

# **Lean Application and Efficiency of manufacturing firms: An empirical study of manufacturing firms in Rivers State, Nigeria**

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**Abstract** - *The increasing demand for speedy delivery of quality products at lower production cost have resulted to new trend in manufacturing which reviews the gap between input resources inventory and production output inventory. More so, creating competitive niche in the current market environment is now difficult for manufacturers than ever. Consequently, many manufacturing firms are becoming flexible to catch up with the current challenges so as to simultaneously improve quality and productivity. This paper examined the relationship between lean manufacturing and efficiency of 53 manufacturing firms listed with the Manufacturers Association of Nigeria in Rivers State, Nigeria. The questionnaire was used to collect data from respondents and analysed using mean scores, standard deviations and t-statistic in testing stated hypothesis. It was observed that lean manufacturing has a very strong positive and significant influence on efficiency of manufacturing firms. We recommend that management of manufacturing firms should set up clear policies on lean implementation and communicate same to staff. Also, managers of manufacturing firms are encouraged to increase resource commitment by investing in staff training and development so as to inculcate in them skills and knowledge necessary to implement lean practices within the organisations; therefore, professionalism should be encouraged at all levels of the organization. Again, manufacturing firms should pursue quality consciousness through capability surveillance, constant monitoring of suppliers/throughput process to ensure production outputs conform to product specification and quality standards should be constantly advocated.*

**Keywords:** *efficiency; lean manufacturing; people development; process development; waste elimination.*

## **1. INTRODUCTION**

Manufacturing in the 21<sup>st</sup> century has moved from what was known as traditional manufacturing which focused on the inventory of the system to lean manufacturing. In developing countries including Nigeria, the manufacturing sector is faced with lot of challenges which include: insecurity, shortage of skilled and technical manpower, multiple taxation, poor input, poor patronage of locally manufactured products and lack of necessary technological equipment which aid manufacturing processes, (Ferdousi and Ahmed 2015)[8]. Hence the outcomes of these challenges among many are the reason for the increase in the production of poor quality products and late delivery of orders. As a result, there exists lots of manufacturing waste than necessary in the form of over production which means producing more than the customers' orders within a period of time. This manufacturing waste is as a result of poor forecast and it has a very negative effect on profitability of the firm since excess stock results in additional cost in the form of insurance and storage cost. Abdulmalek and Rajgopal (2007)[1] stated that lean manufacturing is now a predominant initiative that many manufacturing organisations have tried to adopt in order to remain competitive in an increasingly intensive global market.

Lean manufacturing, a Japanese concept, is a production philosophy which shortens the time line between the customer's order and shipment through the elimination of waste and adoption of continuous improvement in the production system. The time line between the customer's order and shipment is often called production lead time which is now a very important performance objective for manufacturers in a fully competitive market. According to Womack and Jones (2003)[25], lean manufacturing is grounded in five principles: (1.) specifying value from the customers' perspectives, (2.) identifying the value stream, (3.) creating the flow, (4.) introducing pull system and, (5.) working towards perfection. The main benefits of lean manufacturing implementation include the use of fewer resources, rapid and efficient product development cycle, lower work in process inventories, smaller floor space requirement, higher throughput and greater flexibility (Abioye, Bello and Olabanji, 2011[3]; Nasab, Bioki, and Zare, 2012)[15]. The goals of lean manufacturing are to reduce waste in human effort and inventory, reaching the market on time, and managing manufacturing stocks that are highly responsive to customer demand while producing quality products in the most efficient and economical manner (Bhim, Shimizu, Soriano-Meier, Garza-Reyes and Basso, 2010)[5].

More so, due to the benefits of lean manufacturing implementation, manufacturers in the different manufacturing sectors have invested in the implementation of lean manufacturing practices (Doolen and Hacker, 2005)[7]. For instance, Nestle, and Nigerian Bottling Company have secured strong competitive advantages in their respective competitive sector through the adoption of lean manufacturing principles. However, some other manufacturing organisations that are yet to effectively implement lean manufacturing concept, are thus lagging in transforming themselves to aggressive competitiveness (Abioye and Bello, 2012)[2]. To further contribute to the concept of lean manufacturing in achieving production efficiency, this study carried out an objective positivist investigation to ascertain how related lean manufacturing is to manufacturing efficiency.

