

Value Analysis of a Rubber Hose Moulding and Assembly Line: A Case Study

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Abstract - At present, the competition between the companies is leading to a constant battle for adequate market share. This is not only done by reducing the prices, but by constantly bringing new innovations in different fields of the company so that the value for a product or an entity is increased. The new concepts or ideas may come from the company itself or from any external source. The main objective of Value Analysis (VA) is to find and eliminate all the characteristics of a product or service which are of no real value to the customer. Thus VA ensures a better product or service for the customer at minimum costs compared to replacing the product with less favorable alternative. This paper focuses on the case study on process optimization for rubber hose moulding and assembly through value analysis.

Key Words: Value Analysis, Takt Time, Assembly Line Balancing, ECRS, Throughput time

1. INTRODUCTION

Value can be given as the relationship between perceived benefits and perceived costs: Value = Benefits / Cost. In order to increase the value, the organization has to improve the value : cost ratio. When the value is provided at high price, the perceived value may be low. This value can be increased by using tools like Value Analysis[1]. VA is the process of reducing costs in a development project. This process is achieved by assessing materials, processes and or products and offering alternatives. The outcome should result in reduced cost but without compromising the quality of the design[2].

2. VA METHODOLOGY

The VA methodology (or the "job plan") can be applied to any subject or problem. The VA job plan divides the task being studied into functions. The job plan is normally organized by a value team leader. It is conducted in eight sequential phases as follows:

- i. *Orientation Phase:* Refine the problem and prepare for the value study.
- ii. *Information Phase:* Finalize the scope of the issues to be addressed, targets for improvement, and

evaluation factors while building cohesion among team members.

- iii. *Function Analysis Phase:* Identify the most beneficial areas for study.
- iv. *Creative Phase:* Develop a large number of ideas for alternative ways to perform each function selected for further study.
- v. *Evaluation Phase:* Refine and select the best ideas for development into specific value-improvement recommendations.
- vi. *Development Phase:* Determine the "best" alternatives for presentation to the decision-maker.
- vii. *Presentation Phase:* Obtain a commitment to follow a course of action for initiating an alternative.
- viii. *Implementation Phase:* Obtain final approval of the proposal and facilitate its implementation.[3]

3. LITERATURE SURVEY

Amit Narwal, (2015) et.al. studied a case on the concept of value analysis in sheet metal. By Value analysis of the parts, the group produces the same parts at the cheaper cost from their competitors in market.[4]

Marjan Leber, (2014) et. al. discussed the development of new product on the basis of value analysis and conjoint analysis. Implementation of such methods resulted in strong reduction in cost inside a company.[5]

Ignacio Cariaga, (2007) et. al. studies the integration of value analysis and quality function development or evaluation design alternatives. This framework enabled to: 1) Elicit customer requirements through the use of FAST., 2) Relate various design options to each customer requirement through the use of QFD, 3) Provide a decision support environment to assist in selecting the most suitable alternative.[6]

4. VALUE ANALYSIS TOOLS AND TECHNIQUES

i. Role of Kaizen and Poka Yoke:

KAIZEN-. It can be defined as the improvement which may be one-time or continuous, large or small. Kaizen is to be done on daily basis so as to increase the productivity.[7]

POKA YOKE is a Japanese term that means "mistake proofing". A poka-yoke is not a process but a concept that

helps the operator to avoid mistakes. It is used to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur.[8]

ii. Takt time:

Takt time is the average time between the start of production of two successive units on a production line, this time is set as per the rate of customer demand.

