# Reducing the Throughput Time by Value Stream Mapping in a Tyre Manufacturing Industry

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*Abstract*— **This study is carried out in a tyre manufacturing industry. Attempt is done to study the throughput time using Value stream mapping (VSM). The current state map is plotted considering the material flow, information flow and cycle times, and thereby creates an improvised future state of value stream wherein the value addition is enhanced.**

*Keywords*— *Current state VSM; future state VSM; Non-Value added processes; throughput time; Value added processes.*

## I. INTRODUCTION

The objective of this study was to chart the various processes in a tyre manufacturing industry and then categorize them under the various tools of value stream map like value contribution scale and directions of material/information flow, and thereby create an improvised future state of value stream wherein the value addition is enhanced. The ineffective usage of the machines available reduced the output thereby increasing the cycle time of processes.

## II. LITERATURE SURVEY

Value Stream Mapping has its roots in lean manufacturing-a set of principles used to enable the manufacture of goods with fewer resources. Lean manufacturing is the relentless elimination of waste and Value stream mapping is a visual tool to improve a process by identifying value added and eliminating waste. It is especially powerful for illustrating the wastes of Overproduction, Idle Material & Transportation. The Lean transformation should provide growth with improved margins, minimal capital and without more employees. Many organizations pursuing lean conversions have realized that improvement events alone are not enough since they create localized improvements, while Value Stream Mapping strengthens the gains by providing vision and plans that connect all improvement activities.

A Value Stream is the entire set of activities running from raw material to finished product for a specific product or product family. In a typical enterprise, value streams can intersect with other value streams, branch apart or Y together.Whenever there is a product (or service) for a customer, there is a value stream. The challenge lies in seeing it.

## III. PROBLEM DEFINITION

The main problem faced by the company is that the 6 billion sales mark is not attainable under the present situations.

The main problems which hinder to achieve this goal are: Value added and non-value added processes accounts to it.

By this project, it is intended to cover the following major tasks:

- − Both Current & Future state VSM.
- − Viable improvements.

- − Enhancement of Value addition to the product.

- − Thorough analysis of the process Throughput time.

## IV. DATA COLLECTION

This study is based on the value stream mapping of current state and plotting the future state map and comparing the throughput time, and optimizing the finished goods handling costs.

The data regarding material flow, information flow was collected. Plant layout was studied and a process flow diagram (PFD) was developed.

### A. Data box details

The data box is a VSM tool used in the chart to address the data input corresponding to each process. The subheadings under each will be as follows:

| DATA BOX |
|---|
| Process |
| Utilization(%) on |
| Man Power/ |
| No. of Shifts |
| Setup time/shift |
| Time Available |
| Cycle time |
| O/p per shift |

Fig. 1  Data Box

Utilization of each process capacity according to the scheduled hrs and the available hrs is calculated in order to get a brief understanding about the work stage efficiency of the plant.

TABLE I
EXCEL CALCULATION SHEET

| EQUIP MENT | Hours | | | Un-Utilised Hours | | | |
|---|---|---|---|---|---|---|---|
| | Sche duled | Ope rate d | % Utilis ation | % Bre ak | % Materi al | % Manp ower | % Oth ers |
| Banbur | 648.0 | 582. | | 0.98 | 0.00 | 2.66 | 6.52 |
| Banbur | 648.0 | 538. | | 5.57 | 0.15 | 4.94 | 6.19 |
| Banbur | 648.0 | 473. | | 2.15 | 0.11 | 18.52 | 6.15 |
| Banbur | 648.0 | 315. | | 3.20 | 0.00 | 41.98 | 6.12 |
| Dual -1 | 648.0 | 416. | | 1.11 | 10.15 | 16.96 | 7.52 |
| Dual - 2 | 640.0 | 446. | | 2.02 | 10.45 | 14.49 | 3.30 |
| Calende | 632.0 | 437. | | 0.25 | 1.33 | 22.32 | 6.81 |
| New | 416.0 | 292. | | 5.56 | 13.88 | 4.47 | 5.71 |
| Two | 608.0 | 411. | | 1.19 | 20.24 | 10.63 | 0.25 |
| Three | 632.0 | 462. | | 1.62 | 15.15 | 9.80 | 0.19 |
| Horizon | 2893. | 2524 | | 1.62 | 9.18 | 0.37 | 1.58 |
| Vertical | 632.0 | 570. | | 0.46 | 9.24 | 0.00 | 0.00 |
| Bead | 1344. | 1268 | | 0.61 | 0.09 | 0.40 | 4.54 |
| Bead | 3856. | 3842 | | 0.22 | 0.10 | 0.03 | 0.00 |
| Bead | 5264. | 5156 | | 0.58 | 1.21 | 0.08 | 0.17 |
| Slitter | 960.1 | 960. | | 0.00 | 0.00 | 0.00 | 0.00 |
| Truck | 2980 | 1839 | | 2.32 | 7.20 | 13.56 | |
| R T | 5832. | 2673 | | 1.20 | 7.30 | 19.26 | |
| Pass. | 1036 | 3375 | | 1.59 | 10.48 | 19.66 | |
| Truck | 5500 | 4740 | | 0.88 | 6.38 | 0.03 | 6.53 |
| R T | 9145. | 7818 | | 1.55 | 5.61 | 0.00 | 7.34 |
| Pass. | 1431 | 1205 | | 1.23 | 8.66 | 0.02 | 5.85 |