## 2. LITERATURE

Lean manufacturing is an integrated social and technical system whose main objective is to eliminate waste, improve manufacturing process, developing the human elements by concurrently increasing efficiency through product quality, on-time-delivery of products and services. Lean manufacturing is one of the improvement initiatives that can be implemented to achieve business excellence (Mohammed, Mann, Grigg and Wagner 2011)[14]. 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 (Ciarniene and Jienazendiene, 2010)[6]. Nordin, Deros, Wahab and Rahman, (2012)[18] observed that in order to create the foundation for lean manufacturing to take hold, a significant organizational change must occur. Also, Ghosh (2013)[9] pointed out that Lean philosophy had contributed to the manufacturing sector by changing the focus of management from optimizing separate technologies, assets and vertical departments to optimizing the flow of products and services through the entire value stream that flow horizontally across technologies, assets and departments to the customer. Again, Shah and Ward (2007)[22] identified lean manufacturing as a multi-dimensional approach including variety of management practices focused towards quality, superior management and less wastage. In general, lean manufacturing is an arrangement of techniques and activities for running a production industries or service operation with minimal waste resources. The fundamental thinking about lean philosophy is that business process and functions should implement stringent practices to eliminate waste while aiming at achieving better performance.

In any case, for organisations to be successful with lean manufacturing efforts, Lathin and Mitchell (2001)[12] posited that they need to integrate social factors and specific employee influences that could be problematic to

the organisation's technical capabilities in lean manufacturing initiatives. Effectively managing the human capital component of any production endeavour is extremely important. Needy *et al.* (2002)[16] identified those critical skills such as effective communication, task prioritization, skill in linking method to suppliers and customers required for employees to productively implement lean practices. Ultimately, successful recognition of such skills could help develop training initiatives, alter hiring practices, allocate workers, and establish compensation systems.

Empirically, Lean manufacturing is a management orientation that focuses on reduction of wastes in order to improve overall customer value. By eliminating waste, quality is enhanced and production time and costs are compressed (Jordan *et al.*, 2001)[10]. To solve the problem of waste, on-time-delivery and product quality; lean manufacturing adopts several techniques in achieving these objectives. These include regular process analysis, pull production and just in time scheduling approaches with Kanban.

In order to understand the concept of lean manufacturing, it is imperative to examine at the critical aspects of the lean manufacturing philosophy which are; process improvement, people development and waste elimination.

**Process Improvement:** Many manufacturing organizations have implemented process improvement; as it leads to significant improvements in their operations. Process improvement has a long term focus, tackles problems at the source and captures the level of continuous improvement activities as reflected by the level of Kaizen activities (Juyamaha, Wagner, Grigg, Campbell, Allen and Harvie, 2014). **People Development:** Human elements are critical factors in maintaining the success of production when compared with technology. People development or employee development has become something that plays an important role in enhancing production apart from boosting careers goals and work lives, therefore, supporting and implementing employee development raises positive outcomes for the organization. Every improvement or changes made in organizations should align with training and development of the employees and analyze the description of each job for effective employee performance on the job in line with defined key performance indicators on the minimum requirement needed to carry out a task (Maurer and Chapman, 2015)[13]. **Waste Elimination:** Waste elimination is one of the most effective ways to increase the profitability of any business. To eliminate waste, it is important to develop and implement strategy to reduce or eliminate its effect on the firm's activities, thereby improving overall performance and quality. These wastes are in form of overproduction, waiting, transporting, and defectives. **Overproduction:** is manufacturing an item before it is actually required. Overproduction is highly costly to a manufacturing plant because it prohibits the smooth flow of materials and actually degrades quality. **Waiting:** When products are not moving or being

processed, the waste of waiting occurs. Typically, greater part of a product's throughput in traditional batch-and-queue manufacture will be spent waiting to be processed. Much of a product's lead time is tied up in waiting for the next operation, this is usually because material flow is poor, production runs are too long and distances between work centers are too great. Goldiah (1999) in his theory of constraints has stated many a times that an hour lost in a bottleneck process is one hour lost to the entire factory's output and can never be recovered. *Transporting*: movement and handling of products between processes has a cost implications which does not enhance product quality or value. Excessive movement and handling usually cause damage and often lead to quality deterioration. However, since transportation cost is difficult to reduce, it is better for material handlers to be used in this regard. *Defectives*: These have a direct impact on the bottom line quality defects resulting in rework or scrap, leading to tremendous cost implications for the organizations. In many organizations, the total cost of defect is often a significant percentage of total manufacturing cost (Ondiek and Kisombe, 2012)[19]. This can be reduced through employee involvement and continuous process improvement so as to achieve efficiency of the manufacturing system. Shahram (2007) observed that despite the wide knowledge and available resources, many manufacturing firms are struggling to stay lean.

The following hypotheses were thus stated.

*Ho<sub>1</sub>: there is no significant relationship between process improvement and efficiency of manufacturing firms.*

*Ho<sub>2</sub>: there is no significant relationship between people development and efficiency of manufacturing firms.*

*Ho<sub>3</sub>: there is no significant relationship between waste elimination and efficiency of manufacturing firms.*

### 3. METHODOLOGY

A survey design was adopted, with 53 manufacturing firms listed with the Manufacturers' Association of Nigeria (MAN) in Rivers State selected as the population of the study. Since the population is relatively small, the study adopted the 53 manufacturing firms as the sample size, but for the purpose of data analysis 4 copies of the questionnaire were purposively distributed to top level managers of each of the firms making a total of 212 copies of the questionnaire distributed. However, only 153 copies of the distributed questionnaire were completed, retrieved and used as sample size for analysis.