Takt time can be determined with the formula:

$$T = T_a / D$$

Where

T = Takt time, e.g. (work time between two consecutive units)

T_a = Net time available to work, e.g. (work time per period)

D = Demand (customer demand), e.g. (units required per period) [9]

iii. Assembly line balancing

Assembly line balancing is concerned with redistributing and rearranging of the work to the workers in an assembly line. The main goal is to minimize the idle time of the workers and to increase the utilization of resources, labor and machines. [10]

iv. Cycle time:

Cycle time is the total time required for the completion of a process. Cycle time includes process time, during which a particular operation is done on the unit, and delay time, during which a unit has to wait so that next operation is started.[11]

v. Multiple activity charts:

Multiple activity charts are used to understand the relationship between the workers and their associated equipment. The activities of each subject are recorded, normally as blocks in tabular form with a common time scale. They serve as useful devices to assist in the redistribution and balancing of workloads.[12]

vi. ECRS:

In generating practical ideas for improvement, a common and practical framework ECRS is used, which stands for the following:

Eliminate
Combine
Rearrange
Simplify

- Eliminate
In this step, all the unnecessary activities, non-value added activities are identified and are immediately eliminated..
- Combine
In this step, the activities which cannot be eliminated are combined.
- Rearrange
Work can also be rearranged. This rearrangement can be either in terms of order of operations, layout of the assembly line.
- Simplify

And, a good rule of thumb regardless of the situation is to simplify anyway. Of course, we want to Eliminate first but, if not, then Combine, Rearrange, and Simplify will be helpful.[13]

vii. Flow process chart:

The flow process chart is the graphical and symbolic representation of the various activities or operations or movements performed during a process. It is used to identify the unnecessary activities, movements and eliminate them, thus makes the process more efficient.[14]

viii. Throughput time

The amount of time required to turn raw materials into completed product is called throughput time. The throughput time or manufacturing cycle time is made up of process time, inspection time, move time, and queue time.[15]

5. CASE STUDY

5.1 Company Background

INNOVA RUBBERS PVT. LTD. is located at Ambad, Nashik, Maharashtra. The industry is one of the technological leader in designing and manufacturing of automotive and industrial rubber moulded and rubber to metal bonded anti-vibration parts. The industry produces silent block bushes, engine mounts and transmission mounts, propeller shaft mountings, torsional vibrational dampers, bare rubber parts, control arms, etc.

5.2 Implementation

Here value analysis was done to optimize the rubber hose moulding and assembly line. This hose assembly consists of two parts made of two different rubbers, namely EPDM and VAMMAC. The main processes involved in this production are: injection moulding of the rubber parts, post curing of VAMMAC rubber part, assembly and packing. Respective raw rubber is feed to the injection moulding machine. The rubber is melted by the heating mechanism in the machine as is then sent to the mould cavity through runners. After allowing the rubber to cure in the mould for some time, the mould is opened and the rubber parts are removed. EPDM rubber is directly sent to assembly with the post-cured VAMMAC rubber parts, while the VAMMAC rubber from the moulding machine is sent to post curing in a post curing oven for 4 hrs. At the assembly line various operations like hole drilling, ID cleaning, thread cleaning, whistle pin painting are done and is then assembled and packed. For the implementation of value analysis, data was collected regarding number of operations taking place, time required for each operation, number of operators on the line. With this a line balancing chart was drawn.

From the data collected and the line balancing chart problems were found out, they were as follows:

- i. More WIP Inventory at every stage
- ii. Shortage at Customer end

- iii. Multiple moulding station engaged for production
- iv. Less output per man
- v. More throughput time
- vi. Frequent incidences of assembly line stoppage.

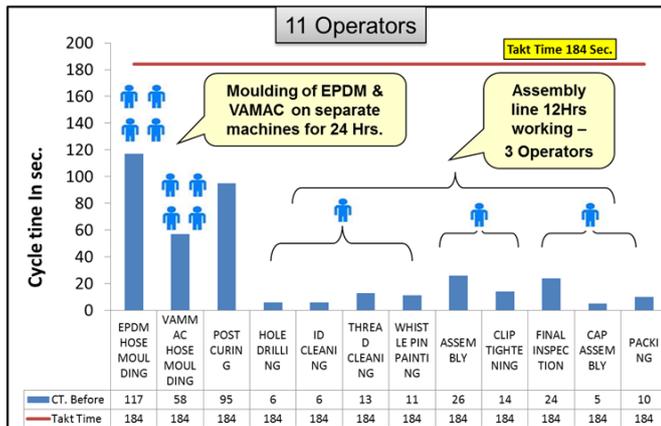


Chart -1: Line balancing chart - Before

- vii. More space utilization
- viii. Excess material handling

Taking note of these problems various brainstorming sessions were taken. Various ideas/ alternatives were put forth, of which the team leader selected. These were:

