# Production Capacity Improvement Using Value Engineering

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*Abstract*— **In these days Industries strives hard to meet the requirements of the customers and tries to reduce production cost by developing new alternatives. Value engineering is a scientific tool to improve the value of a product with reduction in cost without reducing quality. The focus of this project is to use the tools of the Value Engineering such as Micro Operation Sequence Technique Study, Multi Movement Analysis, Methods Time Measurement Analysis and Feasibility Analysis in the assembly line of the MDE and HDE short block to improve the value of the product and reduce the tact time. In automotive industries, assembly line is the major area to be taken into consideration for increasing productivity. So cycle time is noted for each workstation with the help of stopwatch in the Engine assembly line to identify the bottleneck workstations and SWI/JES to determine critical process in these stations. The current layout is redesigned by computing takt time and cycle time in each workstation. The time consuming process in bottle neck stations are reduced and thus the cycle time at all workstations is made possibly equal. The time reduction increases productivity in the form of increased number of units of production in the same previous time.**

***Keywords—Bottleneck, Method Time Measurement, Takt time, Value Engineering***

## I. INTRODUCTION

**Value Engineering** (**VE**) is a systematic method to improve the "value" of goods or products and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. It is a primary tenet of value engineering that basic functions be preserved and not be reduced as a consequence of pursuing value improvements.

Value Engineering Analysis is concerned with existing products. It involves a current product being analysed and evaluated by a team, to reduce costs, improve product function or both. Value Analysis exercises use a plan which step-by-step, methodically evaluates the product in a range of areas. These include costs, function, alternative components and design aspects such as ease of manufacture and assembly.

A significant part of VA is a technique called **Functional Analysis**, where the product is broken down and reviewed as a number of assemblies. Here, the function is identified and defined for each product assembly. Costs are also assigned to each one. This is assisted by designing and viewing products as assemblies (or modules). As with VE, VA is a group activity that involves brainstorming improvements and alternatives to improve the value of the product, particular to the customer.

Productivity is the ratio between output and input. It is quantitative relationship between what we produce and what we have spent to produce. Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more and more with less and less inputs of resources so that there will be maximum distribution of benefits among maximum number of people. Productivity denotes relationship between output and one or all associated inputs.

**TMU (Time Measurement Unit)** are used for the Value Engineering Analysis instead of seconds. It is smaller unit than the seconds which provide better accuracy during the analysis. The number of TMUs to be taken for the analysis is determined on the basis of the degree of accuracy required for the analysis

### *A. Tools of Value Engineering Analysis*

For the Value Engineering Analysis, a definite set of tools are used depending upon the requirement of the analysis and what our target is, tools used are:

- MOST (Micro Operation Sequence Technique) Study
- Multi Movement Analysis (MMA)
- Methods Time Measurement (MTM) Analysis
- Feasibility Analysis

## II. LITERATURE REVIEW

In these days Industries strives hard to meet the requirements of the customers and tries to reduce production cost by developing new alternatives. Value Engineering Job Plan (VEJP) was used to reduce the cost and improve value of a chassis component for a Heavy commercial vehicle (HCV). At the end changes were proposed leading to of cost

saving and ease of manufacturing also helped yield a fourfold increase in the production [1].

Offers exhaustive application-driven coverage of industry principles and practices, from work measurement and material flow, to facilities and quality control–as well as productivity improvement-related case studies [2].

The use of methodologies such as the target costing in cost management which are complimentary process and go hand in hand. While one allows the identification of where cost reduction could be achieved the other shows the target to be achieved to guarantee the long term profitability plan [3].

Methods like revisiting methods engineering, increase productivity and efficiency, reduce cycle time, reduce product cost. reduce labour content, improve motivation and morale of employee was determined. A primary objective in work design is to determine the one best method for a task, and then to standardize it this one best refers to an average worker with a moderate level of skill, operating under normal working conditions with nominal material quality and tool/equipment availability [4].

