International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Value Stream Mapping to Improve Value Ratio of Subcontracting Process in a Pressure Vessel Manufacturing Facility (A Case Study)

Vignesh Ravichandran

Bachelor of Engineering, Department of Mechanical Engineering, PSG College of Technology, Coimbatore, Tamil Nadu, India

Abstract: ***This paper is based on a case study in a pressure vessel manufacturing facility. The facility manufactures air receivers and air-oil separators. The facility subcontracts rolling of shells and forming of dishes. The plant suffers from poor value added ratio. This issue has been addressed with the help of value stream mapping. Current and future state maps have been drawn to improve the value ratio substantially. After implementing the proposed solutions, the value ratio has improved by 100% for shells and 67% for dishes.***

Keywords: inventory; inventory turnover; value stream mapping; inventory replenishment, sub contracting

1. Introduction

The pressure vessel manufacturing facility is a unit of a leading air compressor manufacturer in India. The only customer of this division is their head office. The fabricated receivers and separators are sent to their head office based on the demand. The facility buys cut and blanked sheets from a sister concern of the company. The sheets to be rolled are edge bevelled before being sent to the subcontractor. The blanks that are to be formed into dish ends do not require any pre-processing. The sheets are formed into dishes and rolled into shells by the subcontractor. The formed dishes and shells are then withdrawn from the subcontractor andstored at the facility for fabricating them into air receivers and air-oil separators. The inventory process flow is depicted in a flow chart in the figure 1.

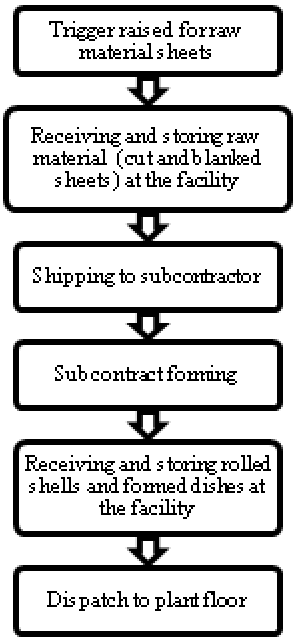

Figure 1: Inventory process flow

2. Literature Review

According to Mike (1998), "A value stream is all actions (both value added and non-value added) currently required to bring a product through the main flows essential to every product:
1) The production flow from raw material into the arms of customer, and
2) The design flow from concept to launch" [1].

Lead-time reduction is a key method in improving cash flow in the company. It clearly has this business advantage in addition to its advantages in the manufacturing system [2]. The VSM methodology has been discussed in [3]. The paper also discusses the importance of reducing lead times. Lead time can be defined as total time required to manufacture an item, including order preparation time, queue time, setup time, run time, move time, inspection time, and put away time. It is the time interval between the initiation and the completion of a production process. The value stream mapping process will likely reveal that a significant amount of non-value-added activities are present in your current processes. These activities consume financial and human resources and make longer lead-time without adding value [4]. The value ratio is given by [5]

$$Value\ ratio = \frac{Value\ added\ time}{Total\ lead\ time} \quad (1)$$

It is evident from equation (1) that, in order to improve the value ratio, either the value added time has to be increased or the total lead time needs to be decreased. In this work, we have improved the value ratio by decreasing the total lead time.

3. Current State Value Stream Map as on Nov 2014

The current state map has been drawn for the subcontract shells and dishes. Figure 2 shows the current state map for the shells and figure 3 shows the current state map for the dish ends.

