Cycle Time Reduction by Implementation of Lean Manufacturing in the Manufacturing Division of CNC Machine Manufacturing Company

H.N.Reddappa1, Chandrakanth Bajantri2

1,2Department of Mechanical Engineering, Bangalore Institute of Technology, Bangalore, Karnataka, India

Abstract—This paper presents a new approach for the reduction of process cycle time. Reduction in cycle time has been gaining significant attention in recent times. Cycle time reduction plays an important role in improving the competitiveness and sustainability of manufacturer. Reduction in cycle time effects in lower manufacturing rate, higher yield and better potential given tool inventory and facility constraints. However, in the past, cycle time reduction was unplanned owing to lack of a systematic and quantitative procedure. This research paper provides a brief review of core approaches related to cycle time’s reduction in CNC machines manufacturing industry. It was found that the most appropriate mapping method for lead time reduction was Value Stream Mapping (VSM). This paper describes the use of VSM technique to reduce cycle time in the manufacturing of structural components of boring milling vertical centre machine.

Keywords—cycle time reduction, manufacturing rate, tool inventory, methodology, competitiveness, sustainability, value stream mapping.

I. INTRODUCTION

More than ever, industrial organizations need effective and efficient production systems so that they can deal with the current markets’ characteristics, namely turbulence and demand variability. Modern industrial organizations should increasingly rely on an enlightened taskforce, appropriate processes and effective technology, along with a suitable organizational framework and a lively production dynamics. Altogether, these aspects may qualify the production system for the effective delivery of economic and high-quality products which are able to fulfill the market demand and generate revenue. By doing so, organizations will become capable of sustaining their activity over the long run and remain and thrive on the global market place.

BMV60 machines also known as Chandra series are vertical centre machines manufactured by Bharat Fritz Werner Ltd. Since, BMV60 has high volume orders reduction in cycle time for this machine will reduce production cost. During the last fiscal year the volume of orders received by BFW for this machine is around 16 machines per month. The demand for BMV60 machine is increasing. It is important to change the process flow for the same. Structural parts of this machine are Manufactured in Manufacturing Division of Bharat Fritz Werner Ltd and supplied to Assembly division.

II. LITERATURE REVIEW

As per Womack Jones and Roos, [1] lean manufacturing uses less of everything compared to mass production, half the human effort in factory, half the manufacturing space, half the investment in tools, and half the engineering hours to develop a new product. It also requires, keeping fewer inventories on site, this will result in fewer defects, and produces well an ever growing variety of products. Ohno, [2] coined the seven wastes targeted by lean manufacturing initiatives: (1) defects (activities involving repair or rework), (2) overproduction (activities that produce too much at a particular point in time), (3) transportation (activities involving unnecessary movement of materials), (4) waiting (lack of activity that occurs when an operator is ready for the
next operation but must remain idle until someone else takes a previous step), (5) inventory (inventory that is not directly required to fulfill current customer orders), (6) motion (unnecessary steps taken by employees and equipment), and (7) processing (extra operation or activity in the manufacturing process).

Russel and Taylor, [3] explained that the purposes of the lean manufacturing are to improve productivity, increase product quality and lead time, minimize inventory, reduce manufacturing cycle time and remove manufacturing waste. To achieve these, the lean manufacturing philosophy uses several concepts such as value stream mapping, kaizen, inventory management, work place organization and reduce manufacturing waste. Haque and Moore, [4] suggested that although explicit application of the Lean principals to product development by educational institutions and industry is lacking, many companies have began with implementation of Value stream mapping. This has showed encouraging results such as clear waste identification, lead time reduction, single piece flow and cost improvement.

Further, a case study on lean manufacturing implementation of value stream mapping of an Indian manufacturing firm i.e. ‘Boring milling vertical center CNC machine’ manufacturer is presented and thus productivity was increased, inventories were reduced and defect free production was done due to waste elimination, reduction in cycle time.

III. VALUE STREAM MAPPING

VSM visually represents the entire value-creation chain of a product or a family of products, revealing material and information flows as well as the potential wastes that affect the shop floor. There are seven value streams mapping tools and compared them in terms of their effectiveness in identifying types of waste. These tools borrowed techniques from various fields, namely engineering, logistics and operations research:

VSM is a tool to understand the material and information flow as a product or service makes its way through the value stream. VSM takes into account not only the activity of producing the product, but also the management and information systems that support the basic process. This is especially helpful when working to reduce cycle time and to gain insight into the decision making flow, as well as the process flow. This is actually a Lean tool. The basic idea is to first map the process. Then above that, map the information flow that enables the process to occur.

The value stream map takes into account different measures such as cycle time, set up time, lead time, and value added time, size of batch, number of operators, number of products, shipment volume, labour hours, rework of products and cassations. Different steps exist within VSM. First, the current state map is created to show the current production situation. Business and manufacturing waste that occurs in this process can be easily identified. Once the current state map has been created, it then becomes the baseline for improvement and for the creation of a future state value stream map. After all, VSM is only a tool unless the future state is achieved. (Rother 2003)

The purpose of VSM is to identify, demonstrate and remove waste in processes. Waste is defined as any activity that creates no value for the customer. VSM can be a starting point to help management engineers, production associates and suppliers to recognize waste and identify its causes. As a result, VSM is a tool for communication, but it can also be used as a strategic planning tool and as a change management tool. In this regard, mapping out the activities in the manufacturing process with cycle times, down times, in process inventory, material moves, information flows, helps to visualize the current state of the process activities and helps the development of the future desired state.
IV. CASE STUDY

The project work associated with the implementation of lean manufacturing was carried out in Manufacturing Division of leading CNC machine manufacturing company of India i.e. Bharat Fritz Werner Ltd, Bangalore (Karnataka).

A. Problem Identification

BMV60 machines also known as Chandra series are vertical centre machines manufactured by Bharat Fritz Werner Ltd. Since, BMV60 has high volume orders reduction in cycle time for this machine will reduce production cost. During the last fiscal year the volume of orders received by BFW for this machine is around 16 machines per month. The demand for BMV60 machine is increasing. It is important to change the process flow for the same.

B. Observation

By doing the observation and scrutinizing the details of structural components that are manufactured in manufacturing division, it was found that major bottleneck was marking process before machining operation. The time required to complete marking process were more.

C. Observation of process

After the problem identification, next phase is of observation i.e. observing the complete process by scrutinizing each and every manufacturing operation which is being done on different machining centers in Manufacturing Division. Total time taken to complete manufacturing process is shown in Fig 2 and Fig 3.

![Figure 1. Marking time required for each of the structural component](image)

![Figure 2. Time taken for manufacturing of each component before implementing VSM](image)
From the above figures it is clearly understood that the lead time to manufacture the BMV machine has reduced.

V. RESULTS

After implementation of new process flow it’s been found that most of the unwanted processes have been eliminated and production cost and lead time required to manufacture these structural components has been reduced. Therefore, productivity of structural components has been improved.

Below bar graph shows the reduction of production cost for each of the structural component of BMV60 machine.

The bar graph shows reduction in lead time for manufacture of structural components of BMV60 machine.
VI. CONCLUSION

The project succeeded its goal. The manufacturing of BMV60 machines was optimized. The production cost was reduced by Rs 25,405/machine. The lead time was reduced and manufacturing wastes were eliminated.

By doing re-routing more time can be saved. The proposed floor plans will be reviewed and will be implemented in this fiscal year.

REFERENCES