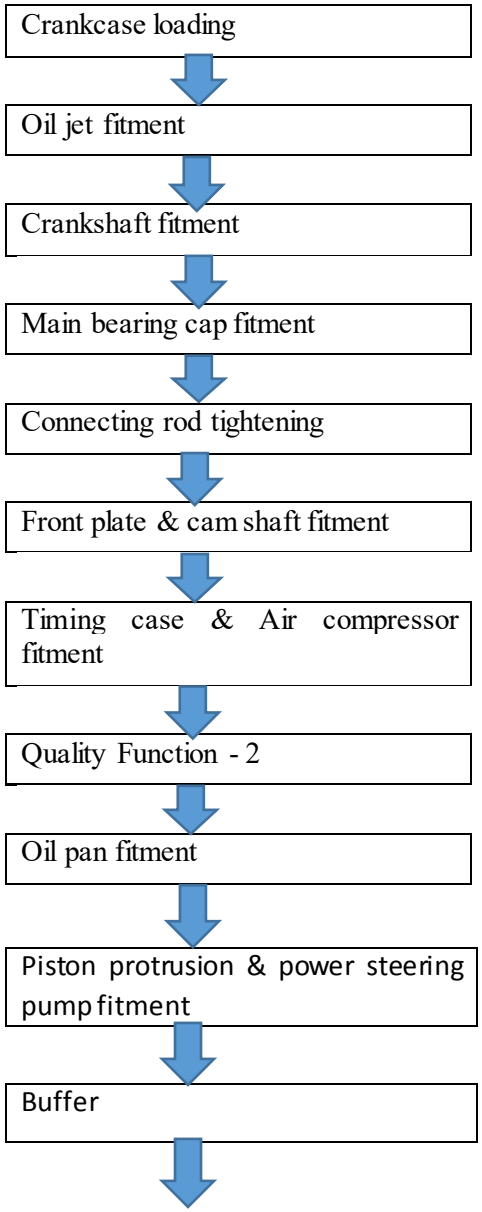
The assembly line design is to minimize the number of workstations for a given cycle time (type 1), to minimize the maximum of the times of workstations for a given number of workstations (type 2) [5].

The correct term should be ‘‘cost management’’ and not ‘‘cost reduction’’, because the latter simply implies the reduction in functionality and quality of products, while the real task would be to provide exactly the same function with better quality, but at lesser cost [6]

From the literature review it has been observed that value engineering is a very important tool for the improvement in the value of the product and reduce the overall manufacturing cost of the product.

