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DEVELOPING THE THEORETICAL MODEL TO ENHANCE THE EFFICIENCY AND EFFECTIVENESS OF THE MANUFACTURING CONTEXT THROUGH EXTENSIVE LITERATURE REVIEW

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Abstract

The selection of manufacturing process for any product is not an easy task because it depends on the various attributes like cost, quality, material, design of the product and many more. The varying attributes increased the pressure on the manufacturer's to produce the products through efficient utilization of all the resources. In present days, the market has become the customer oriented. To accomplish the customer desire within the given frame as dictated by the customer, the manufacturing sector is still in consensus to find out the various output measures and provide the solutions to the resource management (within and outside the industry). In the present work, the published literature on the manufacturing context is reviewed and various gaps are identified. In addition, the theoretical model is developed to fill the gaps identified in the present work.

Keywords: Performance; *Lean Manufacturing, Supply Chain Management, Manufacturing Strategy etc.*

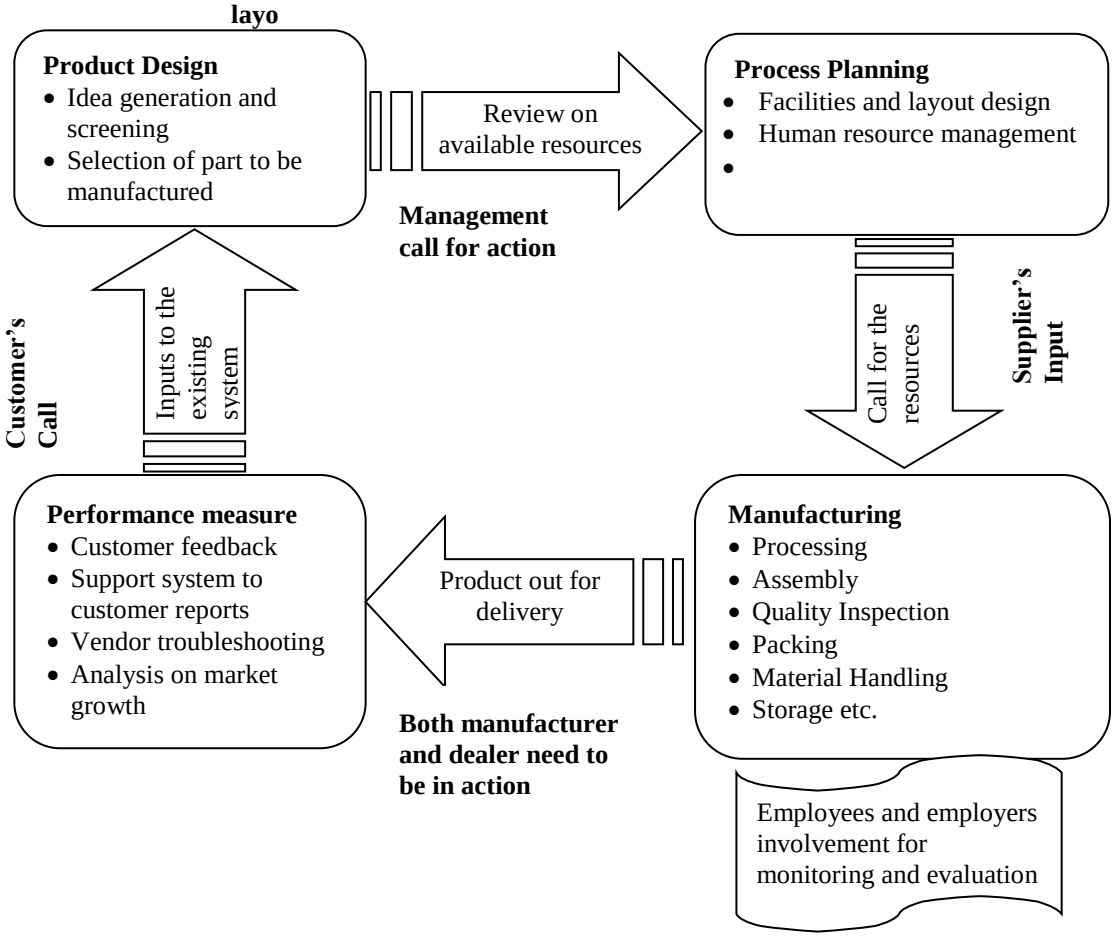
1. Introduction

The manufacturing sector is the vital arm of the nation as well as the vital consumer for resources like men, machine, material etc. It is the important contributor to the national economy and the level of manufacturing activities in any country indicates the economic health of that country. It is the presumed terms of the economists which state that the standard of living of the employees has the dependency on the level of manufacturing activity happens in that particular organization. In addition, it is the widest contributor to the environmental degradation by creating wastes such as harmful gasses, non-degradable constituents.

The Latin word, manufactus, derived the term 'manufacturing' which means 'anything made by hand'. In general, the primary inputs of the manufacturing sector are the men, machines, materials, money, and methods (5M's). The input resources are converted into the useful products passing through a pre-defined sequence of operations. The finished product is then delivered to the end-customer for the use. [15, 19, 33] In general, each manufacturing industry is working on their own perception (which is unique in nature) to cater and fulfill the customer demand. There are numerous variables for defining the unique manufacturing style which varies from industry to industry. [17] The quantity and quality of resources for the manufacturing industries varies with industry to industry and also has the dependency on both the manufacturer as well as the customer perspectives. [28] The huge amount is invested on manufacturing activities like procurement of the raw resources, on the facilities (used for conversion of raw material in the finished product) and on the transportation of finished material (delivery to customer end) etc. [3, 21] The general layout of the