## V. DATA ANALYSIS

### A. Current State VSM

Current state VSM is plotted considering cycle times, material flow and information flows.
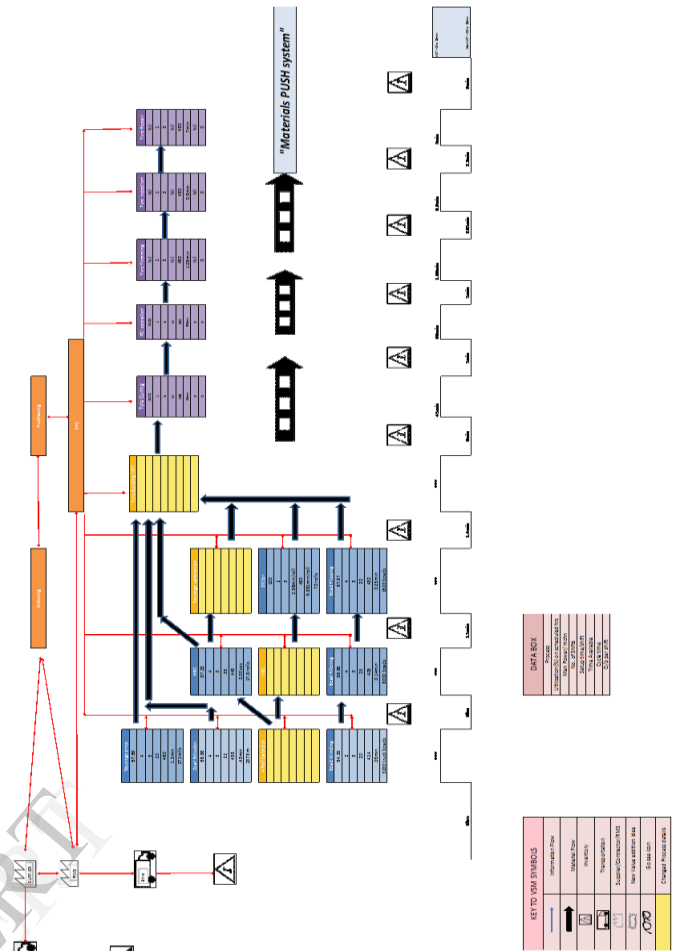


Fig. 2 Current state VSM

### B. Recommendations

- Increase the line speed of fabric Calendaring machine.

- Modify the 2-rolled Squeege calendaring machine to 3-rolled Squeege calendaring machine.

- The cycle time will be reduced by more than 50%.

- Modify the tyre building machine to turret type tyre building machine.

### C. Future state VSM

Future state VSM is plotted taking into consideration all the recommendations.

