

# Lean Production System Implementation in an Original Equipment Manufacturing Company: Benefits, Challenges, and Critical Success Factors

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**Abstract:-** Often referred to as the global best practice in manufacturing, Lean Production system (LPS) is defined as a manufacturing strategy that aims at waste reduction, by utilizing less resources to manufacture high quality products at reduced lead time, thus enhancing profitability and throughput. This study is aimed at appraising the status of 3 years LPS implementation in an original equipment manufacturing company, located in South East – Nigeria, by determining the challenges, benefits, and critical success factors of implementing the manufacturing process. The sample size of 90 from the company's population size of 117 personnel was calculated with the application of Taro Yamane formula. The research was based on the 90 respondents, as 100 percent success rate was achieved in the collection of questionnaire administered to the management and the entire departments of the company. The findings of the study revealed that high cost LPS implementation, inadequate funding and training were the major challenges the company is facing, while management/leadership participation, customers, finance, skills and expertise, and suppliers are their foremost critical success factors of lean implementation. While waste reduction, customers' satisfaction, and competitive advantage offer the best result in appraising the company's LPS performance measures, over 84 percent of the respondents classified the company's lean implementation result as good, very good and excellent. The results also showed that waste reduction, improved quality, customer satisfaction, and increased profitability are the outstanding strengths and benefits of LPS implementation in the firm. The study will enable Kc Auto-Parts manufacturing Company and other manufacturers to streamline their manufacturing processes throughout their entire organizations, and also persist on continuous improvement, in order to become 'more lean'.

**Keywords:** *Lean Production System, original equipment manufacturer, critical success factor, manufacturing, production, muda, kaizen, over production.*

## 1. INTRODUCTION

The study is aimed at assessing the challenges and benefits of Lean Production System (LPS) implementation in an automotive Original Equipment Manufacturing Company located in Nnewi, South East – Nigeria. Established about ten years ago, Kc Auto-parts Manufacturing Company (KAMC) is an Original Equipment Manufacturer (OEM) of vehicle parts, which it supplies to automobile manufacturing companies in Nnewi and other parts of the country. By working very closely with vehicle manufacturing companies, they produce different varieties of vehicular components and parts, such as gear systems, brakes, exhaust systems, throttle, and other hardware, for the manufacture and repair of vehicles.

Despite the early challenges the firm faced during its inception, it was able to break even during the fourth year of its operation as a result of the early acceptance of their products. Based on their track record of manufacturing of quality products, the company recorded tremendous success within the next few years, which enabled them to acquire one of their competitors, and also expanded their production lines at the shop floor.

However, the firm's fortune nose-dived and faced the following challenges for two years: fierce competition from new entrants, importation of cheap products from China, lack of adequate power from the national grid, high inflation rates, as well as excess inventory and defects, which adversely affected their profitability and staff morale.

Faced by the challenges of high production cost, excess inventory, low profitability, as well as increased defects, which led to fortune reversals, the company's management decided to adopt best manufacturing practices. Okpala (2013), observed that "the main reason LPS is required by manufacturers is its ability to give a competitive advantage to the users, as it enables them to manufacture high quality products faster and also at cheaper rates, thereby translating into the production of right quantity of goods at the right time, and supplied to the customer when they are required."

In May 2017, after series of trainings and consultations, the management began the implementation of Lean Production System (LPS) in the establishment. LPS has been successfully applied over the past years by many companies, in a bid to achieve a competitive advantage, as any company that improves its performance on a regular and continuous basis will definitely have a competitive edge over its competitors.

In lean manufacturing, the sole aim is to eliminate wastes and seek to create a manufacturing system that is responsive to the market needs. The automotive original equipment industry is not left out in the success record from lean manufacturing, this is because the manufacturing approach has revolutionized the industry by enabling them to cut costs and also improve efficiency.

The main goals for implementing lean production such as eliminating wastes, reducing inventory costs, providing optimum quality at the least cost, amongst others can hardly be achieved without encountering further challenges. The most common challenge in lean implementation is maintaining it, as lean is a continuous process that requires continuous improvement.