manufacturing process is shown in figure 1 which depicts the activities in the manufacturing process as well as their respective roles/contribution in a manufacturing context.

Figure 1: Manufacturing process sample layo



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The manufacturing process basically works on conversion/transformation principle i.e. procured raw material is converted into the final product/commodities as desired by the customer through processing it on various workstations. [22] The flow of all the resources is oriented in such a manner (sequenced properly) that every workstation aligned to the process can perform/contribute as the productive operation in-time. [9] Through passing the raw data to each station within the manufacturing system, the value addition is done and passed to the successor work-station for the next operation. With the value addition process, some non-value added activities like, over processing, over-production also happens. These non-values added activities are also termed as wastes and characterized as Muda (non-value adding work), Muri (Overburden), and Mura (unevenness). [12, 20, 25] These wastes never add the value in the final product but consume the resources. In addition, the customers are also not willing to pay for these non-value added activities. [1] These activities can be broadly categorized in three ways that are:

1. **Customer Value-Added:** Value-added activities are those activities, which are acceptable to the customer because the value-addition process adds the value in the product. Also, the customer pays willingly for these activities. These activities are essential to the manufacturing process, therefore, need to maintain. i.e. The machining of the components in the manufacturing process

adds value in the final products as good surface finish, shaping etc.

2. **Wastes (Non-Value Added):** The activities, which do not contribute/ add value to the product, are considered as non-value addition activities. These activities are not the part of established process practices. Still, these activities can do for the betterment of the product. For example, the chemical coating/chrome plating on aluminum alloys may not be required as part of the manufacturing process but if carried out shall add to the cost which may not be acceptable to the customer.

3. **Business value Added (Necessary but Non-Value Added):** The movement of material from one work-station to another at the shop floor provides the support to the manufacturing process by reducing the lead-time. These movements of material never add value to the product but add some cost to transport of material in the final product cost. Figure 2 shows the various activities in the manufacturing context. [25]

