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Manufacturing Process Optimization

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Abstract:- The main aim of this paper is to provide information about using conventional production philosophies to achieve Manufacturing Process Optimization. By analysing the present scenario in a given industry different ways were derived to improve the production process by different techniques such as Six Sigma and Lean Manufacturing.

Keywords:- *Manufacturing Process Optimization, Marking Tool, DMAIC approach, Lean Plant Layout.*

I. INTRODUCTION

The DMAIC approach is a tool of six sigma, which is used to analyze different elements of a process, and give out the best possible result. Lean approach which aims at reducing waste was another element which was used to develop a better plan layout. The aim is to achieve a better all round production process, which is more efficient from the prevelant one.

This project follows the five step methodology used in the Six Sigma process. The definite step is where the problem is identified and specific goals are determined. The measure step is the step that focuses mainly on gathering raw data from the process. The third step, analyzing the data will be analysis. This is a breakdown of what the gathered data means for the company. improvement opportunities, the suggestions for the company are explained in more details. Improvement opportunities give possible ways to improve the process and finally the methods for sustaining the changes are discussed where the final section deals with the accrued benefits.

II. ANALYSIS OF THE PROCESS AS WELL AS JOB TIME

When we went to analyze the xyz company then we have the various departments like purchase, Production, quality etc. but we focused in Production department where we analyzed production time and their way of working and we have recorded operation timings and tried to decrease the variations by applying DMAIC approach in which we define the problems and measure their effects and then analysed and improved by providing possible solutions like we have made a tool for marking in drilling process.

III. DMAIC (A PROBLEM SOLVING APPROACH)

A. *Define phase*

The objective of this phase was to clearly understand and articulate the current reality and the desired situation. A clear definition of the problem is the first step of a six sigma roadmap.

- *Defining the problem*

After data analysis, analyzing the lead time and assessing the present situation the following situations were identified for the company.

- Increased lead time and variations in lead time of manufacturing the products in lathe machine.
- Traditional way of marking for drilling.
- Using manual machines for manufacturing and traditional tools for marking.
- Raw material alignment is not proper which makes it difficult to fit in chuck of lathe machine.
- Poor handling of raw material which increases the operation time.

- *Voice of Customer*

The next step was to determine CTQ (Critical to Quality Characteristics) for the project. The tool used for the purpose was VOC (Voice of Customer). The tool was used in lathe machines and drilling machines as the assembly department happen to be their internal customers. The aim was to freeze the parameters for lathe machine product Quality as a good feed stock for assembly department.

Thus the parameters which emerged out of VOC were bad alignment of raw material, poor handling of raw material and traditional methods used. Based on the outcomes, the scopes of the projects were defined. They were as follows:

- Inspection and testing of raw material which is to be purchased.
- To ensure the alignment of the raw materials while plasma cutting.
- Proper handling of raw materials while carrying.

B. *Measure*

Under this phase of project, the aim was to identify the root cause of the problem, narrow down to few potential causes, set measurement for the Project CTQs and potential causes, establishing a measuring system that have less inbuilt variability so as it could capture the variation in the process. Thus step followed were:

1 Defining all causes for variation
2 Variations in operational timings
3 Marking Time

- *Defining possible causes*

The major causes were identified in drilling and lathe operations. The causes identified were : using traditional methods for marking, breaking of tool, poor handling of raw material , bad cutting of raw material, no proper training of employees.

When there is alignment problem in raw material than it takes time to fit that raw material in chuck. When tool breakage is there than same operator is going for repairing the tool so machine is also idle at that time and employee's time is also getting waste.

- *Variations in operational timings*

In this step, the operational timing of product is comapared and noted around 20 times. And there were various factors which is stated in cause and effect diagram for the variations such as bad alignment of raw material, etc. variation is maximum 19 mins approx and minimum 5 mins approx.