### ***Statement of the Problem***

Due to globalization and influx of products from other countries, manufacturing companies in Nigeria must either embrace best manufacturing practices or be forced out of market. This is because to remain competitive, they must jettison their traditional manufacturing practices, and embrace philosophies that excelled and also contributed immensely to successes of manufacturers from other nations. One of those manufacturing practices is lean production system which has been successfully implemented in Toyota manufacturing company for over fifty years.

Local manufacturers in Nigeria have found it very difficult to compete with imported products mainly from China in terms of quality, lead time and price, due to the inherent wastes in their manufacturing processes. This is because while the local original equipment manufacturers were still struggling to meet their customers' requirements, their counterparts abroad that are practicing lean manufacturing were already exceeding the customers' expectations.

This research will seek to assess the status of lean production system in the case study company, by determining the challenges, benefits, and critical success factors of implementing the manufacturing process. The need for the study is very crucial as it will enable KAMC and other local original equipment manufacturers to streamline their manufacturing processes throughout their entire organizations, and also persist on continuous improvement in order to become 'more lean'.

Also, since many manufacturing best practices like LPS is still relatively new in Nigeria, the research will expose the manufacturing approach to many industries, enable them to appreciate the challenges and benefits of its implementation, and also give them the opportunity to benchmark themselves with manufacturers from western countries who have enjoyed the dividends for many decades.

### ***Purpose of the Study***

The purpose of this research is to ascertain the challenges and benefits of lean production system implementation in Kc Auto-parts Manufacturing Company, located in Nnewi – Nigeria. Apart from process documentation, questionnaires and oral interviews of management and staff of the establishment were employed in data collection.

To obtain elaborate information for the purpose of the research, and an in-depth knowledge of the processes, both quantitative and qualitative research techniques will be adopted, while inductive reasoning strategy will be employed for data analysis.

### ***Research Questions***

The research is aimed at answering the following questions:

- a. What are the challenges of LPS implementation in Kc Auto-parts Manufacturing Company?
- b. What are the Critical Success Factors (CSF) of LPS implementation in the establishment?
- c. What are the LPS performance measures?
- d. How would you classify the LPS implementation results?
- e. What are the strengths and benefits of LPS implementation in the firm?

## **2. LITERATURE REVIEW**

According to Ihueze and Okpala (2011), LPS is a "manufacturing strategy that is aimed at applying fewer resources to manufacture high quality products that meet the customer's requirements, at less the time, thereby increasing throughput and profitability". They observed that unlike mass production that is geared towards the production of large quantities of products, LPS is aimed at increasing efficiency and reducing production cost by manufacturing the number of high quality products when they are needed by the customer, with emphasis on keeping of very low inventory.

However, Manish and Bhim (2018), pointed out that LPS is an ordered approach to production that minimizes waste in the entire value chain, while at the same time improves the quality of products, and also creates more value for the customers.

Also, Pavnaskar et al. (2003), explained that the goal of LPS is to reduce the waste in human effort, inventory, time to market and manufacturing space, to enable it to become highly responsive to customer demand, while producing world-class quality products in the most efficient and economical manner.

Ihueze and Okpala (2012), observed that apart from wastes identification and subsequent elimination, LPS enables organizations to be more profitable through the application of fewer resources to manufacture more quality products at a faster rate, thereby leading to competitive advantage and customer satisfaction.

Okpala (2014), observed that LPS which is the World's best practice in manufacturing is not aimed at working faster and better, but at identification, and elimination of all forms of wastes. He explained that recognizing all non-value adding activities in manufacturing processes as wastes leads to the identification of their root causes, for immediate reduction and possible elimination.

While explaining that LPS has been accepted as the best manufacturing approach, Okpala and Ihueze (2019), pointed out that low throughput and profitability, as well as rise in lead time, defects, customers' complaints, and high scrap rate were the main reasons that can compel a company's management to embrace LPS. However, Okpala, Anozie, and Mgbemena (2020),

explained that the successful implementation of lean production will enable manufacturing companies to shift emphasis from meeting the customers' requirements to exceeding their expectations.