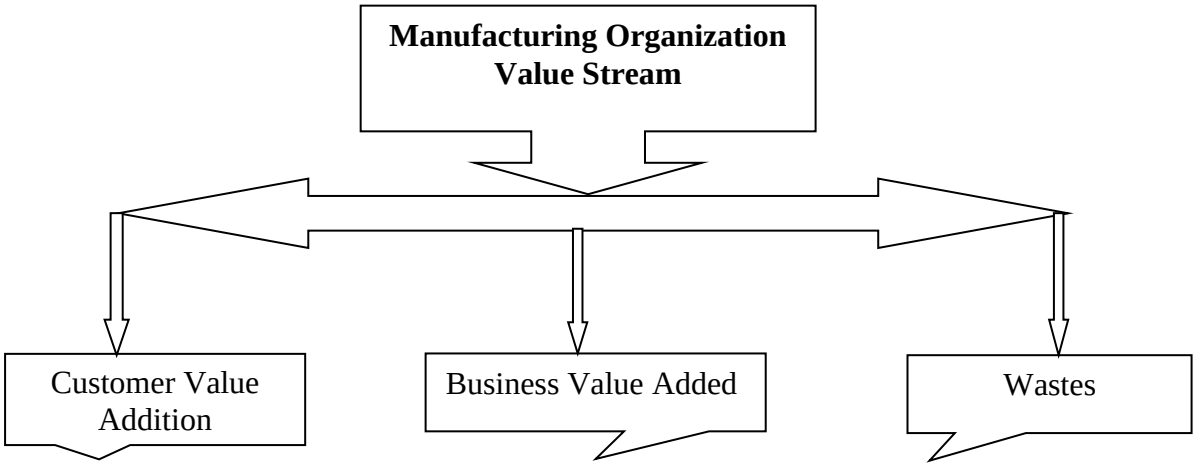

Figure 2: Activities in the manufacturing context [14]

In the past three decades, the manufacturing scenario has undergone the major changes because of the reasons like new technology innovation; changes in the economic environment; the presence of dynamism in customer needs; globalization of the market etc. So, it becomes difficult to take the decision regarding the resources (selection and consumption) for the manufacturing context. [7, 32] Most of the time, the wrong planning/decisions regarding the resources procurement and their utilization are taken by the manufacturer because of uncompleted information or supporting data for decisions. This further leads to affect the entire working system of the industry. [26]

2. Literature Review

At the early age of the twentieth century, Henry Ford (owner of Ford Company) introduced the concept of mass production in the Ford Company. He reported that the performance of an organization is dependent on the efficiency and effectiveness of the man-machine management system used in the organization. At that time, the craft production was very popular and facing the problem to meet the high demand. [11] His work on mass production based on standardized process admires the other manufacturing giants especially in the automobile sector in the world to produce the goods in shorter manufacturing cycle with reduced cost. After that Frederick Winslow Taylor, an American Mechanical Engineer (known as the father of Industrial Engineering) worked on industrial efficiency improvement. His studies and working on the industrial efficiency improvement were conceived and appreciated by the American industries during 1890's to 1920's. His book on '*The Principles of Scientific Management*' was pioneered and used as the basis for the factory floor design and development until today. His works help the manufacturers to think of modified ford production lines (design and functioning). [3, 6]

In continuation of the industrial revolution, Deming (1920) devised the statistical quality control tools to help the manufacturing sector on the quality front. He developed the tools to identify the defectives production and the causes by which defect occurs. The literature on manufacturing sector reveals that the mass production in manufacturing context was the first revolution. Later on, the manufacturing system efficiency and effectiveness of the organizational activities are considered as the important parameters. [6, 23]
In Indian manufacturing context, the globalization has resulted in a competitive environment with the uncertainty in customer demands, due to plethoric imports of all types. This has created a large volatility calling for a fighting spirit and a huge pressure for improvement in design, quality, and services of products. There is thus a need for meeting customer satisfaction achieved through lower costs, which may be materialized by effective monitoring of product flow, efficient utilization of all the resources with high-performance rates. [20]

The literature on manufacturing context reveals the domination of manufacturing process like the design; development and delivery are caused by the customer needs as the demand reaches from the customer right back to the raw material suppliers. [29] The competitive environment forced the manufacturing context to maximize its output on the other hand reduction in the resources consumption as well. The faster communication to customers regarding the product design, quality, comparative index (various aspect in comparing the same kind of products offered by competitors), availability etc. and the demand communication to the manufacturer influenced the market scenario. [13] In addition, the stringent regulations on the manufacturing context to meet the specific demand as depicted by the national/international market also impact the sustainability of the manufacturing industries in the long-term running business entities. [10]