### 4. DATA PRESENTATION AND DISCUSSIONS

In determining the statistical technique to suit our purpose, Kothari (2004)[11] argued that when there exists association between two variables, correlation technique should be used and when there exists cause and effect relationship between two variables that bivariate analysis is appropriate. This section will therefore be used to present answers to our research questions and hypotheses. Furthermore, Neuman (2000)[17], advocate for the adoption of a scatter graph as one of the techniques used in deciding whether relationship do exist between variables. In the bid to determine the existence and trend of this relationship, a scatter graph is presented in Figure 1, with Lean manufacturing as predictor variable on the x-axis while Production efficiency as the criterion variable is on the y-axis.

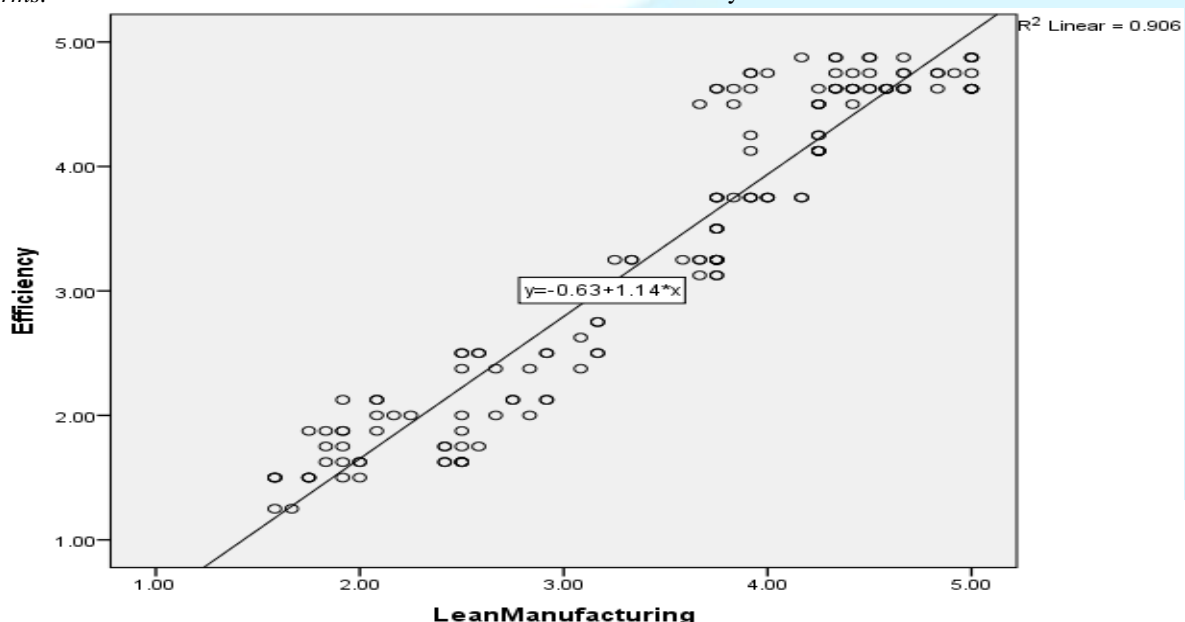


Figure 1: Scatter plot of the study variables



The scatter plot sloping upwards from left to right is an indication of existing linear and positive relationship between Lean Manufacturing and Efficiency.

#### 4.1 Relationship between Process Improvement and Efficiency

The relationship between process improvement and efficiency is presented below in the table below

Table1: Correlation analysis of Process improvement and measures of Production efficiency

		Process improvement	Product Quality	On time Delivery
Process improvement	Pearson Correlation	1	.795**	.867**
	Sig. (2-tailed)		.000	.000
	N	153	153	153
Product Quality	Pearson Correlation	.795**	1	.918**
	Sig. (2-tailed)	.000		.000
	N	153	153	153
On time Delivery	Pearson Correlation	.867**	.918**	1
	Sig. (2-tailed)	.000	.000	
	N	153	153	153

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

Source: Research 2018

Table 1 showed that relationship between Process improvement and Product Quality ( $r = 0.795$ ,  $p = 0.000 < 0.01$ ); and relationship between Process improvement and On-time Delivery ( $r = .867$ ,  $p = 0.000 < 0.01$ ) and therefore based on the results stated there is, significant relationship between Process improvement and Product Quality; and significant relationship between Process improvement and On-time Delivery. The test of hypotheses showed that there is a positive relationship between process improvement and each of the measures of efficiency. This implies that process improvement leads to significant

improvements in the firm's operations. This finding is in line with Salleh, Kasalang and Jaffer (2002)[21] who stated that process improvement could be measured with time saving, productivity, process time, cycle time, production rate and utilization. It also corroborates with Bagshaw (2016)[4] who stated that a successful process design leads to the competitive positioning of any manufacturing firm and recommended that manufacturers need to propose designs that support their firm's competence as it is interlinked with production efficiency.