- i. Reducing the labor force.
A total of 11 workers were required over the entire production line. This would cause more expenditure on the workers in terms of salary. By reduction of workers there would be less investment on the labors and this would led to saving of capital.
- ii. Combining of operations.
As the workforce was to be reduced combining of operations was necessary. In this multiple operations were done by a worker.
- iii. Combining the moulding of the rubber hose on single injection moulding machine.
The rubber hose assembly consists of two rubber part together. Each rubber part was produced on different machines. But production of both the parts on single machine would result in elimination of one injection moulding machine.
- iv. Changing the internal design of the post curing oven.
One of the rubber part requires a post curing of 4 hrs. This is done in post curing oven. Its capacity was of 160 units. The internal design was further modified which resulted in accommodation of 216 units. By which the productivity increased.

6. RESULTS

By implementation of the above ideas, the results obtained were as follows:

- i. Better line balancing
By combining the operations, reducing the number of operators on the production line and also

reducing the takt time resulted in simplified line balancing.

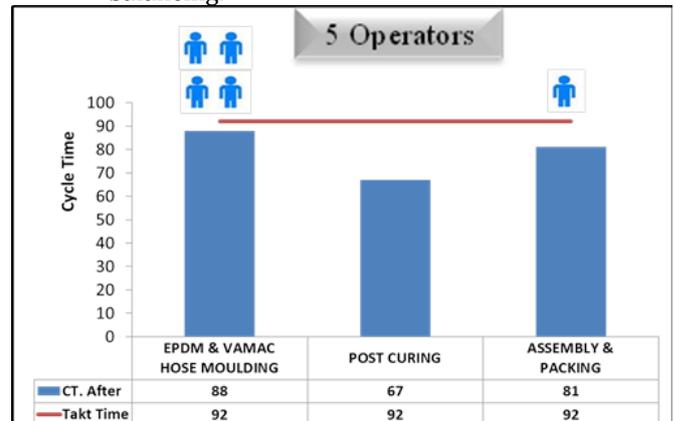


Chart -2: Line balancing chart- After

- ii. Reduced Throughput time ratio
By combining the moulding on single machine and modifying the internal design of the oven, the ratio of throughput time required to the ideal throughput time was reduced from 22 to 2.76, i.e., by 87.4%.
- iii. Reduced Space Utilization ratio
Due to the rearrangement of the machines, the ratio of actual space utilized to the minimum space required was reduced from 2.79 to 1.37, i.e., by 50.89%.
- iv. Reduced material handling ratio
Due to simplification of the workplace layout, the ratio of the actual working width to the minimum working width was reduced from 2.93 to 1.41, i.e., by 51.8%.
- v. Increase in productivity of each operator
Before, the output per man was only 100 units, while after the implementation; the output per man was increased to 350 units. This increased the productivity of each worker by 250%.

7. CONCLUSION

Value analysis is a systematic effort to improve upon cost and performance of product produced. It examines the materials, processes, information systems, and the flow of materials involved. While we strive to implement the different VA tools, we realize that the years of experience in product design and development is very essential to achieve the desired objective. VA tools and techniques if applied properly, with trained and experienced resources will provide an extremely powerful suite to improve productivity, lower cost, improve quality and also shorten the time-to-market. This paper showed the implementation of value analysis in a production line which led to reduction in labor resulting in reduced investments. Also it help in reducing the space utilization, material handling, throughput time and lastly increase in the productivity. Value analysis thus helps realize substantial company-wide improvements, thereby delivering significant competitive advantage.

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