3. Problem identification

The improvement in the manufacturing industry performance has been the never-ending effort, which is being driven by the culture of the organization. [13, 26] Therefore, an attitude of perfection, innovation, and devotion is an essential part of the performance improvement of an organization. Recently, innovations in the field of engineering have helped the manufacturing context to produce and sold the products in the very short span of time and making more profits. Perhaps, the design criteria; cost and timely delivery of goods, works as the yardstick, which contributes to the performance index. [5] The performance of the manufacturing industry is mainly dependent on how best the industry utilizes the resources pertaining to the industry. As per the past literature the following gaps are identified:

- Un-optimized resource consumption
- Rigidness in production system
- Higher setup time
- Lower workforce welfare
- Less effectiveness of the industry because of improper planning and execution
- Higher delivery time and costs
- Lower customer support system

4. Theoretical Model Development

The Japanese automotive products manufacturing industries are well-known for their contribution to industrial revolution i.e. in the production sector and quality as well. They developed several techniques to increase the production rate, subsequently work on a quality aspect of the products. Contribution by Taiichi Ohno (an Industrial Engineer) at Toyota Motor Corporation after the Second World War was remarkable. He developed the Toyota Production System (TPS) with the help of which the production rate and quality of the product increased. In the Western countries, TPS was known as Just-in-Time (JIT) in the initial stage later on modified as the Lean Manufacturing. [4, 14, 30]

The literature reveals that the lean thinking in general helps to understand the industrial processes and their contribution on an individual basis in the final product. At the earlier age, lean is simply focused on shop-floor which only works on reduction in wastages. But nowadays, it is referred to the cost and waste reducing approach i.e. reduce the cost of operations that consistently sought to increase value for customers by adding product or service features and removing wasteful activities. [16, 35] In the manufacturing context, the implementation of lean principles in the manufacturing context reveals the changes in the value stream (flow stream through which the material flow from one workstation to other) and finally impact on the organizational performance. Still, there is consequence remains in the manufacturer mind on various attributes like supply

chain operations; management decisions; and workforce contribution etc. in the newly developed value stream (modified one). [34]

To overcome the consequences discussed earlier in the last para, the supply chain of the manufacturing context should be lean so that maximum benefits within the organization are to be sustainably realized. The lean manufacturing approach can be applied to all the aspects of the manufacturing organization supply chain. It helps in developing the pull production paradigm that extended beyond the boundary of the manufacturing organization to include the upstream and downstream of all the supply chain partners. [16, 35] In the manufacturing context, lean manufacturing integrates the value stream in such a manner to avoid any interruption in the value chain through segregating the activities. The integration attempt of lean manufacturing in the supply chain supports the manufacturing process and improves the output that creates the substantial opportunities in the market. [18, 24]

