Productivity Improvement Of Rubber Manufacturing Industry

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Abstract: *There has been a significant increase in the pattern of the competitiveness among the companies with each aiming to be a leader in a particular field or with a particular product. This has been achieved by significantly increasing the output with the same input. This is known as productivity and has been used globally to increase the output which ultimately leads to more profit. This paper focuses in increasing the productivity of a small-scale rubber products producing industry with the use of certain tools. This paper covers the identification of problems, studying the flow and finding an optimum solution with the use of time study, value stream mapping and plant layout to increase the output.*

Keywords: time study, value stream mapping, productivity, plant layout, takt time.

I. INTRODUCTION

In today's scenario it is very important for a company to improvise daily in order to survive in the market. With a limited number of resources available and the demand and competition increasing it is necessary to utilize the available input to its fullest with minimum or nil wastage and maximum output. Many tools are adopted by leading Industries like lean manufacturing, six sigma, etc. to get the required output.

A Small-scale industry comprises of a limited number of employees, semi-automatic machines and a small annual turnover. One of the industries was Jade Rubber industries that manufactures rubber-based products. Their products include Rubber Rings for PVC Pressure pipes, Rings for PVC

Underground Drainage/UGD/Sewer-Orange/Brown Pipes, UPVC ASTM Pipes & Fittings – ASTM D 2467, ASTM D 1785 CPVC Pipes & Fittings.

II. PROBLEM STATEMENT

Small Medium Enterprise or small-scale industry as they are usually called use semi-automatic machines to produce their product. Such companies usually do not follow a standard procedure or various standards to manufacture their product. Sometimes the product is produced quickly whereas sometimes it takes longer time than usual to produce the same product. The workers or supervisor here do not follow a standard time to produce a specific product, they just make a rough estimate and start the pre-determined process to produce the product. This delay knowingly or unknowingly has an impact in the overall efficiency of the plant. Problem identification in our industry:

- Initial analysis and time study helped reach a problem.
- Unloading of sheet takes longer time with most of it being wasted.

III. OBJECTIVE OF STUDY

- To evaluate workers performance.
- To facilitate operation scheduling.
- To eliminate ineffective time.
- To improve work process with the help of work measurement and suggesting a standard operating procedure.

IV. LITERATURE REVIEW

Work study:

According to ILO — International Labour Organisation — work study is "a term used to embrace the techniques of method study and work measurement which are employed to ensure the best possible use of human and material resources in carrying out a specified activity." In other words, "work study is a tool or technique of management involving the analytical study of a job or operation." Work study helps to increase productivity. It consists of two parts

Method study:

According to ILO, method study is "the systematic recording, analysis and critical examination of existing and proposed ways of doing work and the development and application of easier and more effective method". In short, it is a systematic procedure to analyse the work to eliminate unnecessary operations.

Time and motion study

According to ILO, Time Study means "a technique for determining as accurately as possible from a limited number of observations the time necessary to carry out a

given activity at a different standard of performance". In other words, "time study is the art of observing and recording time required to do each detailed element of an individual operation." Practically, it studies the time taken on each element of a job.

Motion study, on the other hand, is the study of the body motion used in performing an operation, with the thought of improving the operation by eliminating unnecessary motion and simplifying necessary motion and thus establishing the most favourable motion sequence for maximum efficiency.

Time study:

It is defined as a work measurement technique for recording the time of working for elements of a specified job.it is the most widely used work measurement technique for recording time and rates of performing a particular operation under given conditions. Basic equipment required are:

1. A stop watch
2. A study board
3. Time study forms

According to Fred E. Mayer (1992), time study was developed by Frederick W. Taylor in about 1880 which he is the first person to use a stopwatch to study and measure work content with his purpose to define "a fair day's work." He called as Father of Time Study. Time study turned out to be an important parameter for carrying out the calculation for our industry. The basic process is

1. Obtaining and recording all available information about job, operator, surrounding etc.
2. Recording complete description of the method, breaking down operation into elements.
3. Examining the detailed breakdown to ensure most effective method and motions are being used.

