# Value Stream Mapping Tool for Waste Identification in Tyre-Rim Assembly of Tractor Manufacturing

Sandip J.Kadam
Department of Mechanical Engg.
Yeshwantrao Chavan College of Engg, Nagpur, India

Prashant.N.Shende
Department of Mechanical Engg.Yeshwantrao Chavan College of Engg. Nagpur, India

P.D.Kamble
Department of Mechanical Engg.Yeshwantrao Chavan College of Engg. Nagpur, India

## ABSTRACT

Value stream mapping has been used in several companies as a powerful tool to identify wastes and to help to design production system incorporating the lean concept.Its application to extended value streams is recent and it has shown the substantial wastes can be eliminated across different companies in the supply chain. This paper is a case of adoption of Lean manufacturing methodology to Tyre Rim Assembly at Mahindra and Mahindra Ltd. Nagpur. The author discuss wastes that can be identified and possible proposals to reduce in the current state of tyre rim assembly line, also to enhance the performance through continuous improvement and cutting down SEVEN TYPES OF WASTS (muda,mura,muri in Japanese). Being originally a concept applied to production, "LEAN MANUFACTURING" is the name of the production systems that produces"more with less", also known as Lean production or No waste production or minimum COSTS production.

The various problems are found in assembly line. The SEVEN WASTES for the assembly lines was an area of concern, which has been analyzed here, and considering other various problems a lean system has been developed for tyre and rim in assembly line. In waste reduction activities we focus on non-value adding activities, which add to cost and not value.

## Keywords

Lean manufacturing Methods and processes, concept of kanban, kaizen, Single flow material using in industry.

## 1. INTRODUCTION

Manufacturing processes are the basis on which businesses create their wealth through value addition. Some processes in manufacturing are essential but do not add value while others are not essential and do not add value. Most organizations are not quite aware of the non-value-adding processes in their plants. Value Stream Mapping (VSM) is a set of methods to visually display the flow of materials and information through the production process.

Everyone knows that the tyre is 'A' grade material so it is required to take care of it seriously because if we neglect it causes a serious loss of money but in a plant there was no proper handling.

In this project, we studied about a flow of tyre from the order to the attach to the tractor and various wastes which previously had. In order to improve the performance of the system, we used lean manufacturing technique to eliminate the wastes. For that we found out the non value added activities and drawn the process chart, by using this we prepared the value stream mapping.

## 2. LITERATURE SURVEY

The above-discussed problems were resolved by use of lean manufacturing methodology. Lean manufacturing, which focuses on the elimination of waste in the production process. Early Japanese leaders such as the Toyota Motor Company's Eiji Toyota, Taiichi Ohno and Shingo developed a disciplined, process focused production system now known as the Toyota Production System, or "Lean Production". The objective of this was to minimize the consumption of resources that added no value to a product. The "Lean Manufacturing" concept was popular in American factories in large part by the Massachusetts institute of Technology (MIT) study of the movement from mass production toward production as described in 'The machine that changed the world', which discussed the significant performance gap between Western and Japanese automotive firms. The term "Lean" was used because Japanese business methods used less human effort, capital investment, floor space, materials, and time in all aspects of operations.

A systematic approach of identifying and eliminating waste (non –value added activities) through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection.

The stated problem can be solved by reducing waste. In waste reducing activities, we are focusing on value adding activities and eliminate those activities, which add to cost and not value.

The company has a long-term objective of achieving just in time performance. With this in mind they have started out in various activities such as reduction of set up times, improvement of quality, formation of cell, improving supplier relation and finally attempt to reduce the inventories. The preliminary study of the system showed that the company would substantially benefit from the application of the system.

### *A.* Principle of lean Manufacturing

Waste minimization, Responsiveness to change, Right thing at right place, at right time and in right quality, Effective

relationship with on the value stream, Continuous improvement, Quality from the beginning.

B. Waste in manufacturing

All activities in manufacturing processes that do not add any value to the products are waste. It is necessary to find all sorts of waste in manufacturing processes and suggest the ways of their elimination. SEVEN TYPES OF WASTE were found in Toyota.

1. waste of OVERPRODUCTION
2. waste of WAITING
3. waste of TRANSPORT
4. waste of INAPPROPRIATE PROCESSING
5. waste of UNNECESSARY INVENTORY
6. waste of UNNECESSARY MOTION
7. waste of MANUFACTURING DEFECTS.