#### 4.2 Relationship between People Development and Efficiency

Table 2: Correlation analysis of People development and measures of Production efficiency

		People Development	Product Quality	On time Delivery
People Development	Pearson Correlation	1	.967**	.927**
	Sig. (2-tailed)		.000	.000
	N	153	153	153
Product Quality	Pearson Correlation	.967**	1	.918**
	Sig. (2-tailed)	.000		.000
	N	153	153	153
On time Delivery	Pearson Correlation	.927**	.918**	1
	Sig. (2-tailed)	.000	.000	
	N	153	153	153

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

Source: Research Data 2018.

Table 2 showed that relationship between People development and Product Quality ( $r = 0.967$ ,  $p = 0.000 < 0.01$ ); and relationship between People development and On-time Delivery ( $r = .927$ ,  $p = 0.000 < 0.01$ ) and therefore based on the results stated there is, significant relationship between People development and Product

Quality; and significant relationship between People development and On-time Delivery. The test of hypotheses showed that there is a positive relationship between people development and each of the measures of efficiency. This supports the findings of Rono (2013)[20] which stated that every improvement or changes made in

organization there should be aligned with people improvement, meaning that organization must develop those people or employee to streamline the budget for the development.

### 4.3 Relationship between Waste Elimination and Efficiency

Table 3: Correlation analysis of Waste elimination and measures of Production efficiency

		Waste Elimination	Product Quality	On time Delivery
Waste Elimination	Pearson Correlation	1	.759**	.813**
	Sig. (2-tailed)		.000	.000
	N	153	153	153
Product Quality	Pearson Correlation	.759**	1	.918**
	Sig. (2-tailed)	.000		.000
	N	153	153	153
On time Delivery	Pearson Correlation	.813**	.918**	1
	Sig. (2-tailed)	.000	.000	
	N	153	153	153

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

Source: Research Data 2018

Table 3 showed that relationship between Waste elimination and product quality ( $r = 0.759$ ,  $p = 0.000 < 0.01$ ); and relationship between Waste elimination and On-time Delivery ( $r = 0.813$ ,  $p = 0.000 < 0.01$ ) and therefore based on the results stated there is, significant relationship between Waste elimination and Product quality; and significant relationship between Waste elimination and On-time Delivery. The test of hypotheses showed that there is a positive relationship between Waste elimination and each of the measures of production efficiency. Therefore, this suggests that a positive relationship exists between waste elimination and product quality and on time delivery. This implies that waste elimination is one of the most effective ways to increase the profitability of any business.

The finding reinforces the position of previous studies by Mohammed, Mann, Grigg and Wagner (2011)[14] which posit that lean manufacturing is one of the improvement initiatives that can be implemented to achieve business excellence. Also, the findings showed that lean practices have positive effect on operational performance as there has been improved operational performance through reduction on waste, improved efficiency and reduced lead times between processes.

Facilities are now examining how their business impacts the environment, and are finding in many cases that reducing waste actually benefits the environment. Reduction in water usage and electric power not only save the company money, but reduce the impact on public resources.

## 5. CONCLUSION AND RECOMMENDATIONS

Lean manufacturing focuses on creating more value for customers by eliminating activities that are considered waste. One of the premises of lean manufacturing is

continuous improvement. This means that manufacturing firms should continue to examine their production processes and ensure improvements in efficiency by providing improved value and reduced costs for their customers.

The study sought to determine the effect of lean manufacturing practices on efficiency of manufacturing firms in Rivers state. The findings showed that variations associated with product quality and on-time delivery are minimized using lean manufacturing practices which enables them to leverage on best practices so as to remain competitively efficient. Also, the findings indicate that product quality can be attained by continuous improvement and effective employee development and improvement in handling task assignments. Based on the discussions and conclusion, the following recommendations were made: (1.) that the management of manufacturing firms should set up clear policies on the implementation of lean practices and communicate same to staff. (2.) Managers of manufacturing firms should increase its resource commitment to staff training and development so as to engender skills and knowledge of lean practices and behavior, hence professionalism should be encouraged at all levels of the organization. (3.) Manufacturing firms should pursue quality consciousness through capability surveillance, that is, endeavour to be in constant touch with suppliers/factory to ensure production conforms to product specification and (4.) quality standards should be constantly advocated.

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