On the need for LPS, Okpala (2014), stated that manufacturers has over the years come to realize that they could not remain economically viable in the present day market without improving their efficiency and productivity in line with their competitors. He noted that to this end, it became evident that this could not be achieved through the traditional system of manufacturing which involves mass production; and that to remain competitive in the global market, many of them have embraced LPS which considerably reduces the cost of manufacturing, as it eliminates the wastes that are associated with mass production, thereby enabling organisations to save lots of money.

### 3. BENEFITS AND CHALLENGES OF LPS

#### I. *Benefits of Lean Production System*

Lean production system has proved very successful in original equipment manufacturing companies because of its numerous benefits, which include improvements in throughput, profitability, and customer satisfaction, others are reduction in the seven wastes that are inherent in production processes. These wastes are over production, defects, excess inventory, processing, unnecessary motion, waiting, over-production, and transportation.

##### ***Inventory Reduction***

The application of Lean production system in the automotive manufacturing industry leads to reduction in unnecessary inventories, thereby reducing the unprofitable time large quantities of raw materials are kept in the warehouse after purchase. Excess inventory include excessive storage of raw materials, intermediates and products.

##### ***Reduction of Over-Production***

Lean manufacturing assists in eliminating over-production in automotive industries. According to Ramesh, Jayachitra, and Abinanth (2016), over-production results from producing faster, sooner and in greater quantities than the demand of the customers. It stems from inadequate flow of information or products. Also, Melton (2005), noted that over-production is also seen when products are made for no specific customer, or developed alternate process routes are not put in use. It increases the extent of warehouse space needed for storing products. Lean manufacturing reduces over-production because it works on the principle of just-in-time (JIT), which entails producing what the customer wants, when they want it without any delay in inventory.

##### ***Reduction in Excessive Transportation***

This includes excessive movement of materials, equipment, products or information, and normally leads to wasted time and cost. While the material is being moved, it is not been processed, hence it does not add any value to the customer. This is in addition to the risk of getting damaged. The application of Lean production in automotive manufacturing company will reduce the numerous transportations involved in an automotive manufacturing system while enhancing productivity.

##### ***Decreased Lead time and Waiting Time***

Melton (2005), pointed out that one of the benefits of Lean manufacturing is that it leads to decrease in lead time. Many wasteful practices, such as manufacturing of products in batches that are unrelated to the immediate need, increases lead time in an automotive company. Waiting involves long periods of inactivity of people, equipment or material before they are involved in processing. This period of inactivity does not add value to the customer.

##### ***Reduction of Unnecessary Motion***

Sometimes in an automotive manufacturing company, the movement of personnel who operate the machines may be excessive and wasteful. There may be large team of operating personnel moving to and fro a manufacturing, with little or no activity actually going on within the unit. Without the application of lean production system, the operators may waste much time for excessive motions in handling some processes.

##### ***Elimination of Over-Processing***

Lean production system eliminates some inappropriate processing that does not add value to the system. This involves the duplication of any steps related to the supply chain process, the wrong use of tools, systems etc. Over processing is when the product is processed beyond the standard required by the customer. Correct application of lean production system eliminates inappropriate processing.

##### ***Reduction of Defects/Rework and Quality Improvement***

Frequent errors that lead to product defects and quality problems result to rework or scrap, as well as poor delivery performance. When these defects are reduced by correct application of lean production system, the quality of products invariably increases.

##### ***Improved Customer Satisfaction***

One of the major benefits of lean production system is the ability to satisfy the customers. When a company's product is delivered on time with the required quality, the customer will be satisfied.

##### ***Increase in Profit, and Reduction in Operation Cost***

When accurately applied, lean production system leads to increase in profit in the long run. As most of the wastes are eliminated or reduced, the cost of manufacturing will decrease which increases a company's profitability.