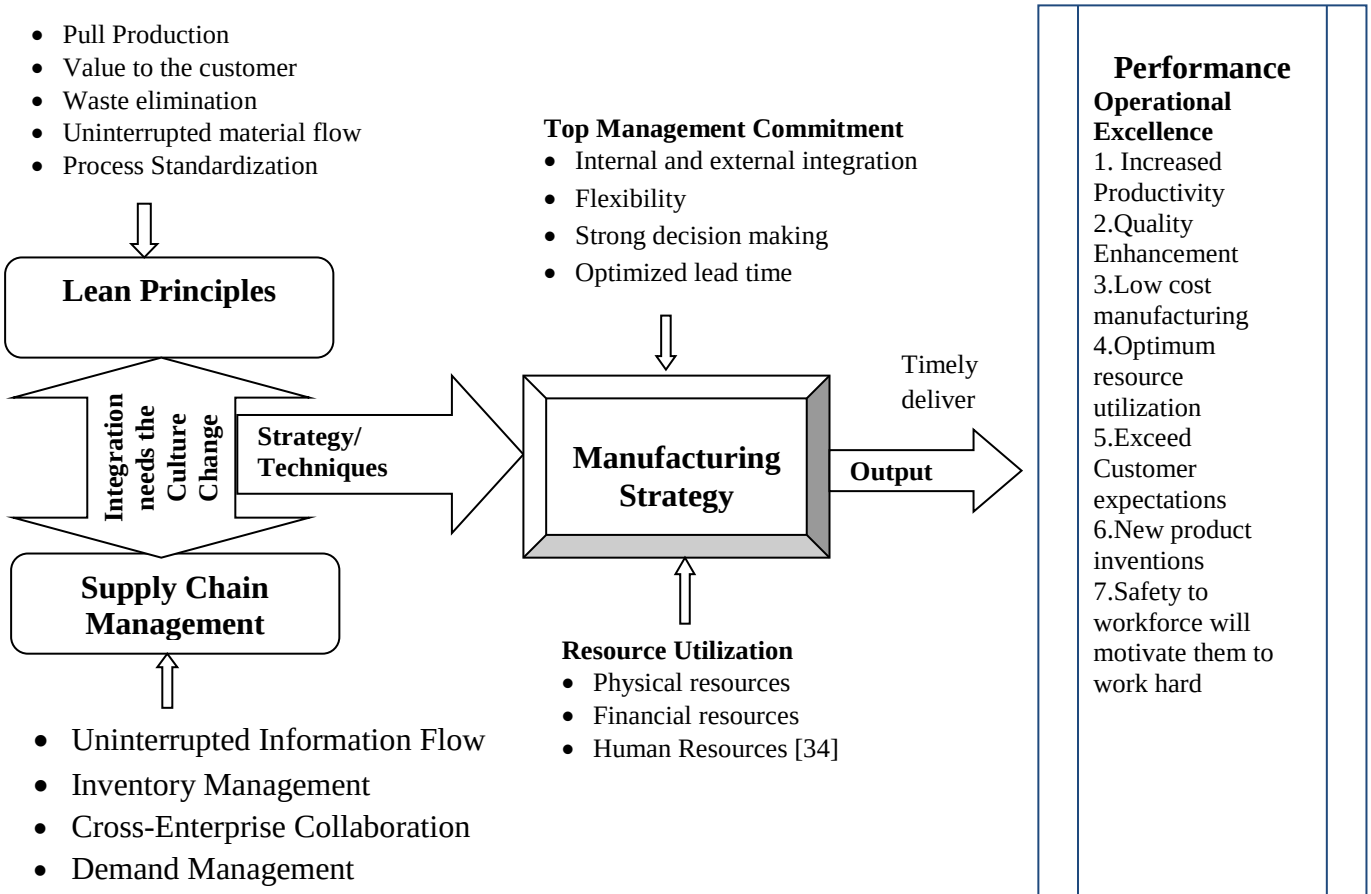

Figure 3: Theoretical model for the present study

5. Results and Discussion

The paper discusses the need to call the change in the manufacturing context i.e. "Why the supply chain should be lean?" The present work reveals the application of any individual approach (i.e. lean manufacturing or supply chain) may result in improvements, but on the other hand, it will affect the others allied areas. So there is an opportunity for the manufacturing sec[illegible] to combine/coupled both the approaches on a single platform. This will reduce the chance of uncertain conditions within the system. The theoretical model suggested in the present work will help in achieving the following objectives:

- Help in Improving the forecast accuracy and delivers the goods in the most optimal

manner to meet with demand,

- Help in enhancing the internal and external collaboration to ensure the visibility and transparency,
- Help in synchronizing the resources flow without any associated waste,
- Help in defining the roles and responsibilities of various key players to foster innovation and knowledge-sharing,
- Help in pursuing the perfection through work standardization,
- Help in Enabling the visual management for review and reporting,
- Help in empowering the employer and employees to create a continuous improvement culture, and
- Help in aligning the core competencies to enable the quick response mechanism to the customer demand within and outside the organizations

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