JJMIE

Volume 5, Number 6, Dec. 2011
ISSN 1995-6665
Pages 527 - 532

Jordan Journal of Mechanical and Industrial Engineering

The Development and Implementation of Lean Manufacturing Techniques in Indian garment Industry

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Abstract

This research addresses the implementation of lean principles in an Indian garment export industry. The objective is to evolve and test various strategies to eliminate waste and to improve the productivity. This paper briefly describes the application of Value Stream Mapping (VSM) and Single Minute Exchange of Die (SMED). Existing state production floor was modified by using VSM efficiently to improve the production process by identifying waste and its causes. At the same time, set up time is also reduced considerably. We conclude with evidence of the early results of the programmes as well as a number of key learning points for other organizations wishing to follow similar path.

Keywords: Lean Manufacturing; Garment industries; Value Stream Mapping (VSM); Single Minute Exchange of Die (SMED)

1. Introduction

In the 1980's the garment industry was led by fashion and retailing and the emphasis was on technologies in the demand-related parts of the supply chain. India ranks among the top target countries for any company sourcing textiles and apparel. Indeed, apart from China, no other country can match the size, spread, depth, and competitiveness of the Indian textile and apparel industry.

Moreover, the global elimination of quotas at the end of 2004 has greatly enhanced the opportunities for sourcing from India. India supplies over US$13 billion worth of textiles and apparel to the world markets. And exports are growing rapidly as more and more buyers around the world turn to India as an alternative to China. In 2005 – spurred by the global elimination of quotas – shipments to the EU soared by 30% and those to the USA shot up by 34%. These increases are remarkable, given that EU imports from all sources rose by only 8% while US import growth was just 6%.

Consumer spending is slowing down all over the world. Retailers are looking for real innovation from their suppliers. They want really new garments made from new fabrics and yarns. They want new services to offer their customers. Competition in the late 1990s will be based on the capabilities and core competences of textile and clothing companies and on the building of long-term supply relationships. There are many opportunities to be addressed. Textile and clothing machinery will continue to be improved but the most interesting technologies for the 2000s are in the areas of fibres, fabrics, measurement, control and multimedia. We can say a garment industry is an independent industry from the basic requirement of raw material to final products, with huge value addition at every stage of processing, Apparel industry is largest foreign exchange earning sector contributing 15% of the total country export.

In this scenario, the Indian garment industries have witnessed substantial improvements in recent years. But the unnecessary capital investment is not going to solve the problem entirely; moderately this will turn out the waste in long run. The implementation of lean manufacturing is greatly recommended, in order to identify the waste and to eliminate them. This research addresses the implementation of lean tool in the shop floor. We reveal that how Value Stream Mapping can be integrated to show a best picture of non value added activities present in the system and, hereby eliminating the problem that causes wastes.

2. Literature Review

In recent years, many literatures have extensively documented the implementation of lean manufacturing, in various manufacturing sectors. Lean production is a conceptual frame work popularized in many western industrial companies since the early 1990's. Initially, the publication of the book "The Machine that Changed the World" [1] started diffusion of some lean manufacturing practices developed by the most competitive auto manufactures in the world.

The interest on lean production is mostly based on empirical evidence that it improves the company's

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competitiveness [2-3]. Lean manufacturing is most frequently associated with elimination of seven wastes [4]. The purpose of implementing it is to increase productivity, reduce lead time and cost, and improve quality [5]. Quality is a major focus in lean manufacturing, because poor quality management should result in huge waste and scraps. Right quality management at right time will help to control the manufacturing process [6]. Companies such as Toyota, Pratt and Whitney, Sikorsky, Delphi, Ford and many other companies have achieved large savings by implementation of lean principles in their manufacturing activities [7]. Lean manufacturing is an integrative concept which can be adopted by selective set of keys or factors. Those key areas are believed to be very critical for its implementation.

Though many literatures on lean implementation are comprehensively available, very few have addressed the garment industry. [8]The pressure placed on firms in the garment industry from international competition has been enormous. The increase in competition has led to an increased focus on customer satisfaction as a survival of the company in the long run".

The garment industry has opportunities to improve, but requires some changes. Under the highly competitive environment, the garment industry has numerous opportunities for improvement using lean principles [9]. Lean practices can fulfil the customer demands with high quality and services at right time. Now, many countries have started to practice lean tools in the garment industry and observed tremendous improvement [10]. In addition to this lean production involves, motivates and develops employee skills through education and multi-skilling program.