### ***Improved Employee Morale and Involvement***

Employee morale may not be increased in the initial stage of lean production system implementation until they accept and willingly contributes to its success. Once this is achieved, employee morale will increase, as there will be reduction in stress and uncertainty in the workplace.

### ***Increased Efficiency***

In lean production system, each personnel work in the most efficient way. This leads to standardized work and Kaizen (Continuous Improvement).

## ***II. The Challenges Of Lps***

Maintaining lean is challenging and also requires a lot of work, of which some manufacturing companies are not prepared to commit to. According to Drew and Roggenhofer (2004), the journey to lean is not for the timid, and there are no stopping places along the way, as making the transition is highly challenging and many fall by the wayside.

The challenges that are faced by automotive original manufacturing companies include but not limited to:

### ***Top Management Involvement***

Drew and Roggenhofer (2004), observed that LPS implementation is a radical process as it changes the usual way of operations (such as eliminating the customary way of accumulating inventory) and the senior management of OEM companies are often opposed to such drastic change. The complete success of the application of lean viewpoint in the long run will depend on close teamwork between the shop floor personnel and the management. It must be noted that people's fear for innovation even when it's a beneficial one can play a role in causing a bottleneck in the successful implementation of the manufacturing system if top management is not directly involved.

According to Bicheno and Holweg (2009), the senior management team's ability to create rewards and incentives to encourage employees to continue to contribute to the company's lean efforts is key, or better yet they could lead by actively participating.

### ***High Cost of Implementation***

In an industry as large as an automotive equipment manufacturing company, implementing lean production system will involve a very huge cost. This is because implementing lean often involves dismantling previous physical plant set ups and systems, employment of skilled/expertise staff such as managers, and training of existing staff. These will cause a reasonable shoot up in the company's human resources expenses. Also, the purchase of new machinery needed to increase efficiency might be achieved by means of a loan thereby throwing the company into a long-term debt. The initial high cost of implementation and with its effects on the industry sometimes discourages LPS implementation in manufacturing companies.

### ***Lack of Proper Understanding of Lean Production Strategy***

According to Bicheno and Holweg (2009), a survey conducted in the year 2007 on the leading one thousand Canadian manufacturing companies showed that going back to the old ways of doing things and the lack of implementation knowledge were the greatest obstacles to Lean. Modern auto manufacturing companies requires the tenacity to invest so much time in developing a lean mind-set in their workers.

Hence, the first basic step is to understand the lean techniques properly, for effective application of such. Lean manufacturing in its usefulness is a system that ought to involve the entire production team for its effective and useful application. This poses a big challenge, since inadequate understanding of any of the team members can mar its successful implementation.

### ***Time factor***

In an OEM industry, successful implementation of lean production system requires adequate time for training, planning, and application of the lean techniques that has been agreed upon by the management and lean experts. This time involvement in the short run poses a challenge to smooth running of production, which in turn affects productivity and profit.

Senior managers and executives frequently look to Lean as a well-known way to cut operating costs and reduce competitive losses. This overly positive view may induce them to question the results prematurely, without ever putting forward the commitment needed for the process to work.

### ***Poor Communication***

It is important to ensure that proper communication channels are being utilized by a company in order to guarantee that the workers (who are the ones who are mainly involved in the actual implementation of Lean) are fully aware of the change that is to come, to enable them not to resist it. In a lean environment, Kaizen notice boards or real-time productivity boards are excellent communication channels. Unobstructed, spontaneous, and rapid communication both horizontally and vertically are both important in lean deployment. Without proper and effective communication, implementing the lean culture successfully will be quite challenging.

### ***Uncertainty***

Sometimes, Lean systems might require a reduction in the workforce. The workforce has a direct impact on productivity and reducing any labour that may have been saved by the lean system would lead to the workforce viewing lean as negative and being uncertain as to how the new system would be of favour to them.

Opposition from the workforce is also a major hindrance to successful LPS implementation.

