

Elimination of delay in the assembly of safety valve: lean manufacturing through method studyKashmir Singh Ghatotra¹, Rohit Sharma²^{1,2} *School of Mechanical Engineering,**Lovely Professional University, Phagwara, Punjab, India.***Abstract**

In order to achieve productivity improvement in the manufacturing companies, it is not always possible to adopt new technologies and mass production system as a measure to increase productivity due to limited investment budgets. The best way is to review and redesign the existing operations. The paper discusses the similar case study done at a press manufacturing company to improve the existing process for the sake of productivity improvement. The study is conducted on the safety valve assembly station of the company. This study has reduced the non value added activities at the safety valve assembly station and eliminated a delay of 4.5 hours.

Keywords *Lean manufacturing, Waste reduction, Method study, Productivity improvement.*

1 Introduction

The continuous improvement in the productivity is the prime requisite to sustain growth in the competitive market for any manufacturing unit. Every manufacturing unit applies efforts for increasing their production and minimizing the production cost in order to improve the profit margins [1].

The productivity improvement measures can be divided into 4 main categories: a) redesign of work operations, b) automation & mechanization, c) application of mass production, d) implementation of new technology. Each of these 4 categories is effective in specific situations. However, in actual practice it is not always possible to apply the new technology and mass production due to various constraints like limited investment budget, product not feasible for mass production etc. So the most practical approach is to redesign of work operations and automation which each manufacturing unit can afford with little or no investment. The redesign of work operations basically means the detailed review of all the processes performed during manufacturing & finding out wastages in terms of bottleneck, large lead times, and inefficient use of man, machine, methods, materials & equipments. The wastages found in the detailed study are removed through the development of improved operations [7].

This research work is based on the similar situation in press manufacturing unit. The study is conducted at the safety valve assembly station of the company to eliminate the wait.

2 Literature review

Shuang et al. optimized the assembly line of lamp manufacturing unit through work study. Due to competitive market the company was in need to lower the total manufacturing cost and improve the production rate. The methodology used in the study was MOD method followed by ECRS principle. The MOD method is the work measurement phase of the work study where the focus is on finding the correct ways of doing work and allowed standard times. In this method the complete operations of the line are studied in detail and problems in existing methods and bottlenecks are identified. The ECRS principle means eliminate, combine, rearrange and simple. In this method the focus is on eliminating the non value added activities, combining two or more operations to reduce number of variables, rearranging the activities to achieve less cycle time and simplifying the existing methods to eliminate the factor of confusion and thus increasing the pace of operation. The results achieved through MOD method are helpful in using the ECRS principle. This research study had achieved increase in the production from 9.97 pieces to 12.19 pieces and the number of workers were reduced to 18 from 21 [8]. Resnick and Zanotti used ergonomic concepts in designing the manufacturing processes for improving the existing productivity. The study suggested that the ergonomics is capable of achieving productivity improvement along with its traditional use of eliminating injuries in different working postures. In the study the focus was on the weight of the tools and equipments used, the distances moved during operation and the working height for improving the productivity. The study showed that all these factors significantly affect the standard time of the concerned operations. Through ergonomics the optimum weight of tools was calculated which resulted in improving the pace of doing work without hampering the objective of the process. The distances moved by the operators from assembly line to delivery area was reduced through work place redesign using ergonomics which resulted in lowering the time standards for those work processes. The height from where operator operates the machine was redesigned and thus access of operator to various parts of the machine was increased which resulted in lowering the overall cycle time of the operation. The study concluded that the design of manufacturing processes keeping these ergonomics points in view help in improving the productivity of any manufacturing unit by a significant amount [4]. Muthiah and Huang reviewed literature on the productivity measurement and productivity improvement of manufacturing systems. The