The companies that adopt lean manufacturing as a working philosophy within their organizations can make significant improvement in terms of their operational performance even if it is in a modified format that best suits their particular business culture [11]. The organisations intending to go for any Japanese manufacturing technology and practices should first understand the need to use that tools and its application, prepare for its adaption and then identify the ways and measures required for its successful implementation[12].To implement lean thinking in any organization the first step is to identify the value stream map[13,14] .Value Stream Mapping is a functional method aimed at recognizing production systems with lean vision.VSM has been applied in variety of manufacturing industries[15]. In this paper we also describe an application of VSM in order to identify the various forms of waste in garment shop floor. Work process across the value stream should be performed with a minimum of Non Value Added Activities(NVAA) in order to reduce waiting time, quieng time, moving time, setup time and other delays [16].. In this research the authors have successfully applied VSM and SMED. In the previous years there were many illustrations on application of VSM and SMED tools in various manufacturing industries, but rarely addressed the application of lean manufacturing in garment industry.

3. Problem Statement: Transportation & Machine Assembly

In general, the key activities usually practiced in every garment industry shop floor include: After receiving an order from the customer, the design is made and it is marked in the marker sheet.

- The proper size of the material is calculated, taking in to account the various allowances from the available empirical relationships, the existing database, and prior experiences.
- After procuring the raw material of the desired quality, the pieces were cut in to required size.
- Thereafter, the various processes were carried out.
- In addition inspection is carried out to ascertain the desired quality.
- Finally, finishing and cleaning operations are performed to complete the process. The finished component is then sent to the customer.

Basically the transportation section has various problems such as

- Weight carried by a worker was too heavy
- Distance between each floor was more
- Time taken for transportation was high
- Increased delay time.

In order to avoid all these NVAA the company decided to implement Lean concepts, so that overall performance will be increased.

4. Case Study

The case study considered in this research is one of the leading garment industries in India. The face of the industry was not publicized; but, we shall after refer to the industry as G.L. fashions. The organization has 14 branches. This industry produces various types of inner garments to European and American continents. The annual turnover of this industry was US $ 18 million. In most of the branches, the company was facing severe pressures, both externally and internally, to improve the performance of production flow line. The industry has made huge capital investments to take initiatives in expansions, modernizations etc. The company management has endeavoured to implement 5S+safety and total productive maintenance; but the results achieved were not significant compared to the investments made.

The activities performed in a company can be simply categorized as Value Added Activities (VAA), Non Value Added Activities (NVAA), necessary but Non Value Added Activities (NNVAA). After extreme brain storming and a thorough study of the shop floor, it was found that the material flow line contains various forms of Non Value Added Activities as follows:

- Distance between the material floor and shop floor was high.
- Floors needed to be converted as sections.
- Change of machine setup time between styles needs to be reduced.

Certainly, all of these above factors lead to low production rate and high setup time. In the existing state the average production rate was 70 products per hour and setup time was 28 minutes. In the coming section, the lean principles are implemented on the garment shop floor.

5. Implementation and Results

5.1. Select the process to be mapped:

The process that we had selected for mapping was manufacturing. In this sector we focused to improve the production rate of the production line and to reduce the fatigue of the worker. We mapped the processes from releasing of raw material to finished goods. We studied about the flow of materials between various floors.

5.2. Collection of data and mapping of existing state:

The second step was collecting all the data from various floors and to draw the existing state map. We collected the time taken for transfer of raw materials from cutting floor to production floor and for doing operations.

5.2.1. Existing state map:

In existing state map, the design of the product was issued by the design engineer to the cutting floor. In cutting floor the designs were given to the operators to cut the raw material. After finishing the cutting process the material release order was issued by the production manager. Then the material is transferred to the production floor.

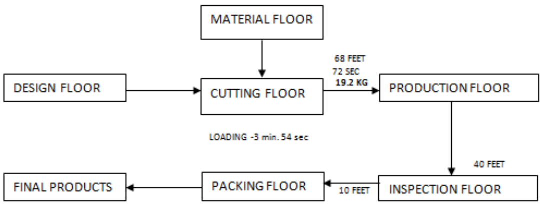

Figure 1: Existing State Map.