## **4. RESEARCH METHODOLOGY**

As an exploratory and descriptive analysis of an individual, people or phenomenon, case study analysis was selected as the research design for this study, as it is targeted at the analysis of distinctive subjects within the borders of an area of interest.

Teegavarapu, Summers, and Mocko (2008), defined case study as an “empirical research method used to investigate a contemporary phenomenon, focusing on the dynamics of the case, within its real life context”

However, Harrison et al. (2017), explained that case study research has wide applications and “has grown in reputation as an effective methodology to investigate and understand complex issues in real world settings.” Quite essential in the comprehension of specific problems, case study method enables the researcher to conduct a reliable research design and result validation.

This study is targeted at an original equipment manufacturer - Kc Automobile-parts manufacturing company, with a population size of 117 staff. To determine the sample size, the Taro Yamane formula was applied as shown below.

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Where:

n = sample size

N= finite population size (117)

And e = limit of tolerable error (5% = 0.05)

1 = constant

Substituting in equation 1 gives:

$$\begin{aligned} n &= \frac{117}{1 + 117(0.05)^2} \\ &= \frac{117}{1.29} \\ &= 90 \end{aligned}$$

The collection of primary data with semi-structured questionnaire was therefore targeted at the computed sample size of 90 participants drawn from all the departments of the manufacturing company, which include the following: management, design and development, production, supply chain and logistics, maintenance and utilities, administration, finance, and sales and marketing.

## 5. RESULTS AND DISCUSSION

To analyse the primary data that were collected with the administered questionnaire, descriptive statistics was adopted for the study.

### **Research Question A**

What are the challenges of LPS implementation in Kc Auto-parts Manufacturing Company?

According to the respondents, the original equipment manufacturer faced some challenges during the LPS implementation in the company. The challenges which were ranked in accordance to their intensity in Figure 1 showed that high cost of LPS implementation is the most mentioned, followed by inadequate fund, inadequate training, lack of proper understanding of LPS, poor communication, as well as uncertainty.

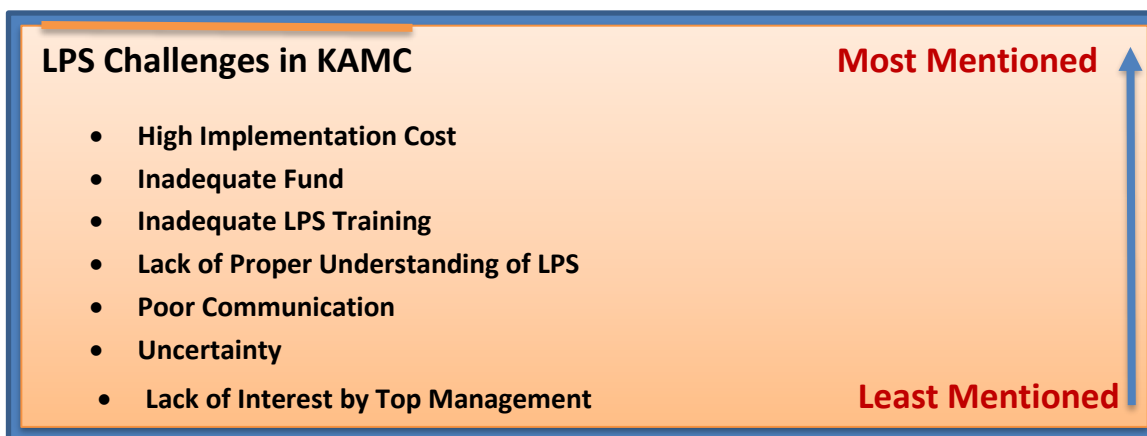


Figure 1: Challenges of LPS implementation in KAMC

Lack of interest by top management was the least mentioned, as the respondents observed that their top management gave their full support for the implementation of the manufacturing strategy.

### **Research Question B**

What are the Critical Success Factors (CSF) of LPS implementation in the establishment?

