Enhancement in Productivity of an Industry using Lean Manufacturing Technology

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Abstract- *Lean manufacturing has been applied in many companies in different sectors. The automotive industry has many challenges for the implementation of lean manufacturing due to some constraints that are related to the nature of the industry such as large lot production. This study investigated the existing lean manufacturing tool of an automotive organization The objective of this study was to identify the strengths and weaknesses of the current lean manufacturing process in improving quality and productivity. The automotive industry has been experiencing a competitive environment and striving hard to find methods to reduce manufacturing cost, waste and improve quality. Aim of the work is to implement lean manufacturing using tools of lean manufacturing. The study is for automobile industry, which produces automobile parts. We choose crankshaft for our study. Data is collected by time study. Then we study current layout of company. We generate process value stream map for the current state of the company. By value stream map we easily find out wastes occur in the company. After identifying wastes we use continuous improvement for wastes elimination. After that comparison of current state with future state Hence by apply lean with its tools transportation waste, breakdown, high cycle time, lead time etc are reduce and single piece flow of product established.*

I. INTRODUCTION

Lean manufacturing, lean enterprise or lean production is basically a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful and thus a target for elimination. Lean manufacturing focuses on cost reduction by eliminating non-value-added activities so that several advantages can be obtained, such as minimization/elimination of waste, increased business opportunities and more competitive organizations. Lean manufacturing can be adopted where there is a stable demand and to ensure a level schedule. The term 'lean manufacturing', which first appeared in 1990, when it was used to refer to the elimination of waste in the production process has been announced as the production system of the 21st century. Historically, the concept of lean manufacturing was originated with Toyota Production Systems (TPS). Lean manufacturing is called lean as it uses less or the minimum, of everything required to produce a product or perform a service. Lean operations eliminate seven tedious wastes (muda), namely overproduction, over processing, waiting, motion, defects, inventory, and transportation [1].

The technique often decreases the time between a customer order and shipment, and it is designed to radically improve profitability, customer satisfaction, throughput time, and employee morale. The benefits generally are lower costs, higher quality, and shorter lead times [2].

II. LITERATURE REVIEW

Status of implementation of Lean manufacturing principles in the context of Indian industry: A Literature Review

P. Chaple el. presents a review of lean principles and practices in the Indian manufacturing industries. The paper contributes by identifying enablers & barriers in implementing the lean principles and practices, methodologies used in the leanness measurement of an organization in the Indian manufacturing industry. The paper tried to present best way for lean implementation available in literature along with the discussion that lean is applied successfully in different sectors than automobile sector, such as the service sector, discrete manufacturing etc. The recent literature shows that the trend in lean manufacturing for research now is focused on lean assessment. The future research may be to identify such barriers through an extensive literature review and interviews of working professionals as very little work happened on this subject. The literature pointed toward the popularity of lean in India; but when it comes to success, its only start of the journey. Other than automotive and electronics industry, others are having medium to low diffusion of lean in India [3].

Improving quality and productivity in an automotive component manufacturing organization in Durban - South Africa

Raven Rathilall et all. Lean manufacturing was derived from the Toyota Production System (TPS) in Japan, and can be traced back to the borrowed concepts and practices of Henry Ford and other predecessors. Similarly, Anderson et al. Provide strong empirical support of other quality management concepts such as Total Quality Management, Value Engineering and Six Sigma. These concepts also had their origin in Japan and revolve around minimizing waste and resources while improving customer satisfaction and financial results. To understand how this concept applies to industry, Carreira distinguishes "value-added" as an activity that makes a product more complete from "non-value-added" as an activity which does not advance the product to a finished state. From the review of the literature, it can be established that lean manufacturing principles in the production environment are: waste elimination, continuous improvement, multifunctional teams, zero defects, just-in-time (JIT), vertical information systems, decentralized responsibilities, integrated functions and pull systems [4].

Improving Productivity of Manufacturing Division Using Lean Concepts and Development of Material Gravity Feeder –A Case Study

K. Hemanand research work has been carried out as a case study in an automotive industry with the objective of waste reduction; Efforts are made to reduce the motion waste on the shop floor. The problems in the current layout are identified and analyzed through simulation. Then the layout is modified, simulated and the results are compared with the current layout. The results revealed an improvement of 11.95% in productivity. The simulation analysis of current layout is carried out to study the performance in lean perspective and modifications in the layout have been made. A window opening is made between the deburring and inspecting an operation which saves time by 30 minutes for 100 parts. The machines are replaced and their orientations are changed for easy transfer of material and for sharing the idle time of the operators with other machines. The modifications in the layout will reduce two operators and increase the utilization of the operators by 11.95%. It saves 640 rupees per shift from the operator's salary. Hence it saves Rs. 5, 99,040 per year, which is a considerable savings in the total revenue [5].

Lean Manufacturing and Productivity Improvement in Coal Mining Industry

Er. Manoj Ade paper researcher has applied the lean manufacturing concept in order to increase productivity of coal mining. By application of lean tools the overall human effectiveness is analyzed which is converted into productive output to increase the productivity and develop an overview of the conceptual framework of lean manufacturing practices to minimize the production cost of mining.

Lean philosophy is the only way for reduction of waste and improves effectiveness of the resources to compete the world. Identification of wastes is a continuous and never ending process, with the application and implementation of lean production the coal can be produced with the highest quality at cheaper rate. It is clear that global competition demands the effective implementation of lean tools in the coal industry and more research is needed for application of lean tools in the process industry [6].