5.2.2. Flow of material from cutting floor to production floor:

Materials were transferred from cutting floor to production floor using trolley. For a single shift of trolley 6 boxes of materials were transferred. Every box contains 100 pieces, in total 600 pieces were transferred per shift. The weight of material that was packed per box was 3.2 kg. The total weight of load in trolley was 19.2 kg (for 6 boxes). The time taken for loading materials per box was 36 seconds. Time taken for exchange of box was 3 seconds. For loading of materials in trolley the total time taken was 3minutes and 54 seconds. The distance from cutting floor to production floor was measured as 68 feet.

The time taken for travelling 68 feet with load by the trolley was 72 seconds and for unloading of materials from the box is 36 seconds per box. Time for exchange of box was 3 seconds. The return time from production floor to cutting floor was 58 seconds without load. Total time taken for transfer of materials per shift of trolley was 9 minutes and 58 seconds. Production rate of the company was 70 products per hour. Total number of products produced per shift was 19600. Two shifts running per day. Total number of products produced per day were 39200. Totally 5 workers required per shift for transfer of materials from cutting floor to production floor.

Total number of pieces transferred by one employee was 3920 per shift. Number of boxes transferred by one employee was 39.2 say 40 boxes. Load carried by the worker per shift was 40*3.2=128 kg. Total load carried by worker was 128*2=256 kg. (Both loading and unloading). 80 times back bone of the worker was strained. This leads to severe back pain of the worker within 10 years if he does the work continuously.

5.2.3. Production floor:

In production floor same type were arranged as groups. Ten types of operations were done in the production floor, so, ten groups of were formed. There were nine junctions between ten groups. Total time required for transfer of materials between sections was 25*9 = 225 seconds. Weight of material transferred by worker per single time was 3.4 kg/100 pieces. For 19600 pieces weight transferred was 3.4*196 = 666.4 kg. Worker travels about 600 feet/shift with load. Delay time occurs whenever machine breaks down. Then completed products were transferred to packing floor. The distance between production floor and packing floor was 40 feet. Time taken to transfer of products was 35 seconds.

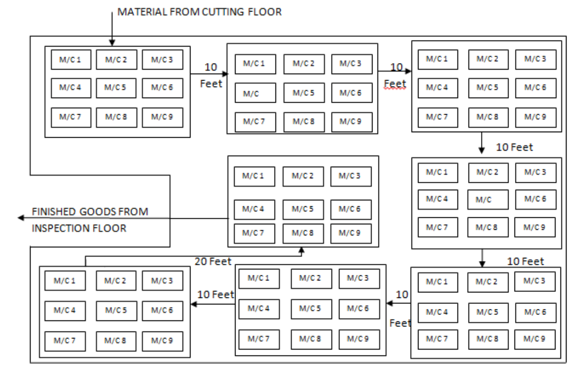

Figure 2: Existing State Production Floor.

5.3. Analyze the Existing State:

The third step for implementation of Value Stream Mapping was analyzing the existing state map. We analyzed thoroughly to find out the various Non Value Added Activities of the existing state map. The time taken for transfer of materials from cutting floor to production floor and from production floor to packing floor was high. The workers were stressed heavily by transferring more loads. The production rate was very low. More machines were set to idle due to the unavailability of the raw material. This is due to the distance from cutting floor to production floor. Rework of the product was difficult, because after inspection the product which has defect was returned to the production floor. This will take more time. If a problem occurred in a single machine the production time was affected.

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5.4. Mapping and Implementation of Future State:

We mapped the future state in order to avoid the Non Value Added Activities of the existing state map that we had analyzed in the third step. We hardly concentrate to reduce the time taken to transfer of materials from cutting floor to the production floor. Avoid the fatigue of the workers. Improve the production rate. Reduce machine break downs. Improve the rework process and to reduce the time taken for rework. Avoid the machine idleness. We constructed the future state map by integrating all the floors as a single floor. This single floor contains various sections. Those section were,

- Cutting section.
- Production section.
- Inspection section.
- Packing section.

In the future state map, the input was raw material and the output was the finished product (packed one).