From Figure 2, it could be observed that management/leadership participation is the main critical success factor of LPS implementation in the firm, as indicated by 88 out of the 90 respondents. The additional identified critical success factors in their rankings are customers, finance, skills and expertise, suppliers, improvement tools and techniques, organisational infrastructure, education and training, and cultural change.

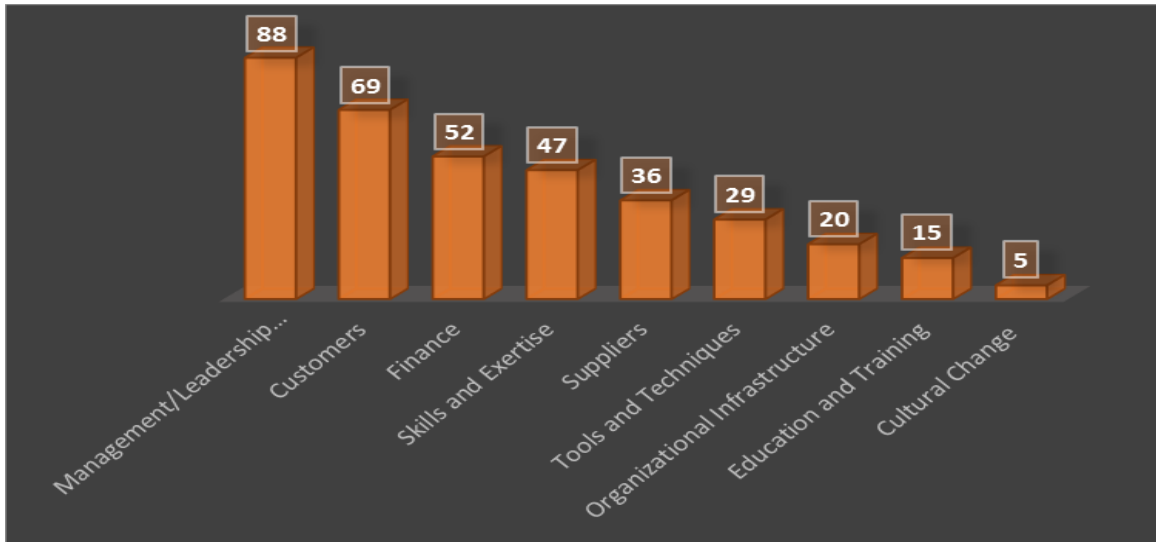


Figure 2: Critical success factors of LPS implementation

With just 5 indications, cultural change is therefore the identified least critical success factor of LPS implementation in the manufacturing company.

**Research Question C**

What are the LPS performance measures?

To assess their Lean Production System implementation results, the company adopted different performance measures. On the level of their usefulness as depicted in Figure 3, waste reduction scored 40 percent, followed by customer satisfaction, competitive advantage, lead time reduction, and increased throughput, with scores of 20 percent, 17 percent, 13 percent, and 10 percent respectively.