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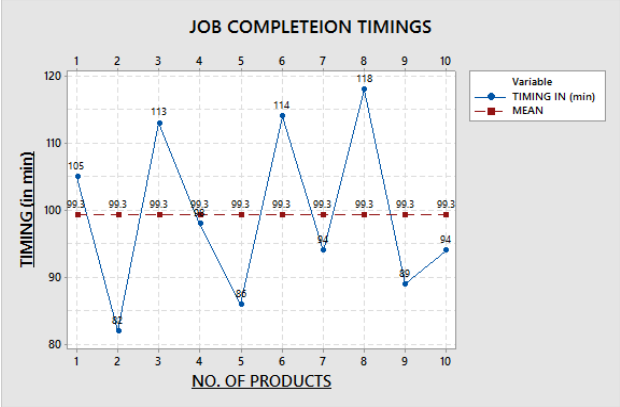
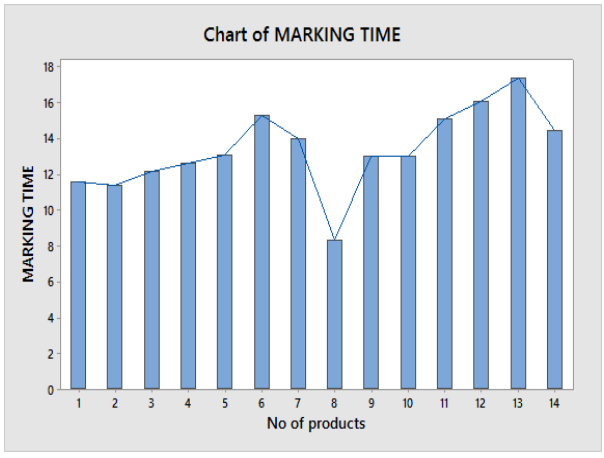


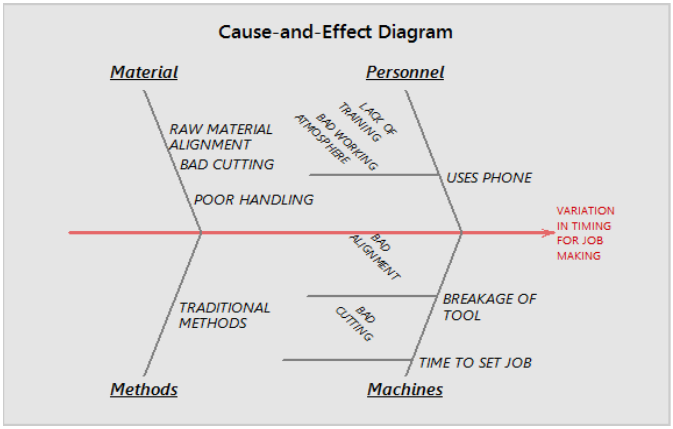
- *Marking Time*

In drilling machine for drilling operations , marking is needed and that is done by divider which is shown in figure. Time taken for marking is around 10 mins for one job. In manual machines marking is done by manual methods by the operators and if we use CNC machine ,it is costly as compared to manual machines. Divider take much time for marking ,sometime half of the operator time is used in marking. We can not use fixtures also because there is variations in size of the products.



C. Analyze

Cause and effect analysis technique was used to identify all the causes. Cause & effect diagram was used to prioritize the potential causes . there variations in operation time. This was the outcome from a brainstorming session of the concerned managers.



Variation for one job was 10 min average , and there are various lathe machine so this is a place where we can reduce time and use lean technique to reduce the number of machines and employees.

- *Brainstorming*

Brainstorming method was used in analyzing and finding the ideas for solution. Techniques like 5S was the solution for achieving the better work place. A new tool is designed for the marking in jobs for drilling machines.

Training of employees and techniques as lean can be used for the problem solution.

D. Improve

After the root cause has been determined, the DMAIC's improve phase aims at identifying solutions to reduce and tackle them (OMACHONU; ROSS, 2004).

- A new tool was designed for marking, which will reduce the marking time to 1/4th of it.
- Implementation of 5s technique.
- Training of employees
- Pre preparation for manufacturing and regular meeting of all the employees

- *Tool for marking*

Divider were used by employees for marking of drilling operations which was consuming a lot of time, as stated in measure phase so a new tool was designed for reducing the marking time. New tool's marking time is 3 min approx for the marking.

