
26. Robbins, S.P. (1987). *Organizational Theory: Structure, Design, and Application*. San Diego: Prentice-Hall.
27. Roslin. N.H, Seang.O.G. Dawal.S.Z., (2008). A study on facility planning in manufacturing process using witness. *Proceeding of the 9th Asia Pacific Industrial Engineering & Management Systems Conference*. APIEMS 2008.
28. Schein, E. H. (1985). *Organizational culture and leadership: A dynamic view*. San Francisco: Jossey-Bass.
29. Sharifi, H., & Zhang, Z. (1999). Methodology for achieving agility in manufacturing organization: An introduction, *International Journal of Production Economics*, 62, 7–22.
30. Sharp, J., Irani, Z., & Desai, S (1999). Working towards agile manufacturing in the UK industry, *International Journal of Production Economics* (62) 155–169.
31. Stevenson, W. J. (2009). *Operations Management*. New York: McGraw-Hill Irwin.
32. Sulkowski, L., & Stopczynski, B. (2018). *Innovativeness of polish enterprises in the development of competitive advantage*. Krakow, Poland.
33. Sun, S. (2008). Organizational culture and its themes. *International Journal of Business and Management*, 3(12). 137-141.
34. Tompkins, J. A., 2003. *Facilities planning*. New York: John Wiley and Son.
35. Tompkins, J. A., White, J. A., Bozer, Y. A., & Tanchoco, A. J. (2010). *Facilities Planning* (4th edition).
36. Riverstreet, Hoboken: John Wiley and Sons.
37. UNIDO. (2010). *Publications: Leather panel*. Retrieved March 3, 2017, from Leather Panel website: [https:// leatherpanel.org](https://leatherpanel.org)

38. Wangari, P. N., Muchiri, Peter Ng'ang'a; Onyancha, Douglas (2008). Impact Assessment of a Facility Layout on Manufacturing Cycle Time and Throughput: A Case Study of a Tannery in Central Kenya
39. Yuchtman, E. & Seashore, S. (1967). Factorial Analysis of Organizational Performance. *Administrative Science Quarterly* (377-395).