

DESIGN OF LEAN PRODUCTION SYSTEM USING INTEGRATED VALUE STREAM MAPPING APPROACH

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ABSTRACT

This research integrates value-stream mapping method with cost by the use of cost line that enables in simplifying the decision-making process. Calculation of takt time serves as a comparison for the speed of production and target cost serves as a comparison to production's cost. The result shows that the implementation of cost integrated VSM can bring as following improvements: Decrease of production lead time, total Cycle time, total value added cost, total non value added cost, and distance transport as follow 59.8%, 19.75%, 2.6%, 53.4%, and 19.34%. It concludes that cost integrated VSM concept has significant impacts in the automotive industry.

Key words: Lean manufacturing, Value stream mapping, Activity based costing, Target costing.

1. INTRODUCTION

The growth of car production in Indonesia has increased on average every year by 10% during last five years. This course will lead to competition among manufacturers of motor vehicles and will also affecting both of suppliers to the industry's first tier suppliers (first tier) and the second level (second tier).

The success of manufacturing industry in the face of competition directly related to the winning company in the market competition. The factors depend of market competition as effective and efficient cost. Many manufacturing companies make changes in their system, both of physical and non physical, including work culture by adopting lean concepts. Lean manufacturing or lean production is a management philosophy of Toyota Production System (TPS), known in 1990 with name as "lean". "Lean" is defined as a process to eliminate waste of book "The Machine That Change the World" (Womack et al, 1990).

2. THEORETICAL BACKGROUND

One of the main tools in lean concepts that can be found in the literature and has been used effectively in evaluating activities that

do not add value to the VSM. This is a tool that can assist in visualizing a system by representing the flow of information and material. VSM also provides a common language in explaining a process, so decisions can be made to eliminate or reduce activities that do not add value (Kannan et al, 2010). VSM can be a good start for companies that want to implement lean systems because it can show good activities that add value or not add value to a product that uses the same resources in a similar process of starting raw materials to consumer (Abuthakeer et al, 2010).

The researchers define the VSM as a visual mapping process from the flow of information and material. It can helpful in seeing cycle time, inventory at each workstation, manpower, and information flow throughout the supply chain (Womack and Jones, 1996). Value stream mapping provide blueprint to implement lean manufacturing concept with illustration how the information and material flow should operation.

Some illustrative examples to explain the following Ramesh, et al (2008) has make the value stream mapping in producer companies of machining center, with target to draw current state map for main component as Base, Column, Milling head

and table-machine. Current state map identify some process that can be done by subcontractor and improvement suggestions which should be decided by top management in reducing the activity that do not add value, and discuss plans for improvements to the proposed state map.

Woehrle, S.L. & Louay, A.S. (2010) explain simulation of value stream mapping use lean accounting box score that capable of bridging the operational and financial perspective at an understanding with the aim to support management in making decisions with full certainty. Summer (1998) explains that Activity Based Costing (ABC) can identify cost activity and analyse relative contribution at total cost. Basics concepts from ABC are, products consume activities, activities consume resource, and resource led to the incurrance of costs. Therefore, need to build relationships between activities, cost driver and activity measurement. Target cost is needed to anticipate the market price of which can still be acceptable to consumers that products can still survive in the competition. Both of design team and production part together to keep cost of production process in accordance with target cost. Target cost of itself is a cost incurred while still getting the desired benefits.

All **tables**, **charts**, and **graphs** should be given on separate sheets with titles. Wherever necessary, the source should be indicated at the bottom. Number and complexity of such exhibits should be as low as possible. All figures should be indicated in million and billion. Decimal separated by dot (.). All graphs should be black and not in color. **Endnotes**, **italics**, and **quotationmarks** should be kept to the minimum.

3. RESEARCH METHOD

Implementation steps of cost integrated VSM described at Figure 1.