Fig 1:- New marking tool for drilling

- *Making of tool*

Marking Tool is made by combining three tools which is a goniometer and two steel rulers. We have welded two rulers making 180° to each other and a wire cutting is performed in between the rulers so that operator can mark at 90° and at 270° also.

- *Working of tool*

On the job diameter is written or we can see from the job's drawing ,diameter of the job .when we know the diameter of the job we need to put the tool on center of the job by the principle that diameter is the biggest chord. When the tool is in center we can mark on the job at our required angles.

E. Control

The objective of the last stage of the methodology is to develop metrics that will help leaders monitor and document continued success. The real strength of the DMAIC steps is in the Control step. Whole teams do a lot of arduous work to improve the process and results and then implementation of the improved process don't go smoothly. There is pressure to move on, time is not spent on having a smooth transition and the buy-in for full implementation just is not quite there.

The result is that sustaining the improvement realized in the improve step becomes difficult. The purpose of the control step is to ensure a successful implementation of the team's recommendation so that long-term success will be attained. Then the improved process will be flow charted and these new methods will become the new standard operating procedures.

Results will continue to be tracked so that any drift back to previous results can be monitored and addressed in a proactive manner. The control step is about the transfer of responsibilities and establishing plans for long-term process control.

Leaders need to work on the principle of kaizen that is continuous improvement and keep a check of all the data of manufacturing. They should listen to employees and their problems and try to solve them.

IV. PLANT LAYOUT

Plant layout is the most effective physical arrangement, either existing or in plans of industrial facilities i.e. arrangement of machines, processing equipment and service departments to achieve greatest co-ordination and efficiency of 4 M's (Men, Materials, Machines and Methods) in a plant. Layout problems are fundamental to every type of organization/enterprise and are experienced in all kinds of concerns/undertakings. The adequacy of layout affects the efficiency of subsequent operations.

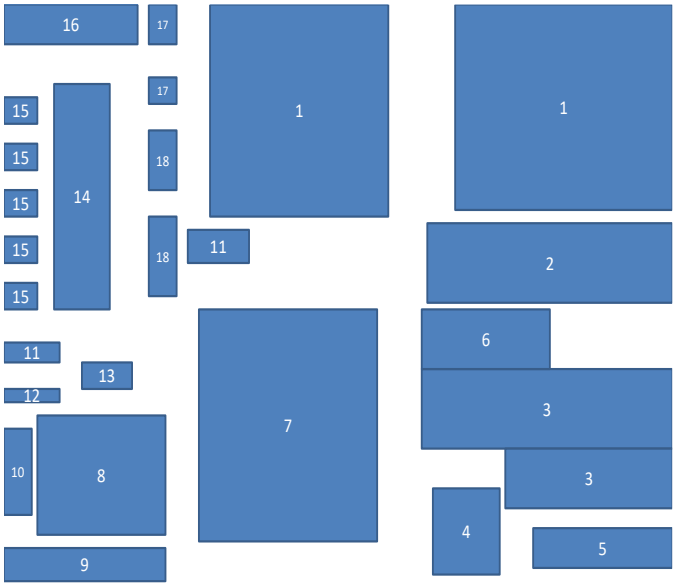
It is an important pre-requisite for efficient operation and also has a great deal in common with many problems. Once the site of the plant has been decided, the next important problem before the management of the enterprise is to plan suitable layout for the plant.

The xyz company employs job type production employing a variety of products. The designs are provided by the clients and each product gives in a different process flow. Therefore there is a need for an efficient layout which encompasses efficient production flow and moves forward.

A. Present System

The current layout employed in the xyz company goes on to facilitate their production time, but increases congestion. The plant itself has been divided into sub blocks and many a times, a machining block has a small inventory associated to it, in its block. Due to less floor space the stacks of high in-process jobs, it does not give a good aesthetic appeal.

The job code or number is marked on the job itself with a marker for identification which includes the product code as well as job number. The sequence is predetermined for different jobs and workstations are decided based on process plans.