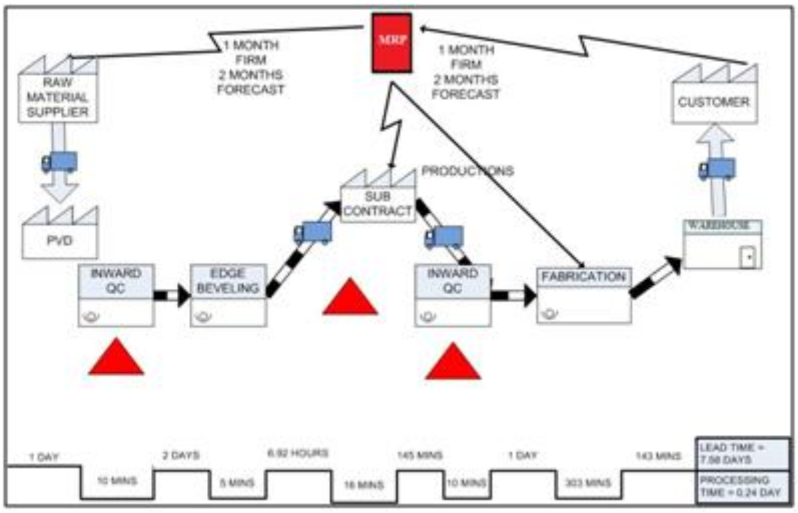

Figure 2: Current state value stream map for shells

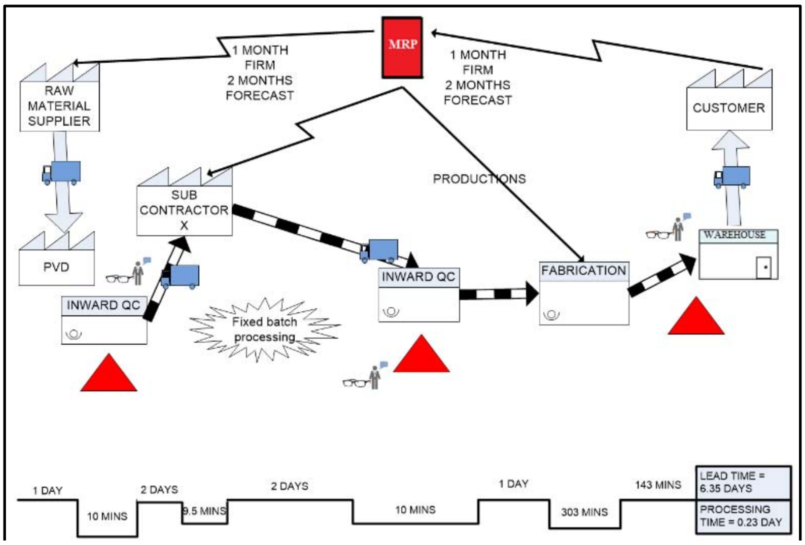

Figure 3: Current state value stream map for dish ends

The current state value stream map was drawn and the value ratio was determined as 3% for shells and 2% for dishes. The VSM is explained as follows.

- As indicated in the VSM, the current production process is push type production.
- The VSM shows that the materials department receives two months forecast and one-month firm plan from its customer and releases the same to its raw material supplier. The raw material supplier supplies the necessary blanked sheets with a lead-time of one day.
- The received sheets after passing the quality control tests are stacked in the raw material storage area. They wait fortwo days before any further processing is done.
- The raw materials are then pushed to the subcontractor's facility where the sheetsare formed into dishes or rolled into shells. The processing time varies because of the variations in the capacities of the subcontractor facilities.
- As the runner model inventory tends to be dumped at the subcontractor's facility, it takes utmost ten days to withdraw the formed dishes. The shells have a better withdrawal time. The formed dishes sometimes wait at the facility before being bought into the facility as the withdrawal is in arbitrary batches.
- The received dishes and shells after passing the quality tests are stored in the storage area. These materials wait for a day before being pushed into the plant floor for further fabrication.
- After the fabrication process is over, the air receivers and air-oil separators are dispatched to the customer.