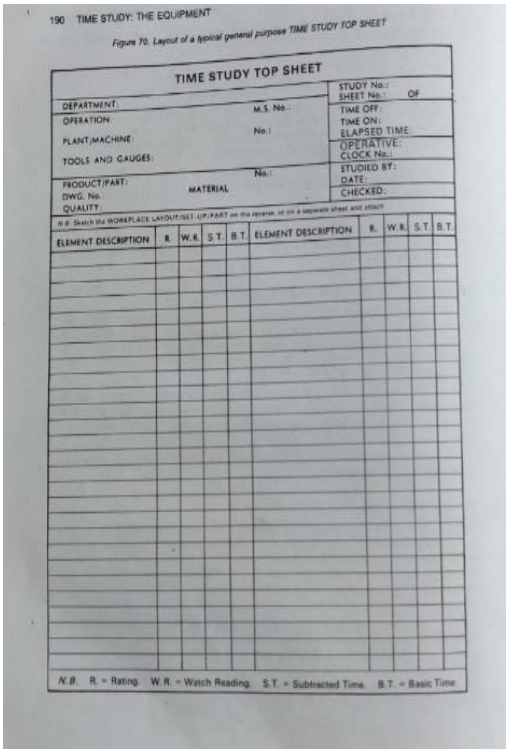

190 TIME STUDY: THE EQUIPMENT

Figure 70. Layout of a typical general purpose TIME STUDY TOP SHEET

TIME STUDY TOP SHEET

DEPARTMENT: M.S. No.
OPERATION: No.:
PLANT/MACHINE:
TOOLS AND GAUGES:
PRODUCT/PART: No.:
DWG. No.: MATERIAL
QUALITY:

STUDY No.:
SHEET No.: OF
TIME OFF:
TIME ON:
ELAPSED TIME:
OPERATIVE:
CLOCK No.:
STUDIED BY:
DATE:
CHECKED:

N.B. Sketch the WORKPLACE LAYOUT/SET-UP/PART on the reverse, or on a separate sheet and attach

ELEMENT DESCRIPTION	R.	W.R.	S.T.	B.T.	ELEMENT DESCRIPTION	R.	W.R.	S.T.	B.T.

N.B. R. = Rating. W.R. = Watch Reading. S.T. = Subtracted Time. B.T. = Basic Time.

Fig1. Time study sheet

4. Measuring with time device and recording time.
5. Assessing the effective speed of working the operator.
6. Determining allowances to be made to the extended basic time.

As far as our subject was concerned, we divided it into two category of operations which were further subdivided into different elements for calculating the standard time.

1. Raw Material mixing.
   - Loading.
   - Mixing.
   - Unloading
2. Rolling of material into sheet.
   - Pick and Load.
   - Rolling.
   - Unloading.

20 observations were taken for each operation with help of a stop watch and the time taken for each element was noted down in a standardised manner.

Upon inclusion of other parameters like worker rating (out of 100), fatigue allowance (2%), personal allowance (5%), contingency allowance, contingency delay allowances the Standard Time for both operations is as follows:

Standard Time for Mixing one Batch	**16.27min**
Standard Time for Rolling one Batch	**14.37min**

Plant layout:

Plant layout is defined as the process of desired tools machines and equipment of a plant in a sequential manner which permits the easy flow of materials, at less cost with minimum handling in processing the product from raw materials to the finished product.

During plant layout design one must take into consideration the type of flow of material and basic requirements for the process, also one must focus on the problems that arises during plant layout designing i.e., maintaining low inventory despite of fluctuations in product demand. To increase the efficiency, it is necessary that one must keep a track on improper flow of material throughout the shop floor and study the current pattern of the shop floor as well as relation of overall plant layout so that a new plant layout can be developed. One can try to also relocate the workstations if possible, to reduce the check point and material handling.

The next step to be followed is to carry out data collection on the basis of existing records such as the area occupied by machines, aisles, storage racks, raw materials, and other similar things. The data from time study can be used can be break down into element and time for each element should be calculated. Further using these data, standard time should be calculated for each process. Use of variousprocess charts like outline process charts and flow process charts is to be made to get overall picture of the detailed sequence of operations and primary activities involved in the plant layout redesign.

The fig (2). Shown below depicts the initial layout design of the rubber manufacturing plant.

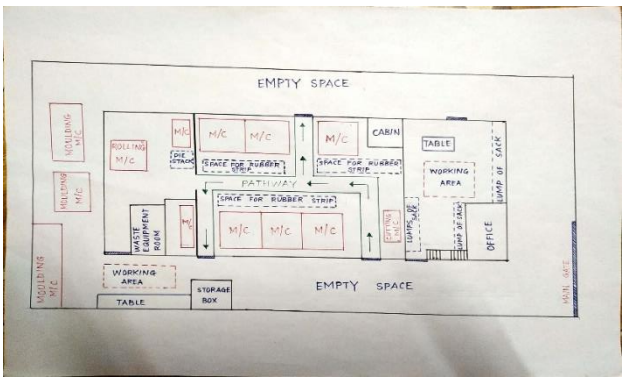


Fig (2). Plant layout (Before)

The layout highlights different elements using different colour coding which makes it easier to understand the layout and its functioning. This plant layout lacks the arrangement of storage to store the final product according to their sizes and also the products which are ready to be delivered. The dotted areas highlight the region where the material is stacked up in bulk in an inappropriate manner. At the time of delivery this stacked up material creates problem and is difficult to find.Fig (3). Shown below depicts the new proposed plant layout.