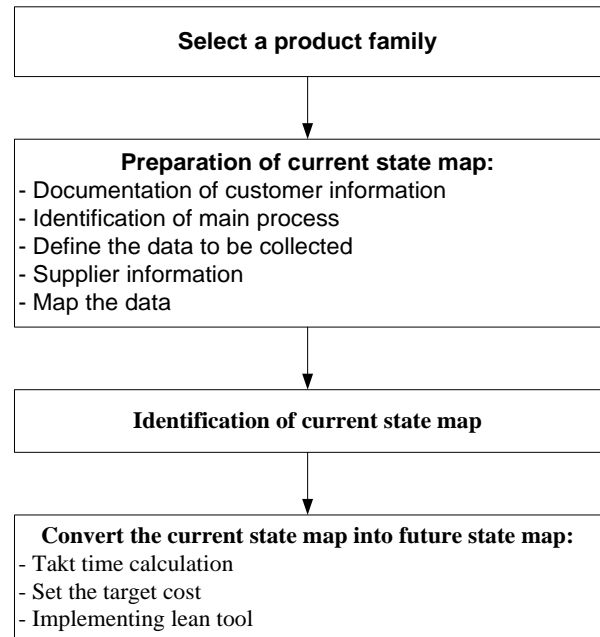


Figure 1. Implementation steps of Cost Integrated VSM

In this research, case study performed in PT. X Stamping Industries (PT. XSI) which is a first tier components supplier for automotive industry in Indonesia. The research was conducted through the seven stages of the following.

3.1. Select a product family

Select a product family is first step of make value stream mapping. Select a product family conducted with analysis technique of production amount and analysis of the production process route. The product is taken as the object of research is product with stamping A. The reason is because product selection is a product of the G-Part of the procurement of raw material products made by PT. XSI , unlike other products that the procurement of raw materials supplied by customers. In addition, when compared with other product family of products has the most lengthy and complex.

3.2. Documentation of Customer Information

To find out the customer information we can ask the management company such as data of product demand per month, data of transmission cycle, and data of transmission amount in each cycle.

3.3. Identification of the Main Process

A direct observation on the production process in the field (gemba) is the best way to identify the main process. As for which is included in the main process in this research are: drawing process, trimming, piercing, repairing, spot nut, bracket assembly, final inspection, and shipping.

3.4. Collect the data needed

Data on data box provide information to see the opportunity to do repairs. The collection of data can reasonably be done to accelerate improvement. Data box of VSM include data such as cycle time, up time, machine hour rate, labor hour rate, material cost, and available time. Inventory triangle includes two data such as data of inventory amount between each process and holding cost inventory. Cost line and time line calculated using the formula on process analysis and cost analysis.

3.5. Future State Map

The main purpose made future state map is to equate speed of production with takt time and achieve the target cost as cost of manufacturing. Takt time is used as a comparison of processing speeds and target cost is determined as a comparison to the cost of manufacturing.

3.6. Takt time: a Benchmark for process pace

Takt time determines how long a time target process is done. Takt time reflects the pace of sales in one day. If the production speed is faster than the time of the sale of the product and will be going to inventory buildup, while if the production longer than the time of the sale then the waiting time be longer. Takt time is calculated by dividing the amount of time working with a number of orders per day.

Available production time = working time – rest
= 29.400 second

Demand = 3.920 part / month

Demand per day = 187 part

Takt time = 157,21 second

Takt time of 157, 21 seconds indicates that, each process must be completed within a maximum of 157, 21 seconds.

3.7. Target cost: a Benchmark for product cost

After an analysis of current state map then the next step is to determine the target costs. Target cost necessary to anticipate the market prices are still acceptable to consumers that the products can remain in the competition. Target cost itself a cost while still benefit you want, in other words the target cost of market cost minus the target profit of the company, the size of the target profit is determined by the management.

After discussion with the company's management had determined the target costs of Rp 85,500 with decrease of Rp 25,050. A decrease in the value added cost/production cost of Rp. 66,900 to Rp. 65,150 and non value added decreased in cost from Rp. 43,650 to Rp. 20,350

4. RESULT AND DISCUSSION

The results of the lean production design visible measures improvements and changes to the performance indicators that occur from the current map being proposed the following folder. Delivery of raw materials from suppliers and conducted in a positive impact on the daily dwindling supplies of raw materials in storage of raw materials from 1160 pieces into 300 pieces, resulting in a decrease in inventory cost amounting to Rp 11,200.