A. Current State Value Stream Map Analysis

The map reveals that the materials wait unnecessarily without being processed before and after subcontracting. One of the main reasons for unnecessary waiting is the absence of a proper inventory model. The materials department stocks inventory based on experience and pushes the inventory to the subcontractor and further down the line, instead of the inventory being pulled. This is one of the main reasons for the very low process ratio or inventory turnover. Due to withdrawal in arbitrary batch quantities, the subcontractors need to be ready with the processed inventory, which leads to over processing, which is a waste. The subcontractors also indulge in overproduction as it will be economical for the subcontractor to process the inventory in a single setting of the die. The map also reveals that items wait for almost two days after arriving at the facility before being processed. The items are being processed at the subcontractor's end without being consumed at the facility. This is overproduction, which is also a kind of waste. The capital also remains locked up in this inventory. Although this may be transported to the facility, these processed items are stored in the racks, without being used. The items are waiting to be processed, which is also a waste. Hence implementing a proper model of inventory with Kanban system for visual controlmechanism is suggested for improving the current state of operations at the facility.

4. Future State Value Stream Map

The future state map has been drawn for the subcontract shells and dishes. Figure 4 shows the future state map for the shells and figure 5 shows the future state map for the dish ends.

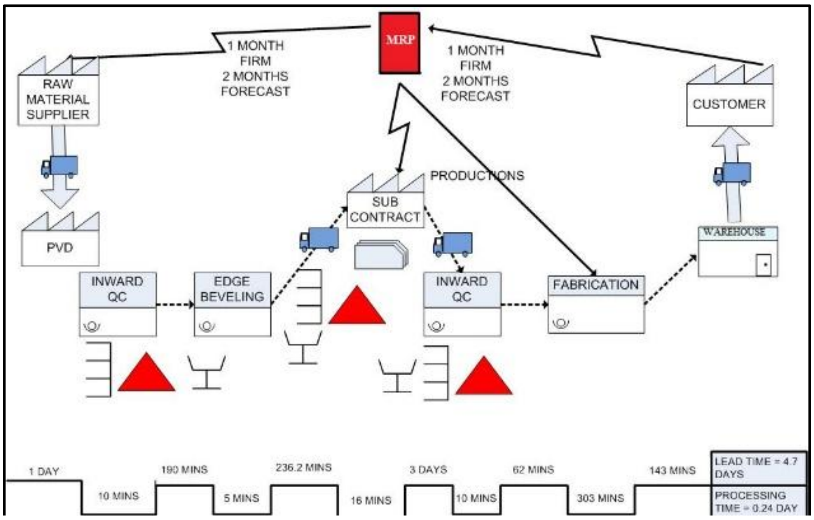

Figure 4: Future state value stream map for shells

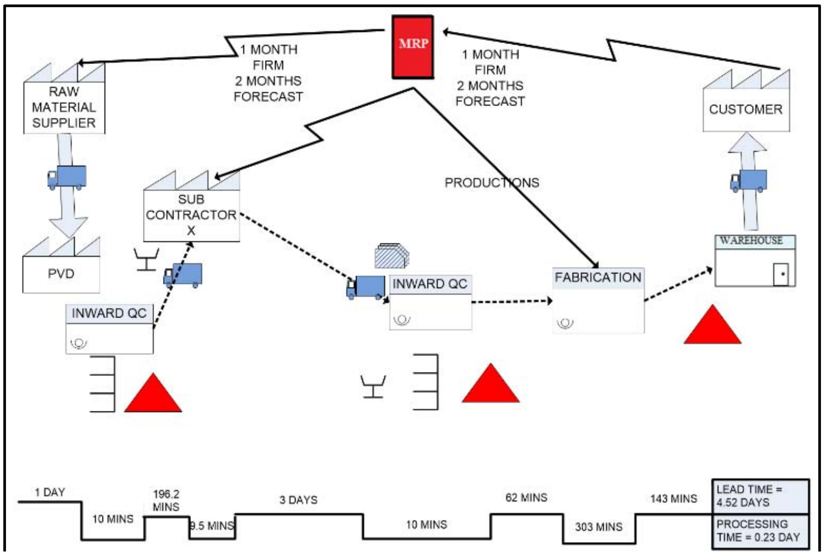

Figure 5: Future state value stream map for dish ends

The future state value stream map has been drawn and the value ratio is determined as 5% for shells and 6% for dishes, which is 67% increased ratio for shells and 100% increased ratio for dish ends. The VSM is explained as follows.