## III. PRESENT WORK

### *A. ASSEMBLE FLOW*



*B. LAYOUT*

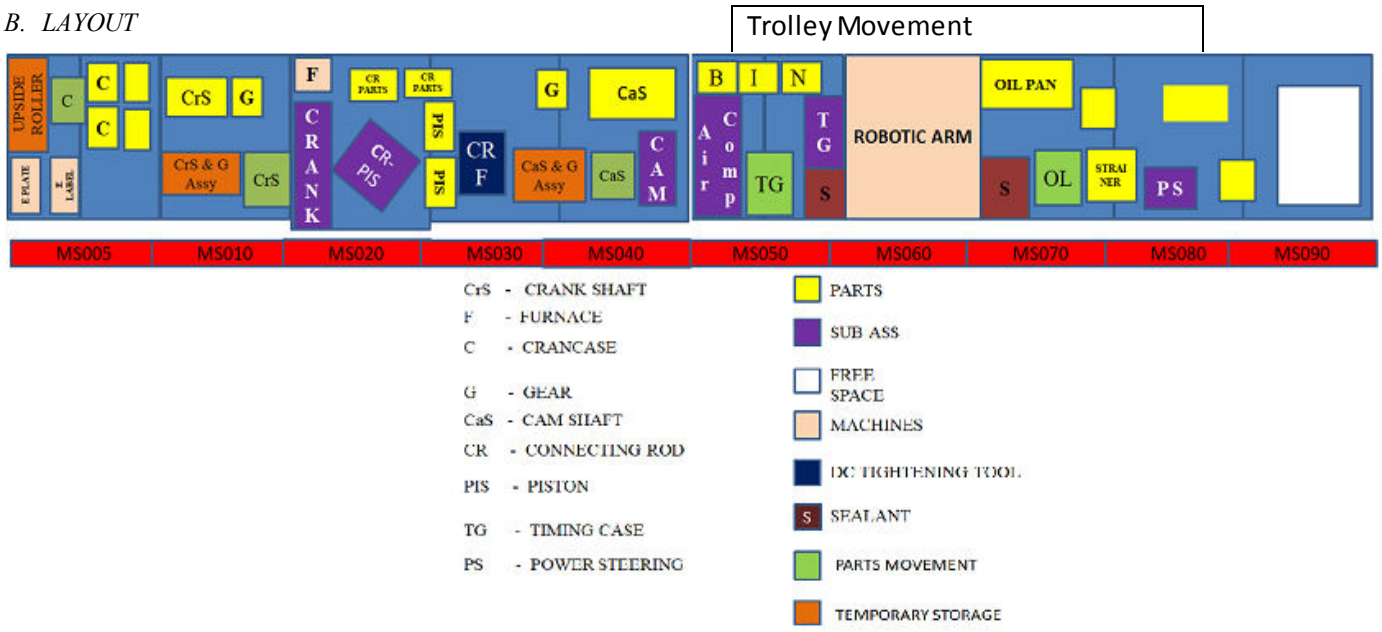



Fig 1. Layout of MDE Assembly

*C. OBSERVATIONS*

The cycle time is noted for each workstation with the help of stopwatch to identify bottle neck and the Video pro software was used for the video study and process study was done with the help of SWI (Station Work Instruction)/ JES (Job Element Sheet) in the bottle neck stations to determine critical process.

The process which takes the longest cycle time is regarded as the critical process and considered as the bottleneck for productivity. The longest cycle time also decides the minimum number of output products that can be produced per shift. So in order to increase the productivity, we have to increase the number of output products produced. This can be achieved by reducing the cycle time for that critical process.

**Table 1**: Cycle Time

| STATIONS | TIME IN SEC | TACT TIME | MAN POWER |
|---|---|---|---|
| MS005 & MS005A | 416.8 | 8.4 | 1 |
| MS010 & MS010A | 432.54 | 8.4 | 1 |
| MS020 & MS030 | 445.01 | 8.4 | 1 |
| MS030A&MS040A | 357.95 | 8.4 | 1 |
| MS040 & MS050 | 430.62 | 8.4 | 1 |
| MS050A TG | 431.08 | 8.4 | 1 |
| MS050B AC | 508.99 | 8.4 | 1 |
| MS070 | 533.95 | 8.4 | 1 |
| MS080 | 443.75 | 8.4 | 1 |

Further, it is found that the Air compressor sub assembly and Oil pan fitment are two workstations in which the cycle time exceeds the takt time of the stations.

*D. METHODOLOGY*

**Methods Time Measurement (MTM)** is a part of Predetermined Motion Time Study (PMTS). It is used for the analysis of the production process at the workstation and as a result of this analysis the standard time for the workstation is determined. Basic motions i.e. Reach, Grasp, Motion, Position, Release etc. will be recorded during MTM analysis. Layout, distance and size of tools and parts is taken as 1:1.

**Procedure**

I **Video Recording:** Record the standard time video at the desired station.

II **Video Analysis:** Analyze the standard time video using **Video Timer Pro** software.

III **Classification:** After the analysis of the standard time video is done then the classification of activities is basis on the value addition:

a) **Value Added Activities (VA)** - Those activities which add value to the product from the customer's perspective are termed as Value Added activities.

b) **Non- Value Added Activities (NVA) -** Those activities which don't add any value to the product from the customer's perspective and are conducted but not required are termed as Non- Value Added Activities.

c) **Waste Activities** - Those activities are considered NVA from a customer perspective but are required by the process are termed as waste activities.

IV **Results and Conclusions:** The results obtained from the Value Engineering Analysis are put together in the form of excel sheets and Yamazumi charts.

V **Brainstorming:** Suggest improvements to improve the production capacity of the MDE short block assembly.

**Table 2**: Value Engineering Analysis

| STATIONS | VA | NVA | WASTE | TOT TIME |
|---|---|---|---|---|
| 05,05A | 117.16 | 183.03 | 116.61 | 416.80 |
| 10,10A | 225.03 | 122.02 | 85.19 | 432.54 |
| 20,30 | 305.99 | 82.60 | 56.42 | 445.01 |
| 30A,40A | 184.02 | 113.90 | 60.03 | 357.95 |
| 40,50 | 234.96 | 119.03 | 76.63 | 430.62 |
| 50A TG | 201.97 | 189.81 | 39.30 | 431.08 |
| 50B AC | 298.84 | 131.31 | 78.83 | 508.99 |
| 70,70A | 299.27 | 170.07 | 64.61 | 533.95 |
| 80,80A | 255.05 | 88.39 | 100.31 | 443.75 |

VA – Value Added, NVA – Non Value Added

*E. BRAINSTORMING IDEAS*

1.The bearing flange can be done in the MS040A.
2.Air compressor can be removed in the inventory.
3.Change of screw tightening (i.e) faster tool in the MS050 & MS070.
4.During the engine rotation the power steering fitment can be done in MS070 itself.
5.Strainer fitment can be done in MS050 station.
6.The modification of fixture in piston sub assy to place connecting rod cap along with bolt.