## 3. WASTE OF OVERPRODUCTION

Overproduction occurs if more products are manufactured than it was planned by the production plan, or if products are manufactured faster that it was planned. Consequences are piles of too early deposited products in intermediate warehouses. In order to prevent that a worker on a machine in a production line would not be without work, he starts processing the next operational order immediately after having finished the previous one. This new product was planned to be manufactured later, so the worker creates overproduction, which requires intermediate warehouses.

## 4. WASTE OF WAITING

Waiting times can be visible or hidden. A clearly visible form of waiting time can be seen in a case of a worker who operates a single machine that has an automatic feed and stop device

## 5. WASTE OF TRANSPORT

Waste of transport is a consequence of excessively long, intersecting transport paths, temporary storage, load and unload, transport of pallets . Waste of transport is also caused by too detailed process breakdown and exaggerated division of work, due to imprecisely defined intermediate warehouses and due to production in large series.

## 6. WASTE OF INAPPROPRIATE PROCESSING

Waste of inappropriate processing is a consequence of a poorly planned production process of the product. The product does not satisfy requirements and has to be reworked; sometimes it is even useless.

## 7. WASTE OF UNNECESSARY INVENTORY

Waste of unnecessary inventory is similar to the waste of overproduction. Just like overproduction, supply of too large quantities leads to the waste of unnecessary inventory. Costs upon exit from the warehouse consist of costs for purchasing material and products, order-launch costs and inventory costs. High costs are therefore related to storage and they can amount up to 20% of the product sales value .Waste of unnecessary inventory can be minimized by defining optimal, maximum and minimum inventory, as well as exact time when the ordered quantity should arrive at the warehouse.

## 8. WASTE OF UNNECESSARY MOTION

Waste of unnecessary motion is clearly visible when holding and depositing products. Workers sit by the conveyor belts and put together parts in order to make the final product. The main element of the assembly line is a conveyor belt, so the waste consists of reaching and depositing. The main reason for waste of unnecessary motion is the sitting work of workers, which reduces workers' moving area and eliminates mutual help of workers. Waste also occurs because of one-hand work: a worker holds the part with his left hand and he uses just one hand for manufacturing activities. Waste of motion can be considerably reduced by a transition from a conveyor belt to the U-shaped production lines.

## 9. WASTE OF MANUFACTURING DEFECTS

Waste of manufacturing defects appears on locations where semi-manufactured products accumulate and therefore intermediate storage is required. It is possible to eliminate waste of manufacturing defects by training workers to control the workplace, product and circumstances: The worker who manufactures a particular part should have the possibility of supervision how this particular part was manufactured at his predecessor.The worker who has just finished a particular part should check it immediately.

C. Throughput time and conversation time

Throughput time – (TPT):-The amount of time required to turn raw material into completed production is called throughput time or manufacturing cycle time.

Conversation Time (CT):- Time when value is added to the product or service as it moves through a particular location.

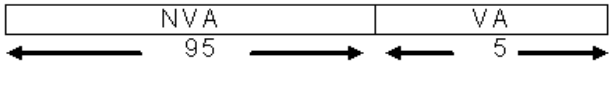
Cost and profit
Price = Cost + Profit
Profit= Price – Cost

D. Value added

- Activities that transform the product.
- Activities that develop its form, fit, & function.
- Activities that customer are willing to pay for product.

E. Non-Value Added

It is observed that little time is spent processing or adding value. Focus on reducing the time and activities that makeup the 95% activity, which do not add value to the end product.




Distribution of activities

Any activity that does not add market form or function or is not necessary (These activities should be eliminated, simplified, reduced or integrated.).

F. Process Mapping:-
It is charting the flow of activities in a process by using various symbols indicating storage, delay, waiting and inspection. This help understanding how the passes between function.

***G.* Value stream**

- The value in the set of all the specific actions required bringing a specific product through the three critical management task of any business.
- Problem solving (Running from to production launch)
- Information management (From order taking to delivery)
- Physical transformation (From raw materials to finished product in the hand of the customer)
- Flow – Make the value creating steps have continuously.
- Pull – Let the customer pull the product as needed)

**H. Overall Equipment Efficiency**
Most industries have some kind of gauge system on their equipment that measure qualities such as uptimes, unit produce, and sometime even the production speed. These are appropriate thing to look at if the focus is on what coming out of the machine .The TPM takes slightly different approach. Beside what is coming out of the machine, we also want to know what could have come out and where we are losing effectiveness tool comes a simple but powerful measurement tool to inside information on what actual happening.