- *Plant Layout*

1. TIG welding spot 1
2. Paint & Inspection of Parts
3. Office
4. Guards Office
5. Quality Control
6. Tool Inventory
7. Product and Raw material inventory
8. Plasma Cutting
9. Scrap
10. Machine Inventory
11. Drilling
12. Welding
13. Hack saw
14. Products of workshop
15. Workshop
16. Carbon Arc Welding
17. Slotting Machine
18. Shaft cutting

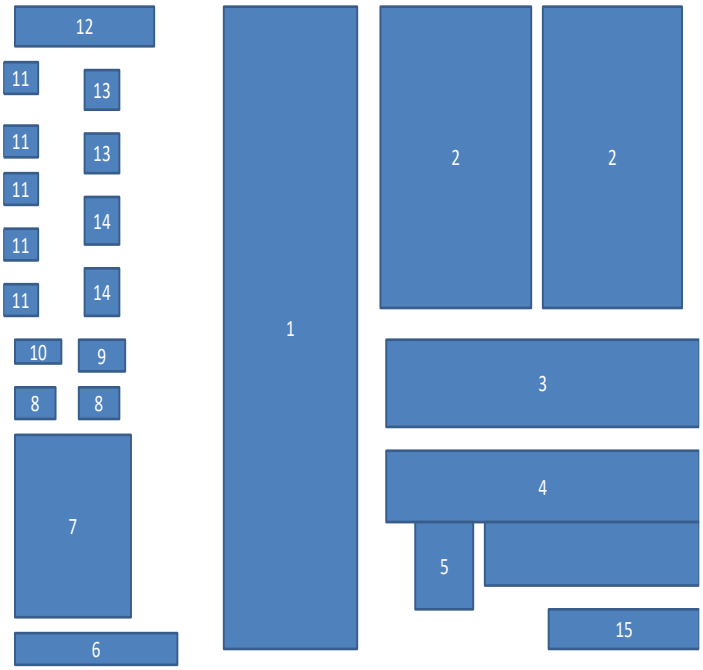
Due to the congestion in the current layout, these may result in fire safety hazards as well. Due to improper or blocked exits, these may prove dangerous in case of a hazard. The congestion affects job time, as it complicates the smooth process flow, resulting in loss of production time. Due to

congestion there is also a hazard of damage to finished products which may result in loss of revenue.

B. Proposed Layout

Due to improper distribution of inventories, and setting up of inventory for every block, it has bulged-in and resulted in consumption of more space. The regulation of a simple centralized inventory will result in a more defined layout with less obstruction to the process flow. The central inventory with different gates for each block will lead to exponential increase in productivity due to decrease in production and lead time.

Lean Manufacturing is all about adding value and avoiding waste. Facility planning (land, buildings, equipment, furnishings) provides the physical capability to add value. Facilities are expensive. Their lifetime is in decades. They take years to commission. By their nature, they are one of the most important strategic elements of a business enterprise. This is why facility design and the strategic thinking that should precede it are so important.



- *Plant Layout*

1.Centralized Inventory for all dept.
2. CIG Welding
3. Paint Shop and product Testing
4. Office
5. Guard Office
6. Scrap Disposal
7. Plasma cutting
8. Drilling Machine
9. Welding
10. Hacksaw
11. Lathe Workshop
12. Carbon arc Welding
13. Slotting Machine
14. Shaft Cutting
15. Quality Control

Therefore applying lean ideology to manufacturing layout regulates the overall output and aims to improve production. Due to congested space and abundance of jobs this is the best ideology to be applied to layout as it aims towards reducing waste. Efficient distribution of space will give an easy material flow, lesser lead time and in the end better production.

V. RESULT

Due to Job type production being present in the given industry it was difficult to recommend changes. Therefore the elements were analysed in such a way, as to have maximum effect on all type of products. The aim was to change the current production process such that the lead time as well as the production time is reduced to a minimum, and a smooth material flow was established. The end result being a more refined layout and a better production process.

VI. CONCLUSION

The primary goal of this project is to optimize the various processes by applying techniques like DMAIC and that will increase production , reduce production time ,better management and improve the quality. After implementing all the solutions marking time was reduced to 1/3rd of earlier time taken and variations in job making will be reduced to 50%.

After successfully implementing all the solutions which we have achieved will decrease the 1/3rd marking time and the manufacturing time on every product will be reduced to 15%. There will be good atmosphere for working and things will be organised and will help the management to keep a control on manufacturing og products.

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