**Construction**

Supporting cyclindrical slots are provided for the bolt in the fixture to maintain alignment.
Fixture attachment is done to assemble four piston at a time

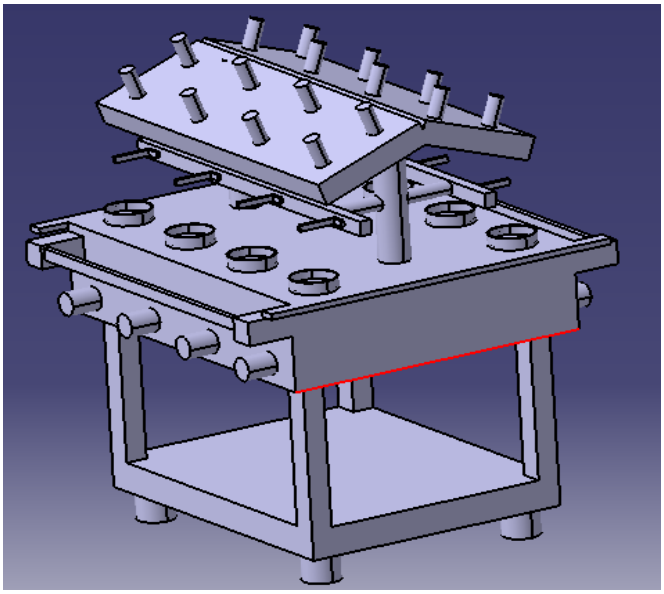


**Fig 2**. Initial Fixture

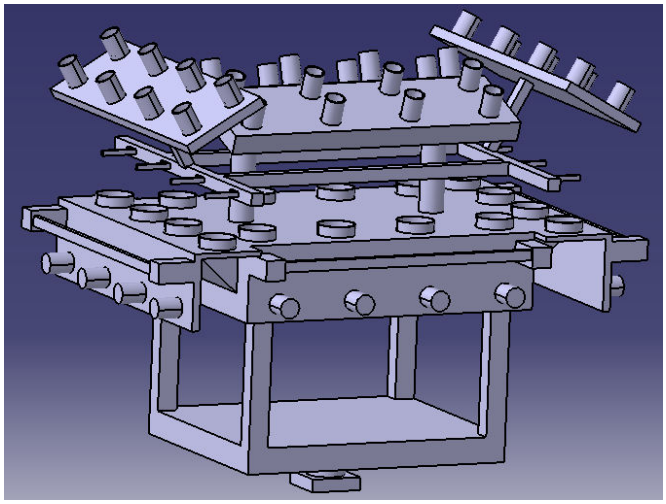


**Fig 3**. Fixture Attachment

7.Engine rotation process can be done with less human intervention with help of sensor.
8.The plastic covers to be removed in the inventory or before entering the bay for all the parts.

*F. CYCLE TIME REDUCTION*

| Workstation | Time Saved |
|---|---|
| **MS040A** | |
| Connecting rod cap | |
| The change of fixture of piston sub assy | 56 sec |
| **MS050 B AC** | |
| Air Compressor | |
| 1.The Bearing flange assy in MS040A | 50 sec |
| 2.Cover removal of air compressor in inventory | 43 sec |
| **MS050 A TG** | |
| Timing Case | |
| Change of tool for screw tightening(faster tool) | 15 sec |
| **MS070** | |
| Oil pan fitment | |
| Strainer fitment can be done in MS050 | 36 sec |
| Change of tool for screw tightening(faster tool) | 15 sec |

## IV. RESULTS

Productivity of a manufacturing system can be defined as the amount of work that can be accomplished per unit time using the available resources. Line balancing is usually undertaken to minimize imbalance between machines or personnel while meeting a required output from the line. Value Engineering is a tool to improve of a work line which at the same time reducing manpower and cost needed. The

line is balanced if the amount of work assigned to each workstation is identical. The following results were

obtained by the value engineering analysis being done at the required workstations and the reduction in cycle time of MDE short block from 8.4 mins to 7.5 mins is achieved.