The VSM is analysed and the data after refining is shown in a yellow shade. This contributes to the enhancement of the Value Adding activities. Thus, by this VSM project the following were analysed: Utilization Factor, Throughput Time.
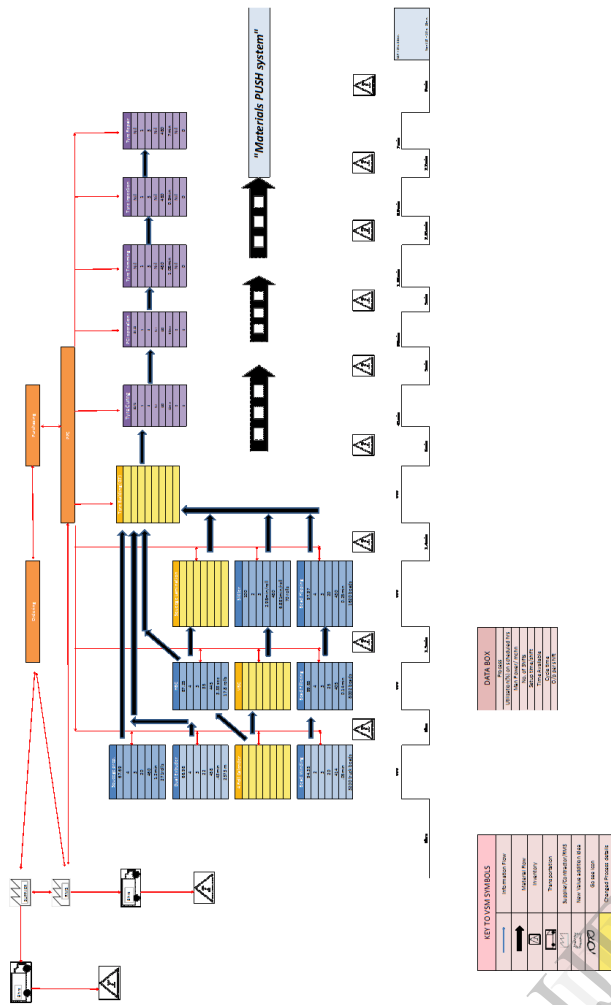
Fig. 3  Future state VSM
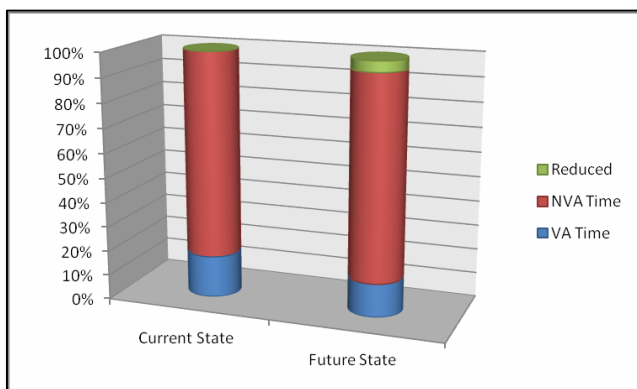
## VI. RESULTS AND DISCUSSIONS



Fig. 4 shows Current state **vs**. Future state

*1)* The Contribution of the process in Value Stream can be understood from the following graph: Fig 4.

*2)* Comparison of current and future state value stream mapping was done.

TABLE II
COMPARISON OF CURRENT AND FUTURE STATE MAPPING

|  | VA | NVA | Total |
|---|---|---|---|
| Current state | 2hrs 58mins | 14hrs 39mins | 17hrs 37mins |
| Future state | 2hrs 23mins | 14hrs 28mins | 16hrs 15mins |

*3)* The various factors that affected the throughput time were studied through VSM and necessary recommendations were suggested to improve the throughput time.

## VII. CONCLUSIONS

Value Stream Mapping is an effective tool to eliminate the wastes and it also suggests ways to reduce non-value added times in a manufacturing process. Value stream mapping is a recognized method used as part of Six Sigma methodologies. It is often used in Lean environments to analyse and design flows at the system level (across multiple processes). Although value stream mapping is often associated with manufacturing, it is also used in logistics, supply chain, service related industries, healthcare, software development, product development, and administrative and office processes.

As a conclusion to this study, I would like to make the following recommendations:

- Value Stream Map provides a future state to be attained by the plant. The enhancement as in the next future stage has to be kept on plotted and the Value Stream has to be kept tracked. It provides a basic understanding of all the processes throughout the plant for all the staff and the decision making management. It gives a ones sight view of all the process and helps in finding the inefficient and the most efficient process at the plant

- The layout of the plant has to be so arranged in accordance with both the Value Stream activities and the plant efficacy.

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