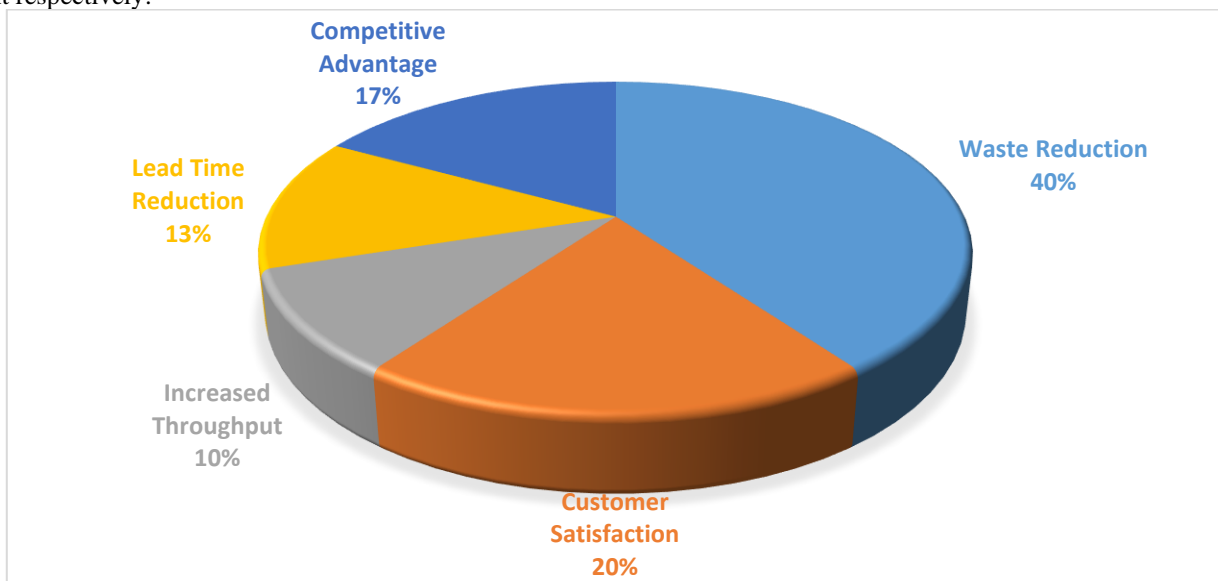


Figure 3: KAMC LPS performance Measures

The result showed that waste reduction offers the best result in appraising the company’s LPS performance measures.

**Research Question D**

How would you classify the company’s LPS implementation results?

On the classification of the auto-parts manufacturing company’s lean implementation results as shown in Figure 4, 52 percent or 47 respondents observed that the results were good, while 21 percent or 19 respondents rated the results as very good. Also, while 10 respondents insisted that the implementation results were excellent, 11 and 3 respondents rated the results as average and poor respectively.

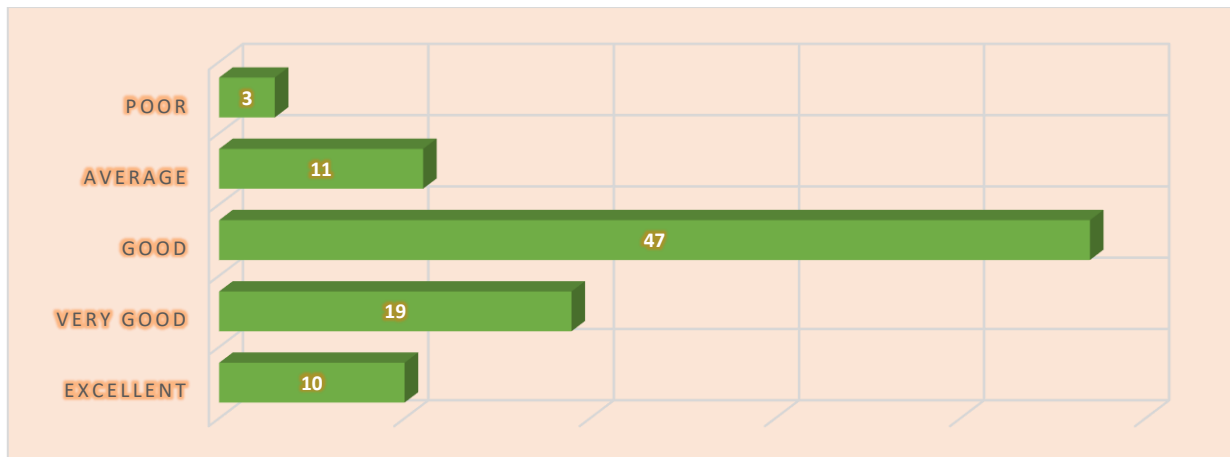


Figure 4: Classification of the company's lean implementation results

The analysis revealed that despite the encountered challenges of LPS implementation, that the firm has recorded remarkable successes, hence the need for other manufacturing firms to embrace the production strategy.

**Research Question E**

What are the strengths and benefits of LPS implementation in the firm?