*A. YAMAZUMI CHARTS*

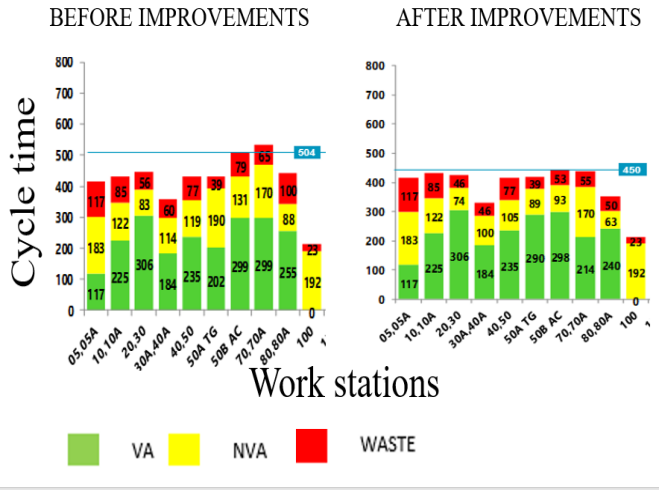



**Fig 4** Yamazumi Charts

**Table 3**: Allowances

| CONTENTS | DURATION |
|---|---|
| Morning tea break | 07 mins |
| Lunch break | 30 mins |
| Afternoon tea break | 07 mins |
| Total time | 44 mins |

**Table 4** Productivity before Cycle Time reduction

| CONTENTS | DURATION |
|---|---|
| Total shift timing | 9 hrs 45 mins |
| Shift timing | 585 mins |
| Allowances | 44 mins |
| Available timing | 541 mins |
| Cycle time | 8.4 mins |
| Output | 64 Units |

**Table 5** Productivity after Cycle Time reduction

| CONTENTS | DURATION |
|---|---|
| Total shift timing | 9 hrs 45 mins |
| Shift timing | 585 mins |
| Allowances | 45 mins |
| Available timing | 541 mins |
| Cycle time | 7.5 mins |
| Output | 72 Units |

*B. PRODUCTIVITY IMPROVEMENT*

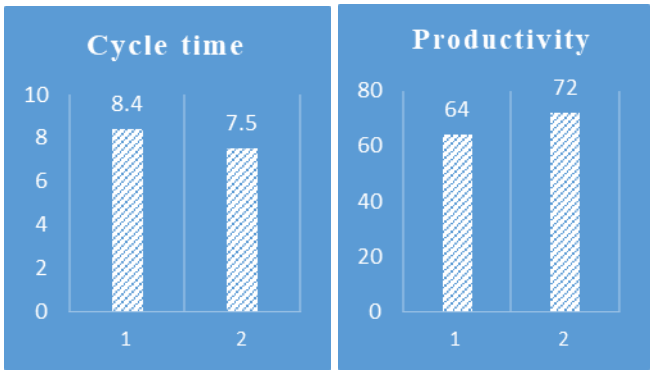



**Fig 5** Productivity Improvement

## V. CONCLUSION

In automotive industries, assembly line is the major area to be taken into consideration for increasing productivity. This project describes assembly line balancing by cycle time reduction using value engineering analysis, is one of the major step to be taken into consideration while increasing productivity of automotive industries. Continuous improvement is the step to reduce unnecessary downtime losses. The productivity of assembly line is thus found to be increased.

The cycle time is noted for each workstation with the help of stopwatch, and each process in the workstations were divided into three activities and using these information Yamazumi charts are plotted (cycle time vs workstation) and compared with the takt time to identify bottleneck stations in the engine assembly. The Video pro software was used for the video study and process study was done with the help of SWI (Station Work Instruction)/ JES (Job Element Sheet) in the bottle neck stations to determine critical process. Suitable countermeasures were proposed to eliminate the bottleneck to improve the productivity. The results are

*A. Productivity Improvement*

The number of parts produced in MDE short block assembly before cycle time improvement is 64 units per shift. Now it can be increased to 72 units per shift by adapting value Method time measurement which is a 12.5% increase in productivity.

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