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A Review on Applications of Lean Manufacturing Principles

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Abstract

This paper has been written for analyzing the policy of the lean manufacturing and identifying its scope by waste reduction techniques. Various concepts of lean manufacturing are analyzed to explore the manufacturing process. Various articles are studied to explore the use of lean principles and techniques to identify the waste. In these literature studies, some of the authors have focused on value stream mapping for analyzing the system, and many of researches have utilized maintenance activities, some authors have also considered the risk associated with implementation of lean principles. This study can be useful for developing economy in manufacturing by implementing lean policy for waste reduction and quality improvement.

Keywords: *Lean manufacturing, value stream mapping, waste reduction, lean principle, maintenance activity, productivity*

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INTRODUCTION

Better quality and low cost are essential for any company for sustaining in the competitive environment, which can be achieved through manufacturing the product in efficient manner so that productivity can be increased, which can be achieved through the application of lean manufacturing. Lean principles do not only improve the product quality but also improve the methodology, process and environment factor. Time, material, man, and cost are the key factors for the improvement.

Lean manufacturing techniques were first implemented and developed in Japan. The main objective of this method is to eliminate or reduce all kind of waste. Manufacturing industries have wide range of applications and scope for implementing lean principles. Andrés-López *et al.* described the concept model of lean services to understand the lean principles, and provided direction for implementation of lean manufacturing strategies [1]. They also described the role of customer for quality and other improvements.

The details about the implementation and continuous improvements are also listed in this paper. A case study was performed for the validation of developed methodology. Wahab *et al.* also developed the concept model, which described all the seven kinds of waste associated with the manufacturing system [2]. Rauch *et al.* also utilized all seven types of wastes [3].

Behrouzi *et al.* evaluated the performance of lean principles [4]. In this paper, lean attributes are identified based on time, cost and quality, and then checked using membership function obtained by fuzzy logic to measure its performance [5]. In this literature review, various papers have been studied to explore the application of lean manufacturing in various areas and to determine the scope of lean manufacturing techniques. Some of assembly and processing areas are considered to analyze the methodology for elimination of waste and optimization of layouts.

METHODOLOGY

Lean manufacturing can be applied by reducing all kinds of waste, which can be identified by considering whole task in to small activities or number of stages, and by evaluating value of each activity or stage. Non-valuable activity can be replaced, refined or eliminated to add the effectiveness in process or task.

Principles of Lean Manufacturing

Some of waste estimation approaches and standard lean techniques used for implementing lean policy are as follows:

Estimation of Wastes in Manufacturing

Some of activities which produce non-valuable effects on material are as follows:

1) Overproduction;
2) Inventory;
3) Transportation;
4) Defects;
5) Over process;
6) Motion; and
7) Waiting.

The Techniques Involved to Carry-Out the Lean Manufacturing System

Some of the techniques associated with lean manufacturing to enhance its performance are as follows:

1. Value stream mapping;
2. Total productive maintenance;
3. Six sigma;
4. Kanban;
5. 5S;
6. Kaizen; and
7. Poke-Yoke.

Applications of Lean Manufacturing

Many of the authors have utilized principles of lean manufacturing in various industrial and non-industrial applications to improve productivity and efficiency which are as follows:

Arslankaya *et al.* applied the lean principles to a firm which produced dairy products [6]. To improve the productivity, various maintenance activities were considered as a part of lean principles. The problem of breakdown in production was eliminated using maintenance activities or total productive maintenance. Inventories were also controlled as a result of maintenance management. Esa *et al.* utilized the principles of lean manufacturing in automotive manufacturing company for reducing high setup time in assembly line [7]. Setup time is concerned with the productivity, and reduces the cost of manufacturing; it also has effect on customer demand. They used SMED (single minute exchange of die) technique for reducing setup time. The method focused on number of workers required for installation related to setup and machines, and after analyzing the process, internal and external work flow was identified. Finally setup time was reduced to about half of the original time.

Salleh *et al.* implemented lean concept with total quality management in forming process company [8]. Main objective of this paper is to reduce work in progress. Value stream mapping is done to prepare material and information chart. Delmia quest simulation is used for improving work layout, which is improved to get maximum benefit of the manpower and by rearranging process activities.

Rahani *et al.* also used value stream mapping in automotive company for improving productivity [9]. They analyzed value added and non-value added activities for transportation, handling and machine time. Rahman *et al.* explored Kanban system, which is one of lean strategies for inventory management and quality control, and developed internal Kanban flow [10]. Kanban system reduces waste, cost and scraps.

Lam *et al.* used lean policy in electronics assembly line [11]. Line balancing was utilized for balancing manpower and workload. They prepared operation flow chart for motherboard assembly, and also its layout. After analyzing the chart, non-value added and value added activities were identified and work load was controlled for each worker, and reduced the manufacturing time. So, lean policy helped in reducing 25% of waste in assembly process. Nguyen *et al.* also used lean policy in similar kind of work [12]. In assembly, work is focused on work place optimization; and value stream mapping is done to analyze the system.

Rohani *et al.* used value stream mapping for manufacturing process of color industry [13]. This approach reduced production lead time. From material to customer, value stream mapping was analyzed to identify the value of each activity. Take time and bottleneck were considered for effective elimination of waste. Choomlucksana *et al.* applied lean manufacturing principles in sheet metal pressing industry [14]. Subassembly line was analyzed by focusing each activity to identify

the waste. Company manufactures stamping parts for electronic, automotive and hardware parts. Cause and effect diagram was prepared to identify the motion waste in assembly. Therefore waste of motions were reduced in deburring, and policing process gave significant amount of improvement in productivity.

Dos Santos *et al.* considered lean policy for automobile multinational company to improve the productivity [15]. Ergonomics principles were also applied to develop comfortable and safe environment; and good working conditions improved the effectiveness of manpower. Value stream mapping was conducted for analyzing the process. Employees were concerned for discussing through asking some questionnaires, and some factors were discussed to check the importance and value of each factor. These all efforts helped to improve the quality of product to satisfy the need of customers.

Indrawati *et al.* applied lean principles for iron ore industry to improve manufacturing process [16]. Various tools of lean manufacturing like six sigma, process activity mapping, and failure mode and effect analysis were used for process improvements. Waste reduction in process improved the efficiency of production.

Risk Quantification for Implementing Lean Manufacturing

Widiasih *et al.* described method to identify the risk associated in implementation of lean principles [17–20]. Delphi method was used for finding potential risk, and analytical network process was used for estimation of weight of each activity. Integrated approach combined various tools like Delphi method, house of risk (HOR), ISM and ANP [21–24].

CONCLUSIONS

Lean manufacturing is an important tool for any industry for increasing productivity by reducing waste and improving quality. Various researches have been done to evaluate the effectiveness of lean policy. Value stream mapping is a useful tool for analyzing the system and identifying waste. Total productive maintenance can be used for improving process and quality. Cause and effect diagram is also used for identifying motion waste. Risk associated with implementation of lean manufacturing can be estimated using Delphi approach, house of risk, ISM and ANP. So this literature work can be used for implementing lean policy, and identifying wastes in any manufacturing company for improving productivity.

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