The result of the analysis on the strengths and benefits of lean production system implementation in the establishment, showed that waste reduction which was indicated 27 times by the respondents, was the main benefit they achieved with the LPS implementation. As depicted in Figure 5, they also listed cycle time reduction as the least benefit they achieved with the LPS implementation.

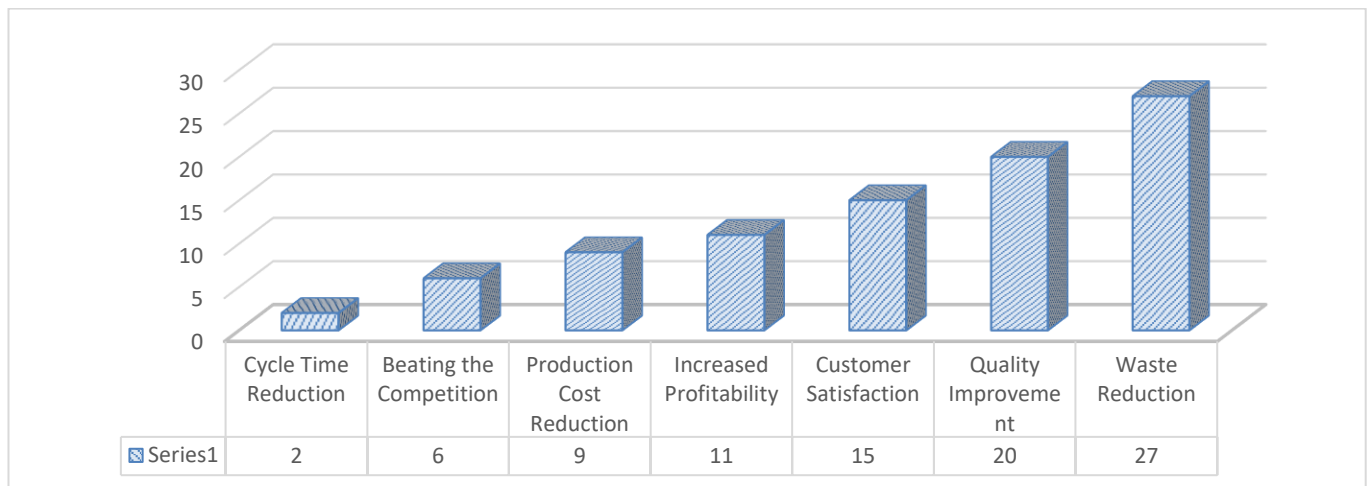


Figure 5: The strengths and benefits of LPS implementation

**6. CONCLUSION**

Although the findings of this study is similar to researches that were carried out on Lean Production System implementation in other parts of the world, they reflect the opinions of the respondents at the Kc Auto-parts Manufacturing Company in Nigeria.

The remarkable improvement that the company made in waste reduction corroborates the findings of Manish and Bhim (2018), and Pavnaskar et al. (2003), as they observed that the implementation of LPS by manufacturing companies leads to the reduction of waste and also improves the quality of manufactured products in economic and most-efficient manner. Also, the result of the study that management/leadership participation and involvement is the major critical success factor of lean implementation in the firm, validates the findings of Drew and Roggenhofer (2004), who opined that the success of the implementation of lean is highly dependent on the teamwork between the management and the shop floor personnel.

Despite the challenges the original equipment manufacturer is facing in their 3 years LPS experience, which are being surmounted with Kaizen and other tools and techniques of lean, they are quite happy with the results of the manufacturing practice which include: increase in profitability, throughput, and competitive advantage, as well as muda (wastes), and production cost reduction.

Based on the outstanding successes recorded by KAMC, which has repositioned the company in just their 3 years of embracing lean practices, the authors are recommending LPS to not just original equipment manufacturers, but other manufacturing companies that are bedevilled with wastes like excess inventory, over-production, defects, etc., as well as high production cost, and low profitability and throughput.

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