# 10. PROBLEMS IDENTIFIED FROM CURRENT SYSTEM

The various problems identified from the existing system of working while designing new assembly line for tyre rim are as follows.

1. More handling during shifting is involved in existing process.
2. Haphazard inwarding of tyres & rims without considering arrival of vehicles, available space & requirement for assembly.
3. Distance travelled by the worker & vehicle is more from storage to assembly & from assembly to production line.
4. Inventory of Tyres & Rims is the major concerns as it is "A" class material.
5. Limited space availability for storage & mixing of tyres & rims.
6. Vehicle turnaround time is very high upto 18 hours from inwarding in plant to outward.
7. Waiting time of direct vehicles is extended upto 8 days due to nonavailability of space for unloading.
8. Paying high vehicle detentation charges due to vehicle detentation.
9. Non availability of space for unloading of Tyres & Rims which are urgent for production due to limited space for unloading.
10. Damages of Tyres & Tubes due to wrong storage & internal handling.
11. Damage of Tyres & Rims during assembly.
12. Production loss due to wrong tyre- rim assembly fitment.
13. Location specific Tyre fitment controlling is also major concern.
14. Obselence of Tyres due to end of shelf life.
15. Entire work is person oriented; no systematic approach is used for this work. So system failure risk is also a major concern.

# 11. CALCULATIONS

*TABLE 1. OBSERVED DATA*

| | |
|---|---|
| Total shift | 3 |
| Total hour per shift | 8 |
| Lunch and tea break per shift | 40min |
| Maintenance time per shift | 10min |

***A. Throughput time***

1. Process time=214 sec
2. Inspection time=22 min, 5 sec
3. Move time=19 min, 16 sec
4. Queue time=40days, 8 hrs, 3 min,48 sec

Throughput time= (process time +inspection time+ move time +queue time)
= 40 days, 8 hrs, 3 min, 48 sec

***B.Overall Equipment Efficiency***

Planned production time = (1440-120)
= 1320

Operating production time = (1320-30)
= 1290

Availability = (Operating time/ planned Production time)
=1290/1320
=0.9772

Performance = (Ideal Cycle Time * Pieces Produced) / Operating Time
= (2.5*500)/1290
= 0.9689

Quality = (Good Pieces / Pieces Produced)
= 0.95

0EE = (Availability* Performance *Quality)
= 0.899

***C.Takt time***

Takt time = (operating time/customer demand)

= 1290/500

= 2.58min/piece

***D.From Current state VSM***

***Value Added Time =84 Min.***

***Production Lead Time =40 day,54 hrs,20 min.***

## 12.CONCLUSION AND FUTURE WORK

The adoption of lean methodology can result in improved productivity, improved process ratio, reduced inventory, man hour per part efficiency reduced, reduced cost and efficient utilization of resources viz labour, floor space etc. Non-value adding activity reduction is one of the principles of lean used for over travel operation elimination.

The process flow map of current state is drawn and its value stream mapping is prepared. Using this, we are focussing on the opportunities where the improvements are possible. Our plan is to design tyre-rim assembly line based on lean methodology by using the lean tools such as layout modification, visual factory, multiskilled labour, kaizen, kanban and 5S.

## 13. REFERENCES

[1] Sugimori, Y., Kusunoki, K., Cho, F., & Uchikawa, S., 1977. Toyota production system and Kanban system: Materialization of just-in-time and respect-for-human system. International Journal of Production Research, 15(6), 553-564.

[2] Spear, S. & Bowen, H.K., 1999. Decoding the DNA of the Toyota Production system. Harvard business review, 77(9 and 10),97-106.

[3] Rachna Shah, Peter T. Ward, 2003.Defining and Developing the measures of Lean Manufacturing.

[4] Hopp, W.J. & Spearman, M.L. 2004. To pull or not to pull: what is the question? Manufacturing and service, Operations management, 6(2), 133-148.

[5] Jack Jared McClellan," The benefit of using simulation to improve the implementation of lean manufacturing case study: quick changeovers to allow level loading of the assembly line",School of Technology Brigham Young University December 2004.

[6] T. Berlec* and M. Starbek ,"Eliminating Waste In Companies",The 10th International Conference of the Slovenian Society for Non-Destructive Testing »Application of Contemporary Non-Destructive Testing in Engineering ",September 1-3, 2009, Ljubljana, Slo venia, 187-196