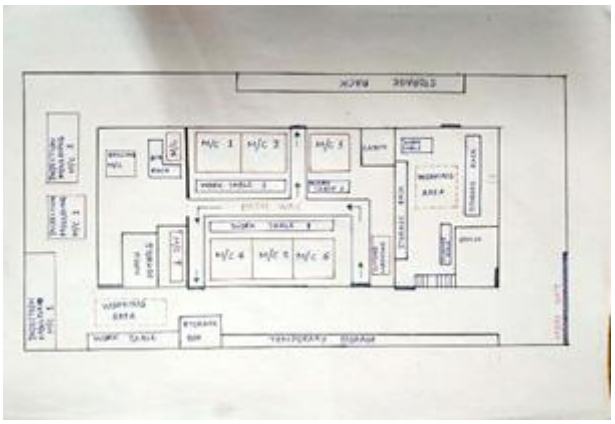


Fig (3). Proposed plant layout

After studying the complete flow of material and the current plant layout, analysis of the movement of material from one machinery to another is done and a new plant layout is proposed by taking into consideration all the previous parameters which caused trouble in the process. The new plant layout consisted of the provisions of the storage racks for materials where the products can be kept segregated according to their sizes. Provision of die rack is made and temporary storage platforms are provided for the materials which are ready for the delivery.

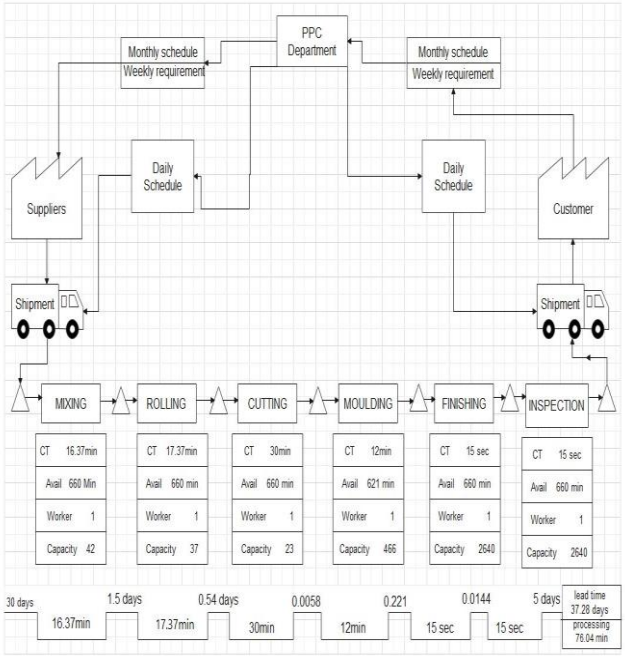
Value Stream Mapping:

A value stream mapping includes all activities required to transform a product from raw material into finished goods. Value Stream mapping scrutinizes business from beginning to end and a visual representation map is drawn for every process involved in the material and information flows. A future state map is drawn to show how things should work for best competitive advantage. It is a methodology for the visualization of the materials, products and information flow within the organization which add value to the organization and eliminate all non-value adding parameters to increase productivity of the organization.

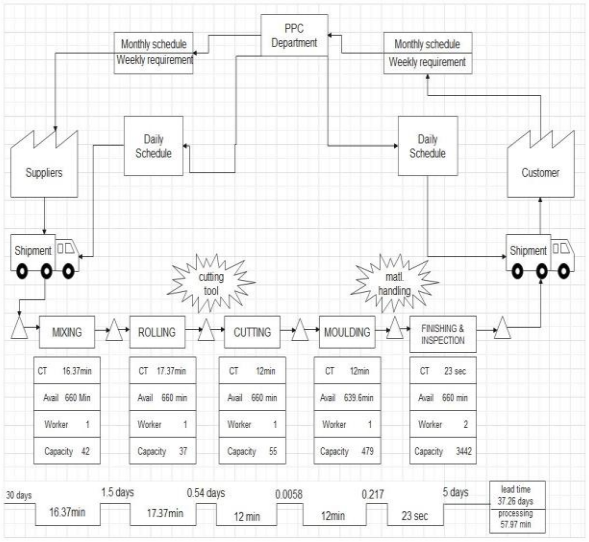
VSM not only allows you to see waste, but also the source or cause of waste. Value Stream Mapping with other good visualizations serves as an effective tool for communication, collaboration and even culture change within the organization.