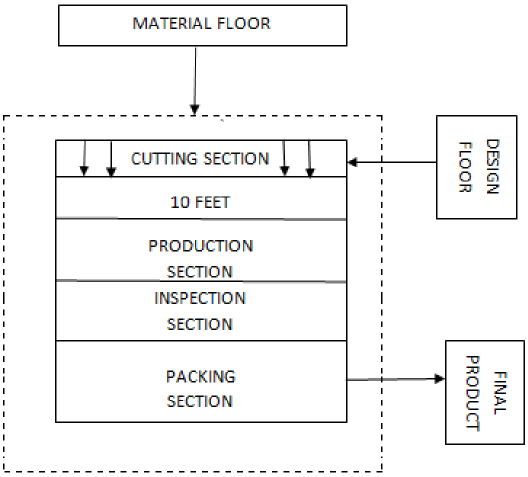


Figure 3: Single Shop Floor Layout.

5.4.1. Transfer of Materials in Future State Map:

Since the floors were integrated, the distance between the cutting section and production section was reduced to 10 feet. The team leader himself transfer the material from cutting section to production section, so separate worker was not required. The material was transferred by box only not by the trolley so human fatigue was reduced. Time taken for loading and unloading of products was calculated as 36*2=72 seconds. Travelling time for 10 feet with load was 10 seconds. Total time taken=36*2+10=82 seconds. Time taken for transfer of 100 pieces of material was 82 seconds.

5.4.2. Production Section in Future State Map:

Arrangement of machines in groups was eliminated and separate teams were formed. Every team was organized by a team leader and the team had 12 workers. Since the machines were arranged as per sequence of operation, the transfer of materials was made easy and time required for transfer of materials in the production section was reduced.

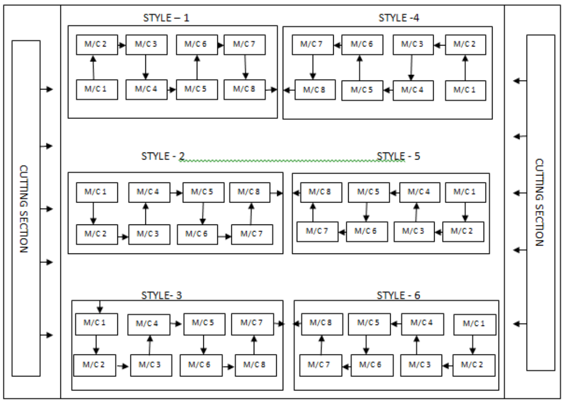


Figure 4: Production Section in Future State Map.

As the material was transferred between the machines in the production section, the weight carried by a worker between the groups was avoided, which reduces human fatigue. The inspection and packing section were integrated within the module, so the time taken for transfer of material to the packing floor was avoided.

5.5. Non Value Added Activities:

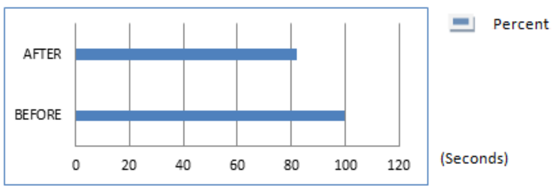
In the existing state map the time taken to transfer of 100 pieces = 598 / 6= 99.7 seconds say 100 seconds. In future state map the time taken to transfer of 100 pieces was 82 seconds. Time saved after implementation of future state map was 100-82=18 seconds per 100 pieces. Time saved per shift= 18*196=3528 seconds = 58 minutes and 48 seconds. Since load carrying capacity and distance were reduced which leads to reduction of human fatigue.

5.6. SMED:

After implementing VSM, the machines were arranged as per the sequence of operations. In the existing state the time required for change of setup from one style to another was 28 minutes. SMED was implemented by the following steps; the sequence of operations performed on the future style was derived. After completion of first operation in the existing style, the first machine of the existing style was replaced by the first machine of the future style. The time required for this process was 49 seconds. The same procedure was followed for the next 9 operations. So the total time required for change of setup from existing style to future style was 8 minutes and 10 seconds.

5.7. Graphical Representation for Clear Understanding:

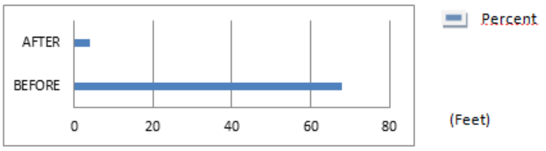
5.7.1. Material Transfer:



- Time taken to transfer 100 pieces was 100 seconds. After Implementation it took only 82 seconds for 100 pieces.
- 100-82=18 seconds. Therefore Percentage reduction of material transfer is 18.