- As indicated in the VSM, Kanban system implementation leads to pull type production, where the inventory is pulled from the end. This eliminates overprocessing, unnecessary waiting, and increased inventory turnover ratio.
- Processing and handling of inventory in fixed batch quantities help in keeping a track of the inventory at the subcontractor's end. This also helps in the orderly movement of inventory.
- Further, supermarket icon indicates that inventory is replenished only if the level of that particular model of shell or dish falls below a certain level.
- Kanban posts are the places where Kanban boards need to be erected which help in tracking the inventory. Implementation of pull production process also limits the inventory level and avoids over processing and locking of capital in inventory.

Kanban system has been implemented at the facility on 10 FEB 2105. Hence the future state VSM mentioned above will become the current state for further analysis, which is beyond the scope of this project.

5. Kanban Implementation

Kanban boards have been designed and erected at the facility. Another set of Kanban boards have been given to the subcontractors to be placed at their facility. Figure 3 shows the Kanban board erected at the plant floor.

Figure 6: Kanban boards erected at the facility

6. Results

The main focus of this study was the supply chain part of the subcontracting process. The objective was to improve the value ratio by 50%. The value stream for the fabrication inside the plant floor was not included in the scope of this case study. It can be seen from figure 7 that the value ratio has improved by 67% for the dish ends and 100% for the shells. This has been achieved by reduction in the total lead time.

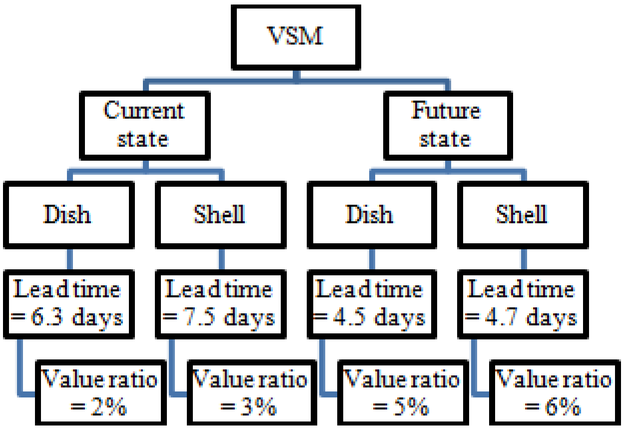

Figure 7: Summary of the results

7. Conclusion

The major outcome of this case study is the significant reduction in the total lead time of the subcontract inventory. This was mainly due to the implementation of pull production by the implementation of the Kanban system. The material flow and information flow has become easier than before at the facility. Reduction in the total lead time has enabled the facility to turn the inventory faster than before. Unnecessary waiting time has been reduced. Overproduction has been eliminated which prevents the capital from being locked up in the inventory.

References

[1] Mike Rother, John Shook, Learning to See: Value Stream Mapping to Add Value and Eliminate Muda, Shingo Prize (1998) 3-5

[2] Wilson, L. "How to Implement Lean Manufacturing". New York: McGraw-Hill Professional Publishing; 2009.

[3] Palak P. Sheth, Vivek A. Deshpande, Hiren R. Kardani, 2014, "Value Stream Mapping: A Case Study of Automotive Industry,"International Journal of Research in Engineering and Technology, vol 3, issue 1, pp.310-314.

[4] Muhammad AbdusSamad, MD. SaifulAlam, and NishatTusnim, 2013, "Value Stream Mapping To Reduce Manufacturing Lead Time In A Semi-Automated Factory," Asian Transactions on Engineering, vol 2, issue 6, pp. 22-28.

[5] Warren, Reeve, Duchac, "Financial and Managerial Accounting," SOUTH – WESTERN Cengage Learning, 12th edition.