"Application of Value Stream Mapping for Reduction of Cycle Time in a Machining Process"

K. Venkataraman et. all shows that lean implementation is required of every industry. Because in the market, there are cut throat completion between various companies to survive in this market every industry requires lean manufacturing. By using lean manufacturing, we increase efficiency, effectiveness, and productivity. By this paper, we know that how a value stream map is helpful in reducing wastes. By this paper, we know that how cellular manufacturing helpful to reduce transportation time and various other wastes. We know about the cellular manufacturing system. There are various tools available for reducing wastes. By this paper, we get information about the Kaizen tool of lean manufacturing. Continuous improvement it means Kaizen and improvement done at every level of an industry [23].

III. PROBLEM DEFINITION

In AVTEC industries there is problem of-

- More transportation time due to improper layout causes transportation, waste is occurring.
- Cycle time in some process is high.
- Single piece flow of product is not possible in the current state because of rejection and rework.

AVTEC group of industries Pvt. Ltd. Manufacture of automobile parts like connecting rod, crankshaft, camshaft etc. AVTEC industries supply these automobile parts to L&T, Ashok Leyland, Ford, Cater Pillar, Mahindra etc.

Industrial unit is followed different sections in the unit

- CNC (turning): In this section CNC turning machines have been installed.
- Camshaft section: The section undertakes manufacturing of camshaft.

- Connecting rod section: This section undertakes manufacturing of connecting rod.
- Machining section: Machining process carried different process by which particular dimension of product is achieved.
- Light section: In light section small operation like grinding, tapping, etc. are performed by workers.
- Checking: - In this part do checking of the product and find the factors which are helpful to lean manufacturing implementation. If defects are generated, we know about defects from checking or inspection room.

IV. METHODOLOGIES

Lean implementation is required for every industry to reduce waste in any stage or any level of a company. There are several tools available for lean implementation like Just in time, Kaizen, Kanban, value stream map, five s, TPM, six sigma, etc. From all these tools we use value stream mapping and Kaizen with following methodology.

AVTEC Industries Pvt. Ltd. is an automotive industry. They produce various automobile components like Connecting rod, Crankshaft, Camshaft, etc. Crankshaft is complex component and more problem face with a crankshaft production line. So we choose crankshaft as a product. There is different machining operation done on the crankshaft in AVTEC industries.

Sequence of operation for crankshaft

- Facing and Centering
- Flange outside Diameter Turning
- Pin Turning
- Pin Balance Hole
- Cross Hole
- Gear Edge Hole
- Tapping
- VMC Boring
- 2/3 Main Bearing Grinding
- 1/4 Main Bearing Grinding
- Gear Edge Angular Grinding
- Pin Grinding
- Balancing
- Keyway
- Flange outside Diameter Angular Grinding
- Super Finishing
- Washing

After these all machining processes, crankshaft ready to deliver to the customer.Time and motion study is very helpful technique for all industries. Frederick Winslow first gives an idea about time study. At that time Frank and Lillian gives an idea about motion study. By time study, we show standard time of the process in which process performs. By time study we easily know about operation time, standard time, loading time, unloading time, etc. with the study, we prepare time study sheet and preparation for further remaining processes.

Flow process charts are very useful when it comes to the development of a previously followed process or sequence of steps. At the same time the flow process chart exhibiting the 5 different symbols and their relation to the process, is of extreme use when it comes to re-arranging, bartering or making a process more proficient. A clear analysis of every step and the right, assigning of the symbol are of extreme importance. Layout of company is very important. We show a flow process chart of the original layout of the company. . In current situation 48.88 min time spends for unnecessary movement of product. By suggesting modified layout this waste is decreased. After identifying transportation, waste in current layout position we suggest “U” shape layout for the company. For this layout new flow process chart prepares and then after “U” shape layout created. More distance is travelled in original layout; distance travelled in original layout is 169m and transportation time is 48.88min.

In”U” shaped layout, we show that distance travelled is 31m and transportation time require for that distance is 17.01 min. In the exiting process, cutting speed and feed are studied. By optimizing these machining parameters we improve the process and cycle time of the process is reduced. In the existing process, machine cutting speed is 180mm/min. By trial and error method we choose various cutting speeds and show that which speed is maximized and not affect product quality. After this trial and error method we find the speed 240mm / min. If the machine running at this speed that time require for turning is less. If now we increase the speed that its effect on product quality. Feed of existing process is 0.35mm/rev. The feed also increases when cutting speed is increased.

V. RESULT

Lean manufacturing is very important for automobile industries. Here we choose lean manufacturing concept for crank shaft making industry. Lean Manufacturing having various tools like JIT, Kaizen, Kanban, 5s housekeeping, TPM, TQM, Value stream map, etc. First draw current level process value stream map and identify wastes. After identifying wastes do work for eliminating waste. After reducing waste construct future level process value stream map with improvement. Here reduce transportation time by

suggesting layout. Cycle time, Lead time, and rework it's reducing by continuous improvement.

Table 1. Comparison Table

Activity	Before	After
Processing Time	5367 Sec	5262 Sec
Lead Time	3.19	2.59
Loading & Unloading	Automatic	Automatic
Layout	zigzag shape	"U" shape
Transportation Time	47.83	16.13
Productivity	2200 Piece/month	2700 piece/month
Breakdowns	3-4 breakdowns	1 breakdowns

VI. CONCLUSION

- Lean manufacturing implementation in crankshaft manufacturing industry to reduce waste like more transportation time, rework, breakdown, high cycle time, etc. By reducing these wastes and establish single piece flow of product. We use a value stream map for identifying wastes. Some kaizen were implemented to process to reduce wastes. Future state process value stream map constructs with improvement
- Processing time reduced 5367 second to 5262 second.
- Lead time is reduced 3.19 days to 2.59 days.
- Transportation time will be reduced 47.83 min to 16.13 min.
- Breakdowns reduced 3-4 per month to 1 per month.
- Productivity improves 2200 piece/month to 2700 piece/month.

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