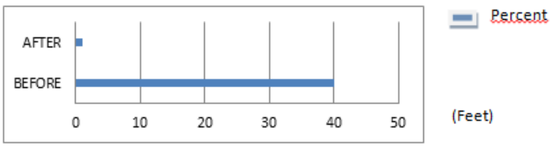
5.7.2. Travelling Distance:

5.7.2.1. Distance from Cutting floor to production floor:



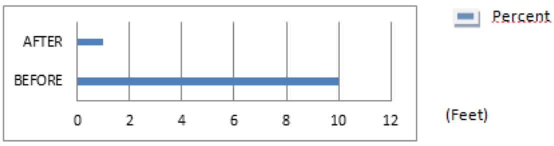
- The Travelling distance from cutting floor to production floor was 68 feet. After implementation the distance was reduced to 10 feet. Therefore reduction of distance from cutting floor to production floor is 85.3%.

5.7.2.2. Distance from Cutting floor to production floor:



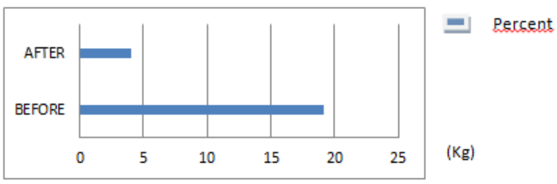
- The Travelling distance from production floor to inspection floor was 40 feet. After implementation the distance was reduced to 1 foot. Therefore reduction of distance from production floor to inspection floor is 97.5%.

5.7.2.3. Distance from Cutting floor to production floor:



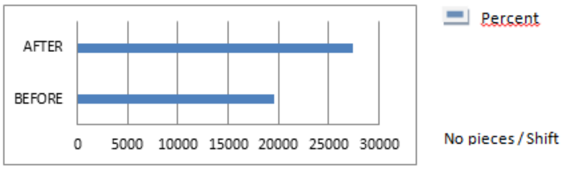
- The Travelling distance from inspection floor to packing floor was 10 feet. After implementation the distance was reduced to 1 foot. Therefore reduction of distance from inspection floor to packing floor is 90%.

5.7.3. Distance from Cutting floor to production floor:



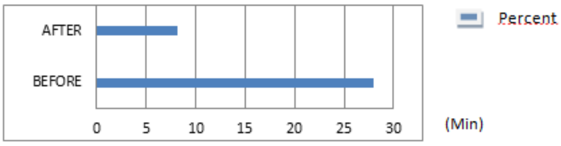
The load carrying capacity was 19.2 Kg. After implementation the capacity was reduced to 4 kg. Therefore the load carrying capacity is reduced to79.17%.

5.7.4. Production Rate



- At the earlier stage the production rate was19600 pieces/shift. After implementation the production rate was increased to 27440 pieces/shift. Therefore 40.0 % of production rate is increased.

5.7.5. Production Rate:



- In the existing state the time required for change of setup from one style to another was 28 minutes. Later it was reduced to 8 min 10 sec. Therefore the setup time percentage is reduced to 70.84.

6. Conclusion

Finally, this research has the proof of advantages when applying lean principles to the garment shop floor. According to our familiarity, it is the prime time that lean thinking has successfully implemented in the garment shop floor. We hope that this paper contains its worth for practitioners in the garment industries.

Due to increased customer expectations and severe global competition, the Indian garment industries try to increase productivity at lower cost and to produce with best product and service quality. Under these considerations, the authors have implemented lean manufacturing techniques to improve the process environment with reasonable investment. In this paper, the effectiveness of lean principles is substantiated in systematic manner with the help of various tools, such as Value Stream Maps and SMED.

Even though, the complete success of the application of lean thinking in the extensive run depends on close understanding between the management and shop floor personnel. Effective management information systems are required for instilling proper organizational values and continuous improvement programs. If these management principles are fully integrated with shop floor principles, then lean systems can be applied efficiently to attain the maximum output. The uneven supply base creates barriers in attaining integration between the links in supply chain. Therefore future studies can be made on supply chain management, to achieve good control, reliability and consistent performance.

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