study explored following methods in detail and discussed about their use and limitations: continuous improvement based methods, operations research based, system analysis based, and performance metrics based. The study concluded that no method can be declared as the best method [6]. Kovach et al. identified the continuous improvement methods followed by various industries in US through a survey. The study discussed the use of different quality control tools and lean tools in different situations. The study discussed the usefulness of these tools and categorized them into most useful and least useful tools for continuous improvement under different scenarios [2]. Kumar et al. improved the productivity through work study. The study was conducted at rim manufacturing company. The study identified the bottlenecks in the manufacturing operations of rim. The first bottleneck operation was slow pace of oxy acetylene cutting. It was replaced by plasma arc cutting which was fast as compared to the previous method. The second bottleneck operation was boring operation on lathe machine as it was responsible for lot of rework. It was eliminated through modification in the size of punch used in the previous operation. The last bottleneck operation was eliminated through the installation of extra welding machine. The jib cranes were introduced in order to increase the existing material handling capacity. The study also worked on the motivation of workers and gave a proposal for incentive plans in order to improve their performance rating. The result of above improvements was 50% increase in the productivity [3]. Singh et al. improved the productivity of small scale company with the help of work study and fixture designing. The study adopted the following methodology: collection of data on the current production practices, identification of the problems, analysis of the problems, solution development, and implementation of the solutions. The study identified that standard machining processes were not in practice and the standard times for the activities were not established. The study found high manual time in the processes and lack of fixtures. The study developed the fixture for the vertical machining center through Pro E software. The study reduced the machining time by 2 hr 15 min. The annual saving resulted with the help of study was Rs 138400 [5].

3 Methodology used

The work study methodology is adopted to improve the existing operations of safety valve assembly station. Work study is one of the industrial engineering techniques used in the examination of manual work. It systematically investigates all the activities involved in the process which are responsible for producing ill effects in the performance and economy of

the process. The work study is focused on eliminating the waste in the methods being used and helps in designing the new methods keeping future developments in frame. The motive is to standardize the work in order to completely eliminate the waste from the processes. Work study is divided into two main categories that are method study and work measurement.

3.1 Data collection of safety valve assembly station

The data related to the working of the safety valve assembly station is recorded with the help of outline process charts. These charts provide overall information of a process. The main operations and their sequence involved in a process are recorded in these charts. This chart includes only two types of symbols that are 'operation symbol' and 'inspection symbol'. The data is collected with the help of direct observation method and video recording.

3.2 Identification of bottlenecks

It is observed through process charts that after the assembly of the safety valve as shown in figure 1, it is tested for obtaining a particular pressure setting. During this testing fitter tries to find out the appropriate size of the spacer required for that safety valve. It is a hit and trial method. After getting the first reading of the size of spacer required for the safety valve, the fitter has to go to the machine shop for machining of the spacer to the size identified in the first attempt of valve testing. Then fitter uses the machined spacer to check the pressure setting of the valve. Depending upon the variations noted, the fitter has to repeat the machining process of spacer again. This hit and trial method results into lot of movement of the fitter and idle time of fitter during machining operation of the spacer. This situation results into delay in the remaining assembly operations.

3.3 Elimination of bottleneck operation

In order to eliminate the motion and idle time of the fitter, it is decided that a set of spacers containing different sizes of spacers should be manufactured in advance and issued to the fitter before starting the assembly of safety valve.

The data related to different sizes of spacer used in the past is collected from the fitters, supervisors and tool room in-charge. A set of spacers is prepared on list which contains different sizes used in the past and approval is taken from the design and production department regarding the advance manufacturing of these spacers. This set of spacers is



Fig. 1 Safety valve assembly

incorporated in the bill of material of the safety valve assembly. The supervisor is given the responsibility of maintaining the complete set of spacers at assembly station. This means that supervisor will give the feedback to the tool room about the sizes of the spacers consumed and accordingly tool room will machine only those sizes for future presses to keep the set ready for the assembly of other safety valves.

4. Results and discussion

The set of spacers of different sizes made available at assembly station has eliminated the unnecessary motion and idle time of the fitter. This method implemented in the assembly of safety valve resulted into saving of 4.5 hours per press.

5. Conclusion

The use of method study in review of existing operations is very effective. It is helpful in designing the operations in a better way and thus eliminates the unnecessary wastage from the production system. The method study is an effective tool in implementing lean manufacturing.

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