Current state Value Stream Map:

Demand per month of 110mm rubber ring is 12870 pieces, effective number of working days are 26 per month, number of shifts per day is 1 and the working hours per shift is 11hrs excluding 30 minutes break and 15 minutes each tea break in morning and evening. Available working time per day in minutes is 660. Fig 1



shows the current demand arising from the customer to the company. The company then checks its available stock and accordingly asks its supplier for replenishment either manually or by electronic media. In present case raw material is kept in inventory that can last up to 30 days. the material moves from the store to finished items store through no. of processes like mixing, rolling, sheet cutting, moulding, inspection, and packaging. Details regarding inventory, average cycle time, lead time, uptime, no. of operators and the distance travelled by the material is shown in figure.



Future state Value Stream Map:

Acting upon the gap areas identified by the value stream mapping of the current state, some changes were proposed as indicated in the figure. Earlier sheet cutting used to take 30 minutes which would cause a delay in the moulding process. With the suggestion of a designed cutter cycle time was reduced by 18 minutes. Also, material handling was a tedious job and lots of efforts was required during the course of working during new shift. Hence, we designed a trolley which reduced the efforts to a great extent and also increased the transportation speed from the machine department to inspection department.

V. MATERIAL HANDLING EQUIPMENT:

Human comfort is an important parameter that contributes to the overall productivity of the company. During the course of our study of the working of the industry we came across a basic problem of human comfort. The problem identified was handling the drum loaded with the rubber product ready to be transported for inspection.

The worker responsible for handling used to handle the loaded drum weighing 30kgs from the machine department to the inspection area. During the course of 11 hours shift handling the drums from 6 machines and for a total of 12 times is indeed a fatigue prone job. Thus, we came up with the idea of reducing the efforts as well as time to handle the material by designing a material handling equipment which helped ease the efforts of transporting the drum to a great extent. The design is based on simple mechanism of links. This not only reduced the efforts but also reduced the time being wasted during the course of transportation.

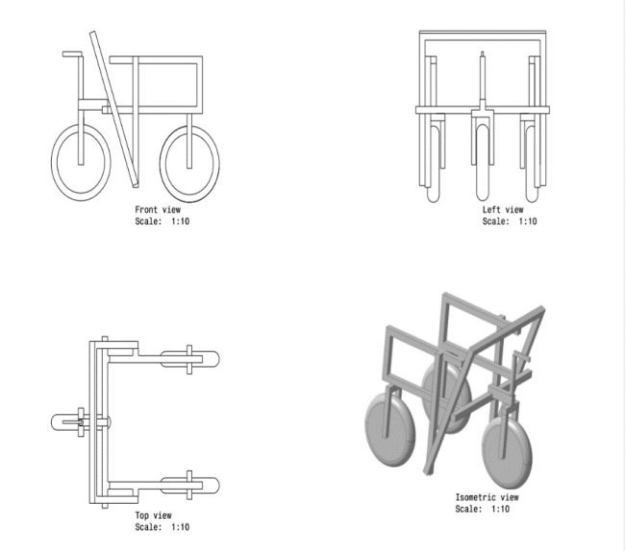


Fig: Material Handeling Equipment

VI. RESULT AND CONCLUSION:

Comparison of current state vs future state:

Variable	Units	Current state	Future state
Lead time	Days	37.28	37.26
Cycle time	Minutes	76.04	57.97
Operators	Number	1	1
Capacity	Number	2640	3442

Initially the worker required 30mins to cut the rubber sheet before transferring it to moulding machine. Upon designing a cutting tool, the time was reduced to 12mins. Also, the efforts required during the course of cutting during one shift was considerably reduced. Earlier there was no specified vehicle/equipment available to transport the drum full of product from machine department to inspection department. 28 minutes of lead time was reduced and 19 minutes for processing time. Upon calculation we were able to achieve an increase in productivity by 23.76%. This result as achieved for a single product during a single shift. I**mplementat**ion of all the proposed changes will lead to a significant cost reduction at Jade Industries and hence it will also help in reducing overall costs in the supply chain.

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