Application of continuous flow in line with the moving process of stamping drawing of machine 800T hydraulic on line A3 to machine 800T mechanical on line B1 dan modification of dies drawings resulted in reduced cycle time on line 36.77 seconds of total stamping 52.25 seconds become 15.48 seconds. The process of material handling from workstations to 800T 400T is eliminated. Transportation distance decreases along 54.5 m, a decrease in inventory cost is Rp 8,050 and process cost Rp 700.

Process improvement with trimming and piercing remedy dies on impact, resulting in a loss in the process of Repairing cycle time reduced by as much as 40.5 seconds, and

the process cost reduced to Rp 600. Merging spot welding Work on a workstation by workstation sub assembly resulted in a reduction in the welding operator of two people being just one person, the process of handling material from spot welding to sub assembly can be removed, leading to a reduction in process cost Rp 450. The use of Supermarkets in the area of stamping and welding that serves as a safety stock resulted in a decrease in inventory cost is Rp 3,848.

The bar graph in Figure 2-6 shows the improvements that can be achieved in the implementation of lean tools. Proposed Cost Integrated Value Stream Mapping can be seen at Figure 7.

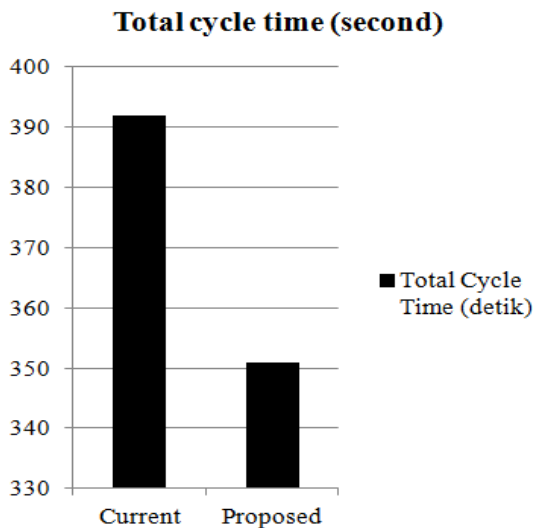


Figure 2. Cycle Time Comparison

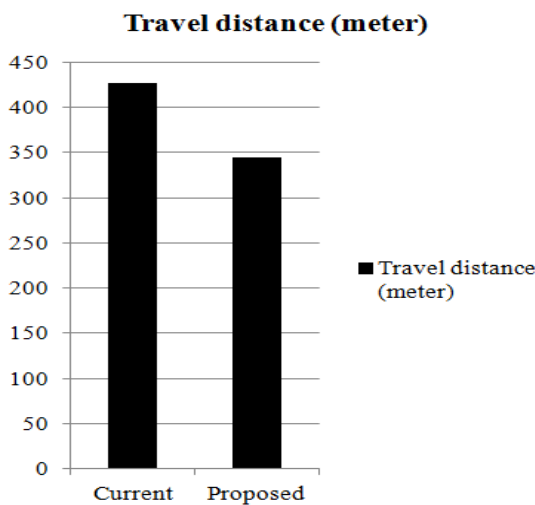


Figure 3. Lead Time Comparison

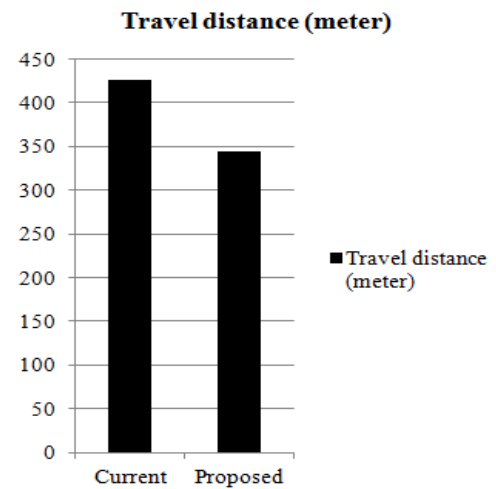


Figure 4. Travel Distance Comparison

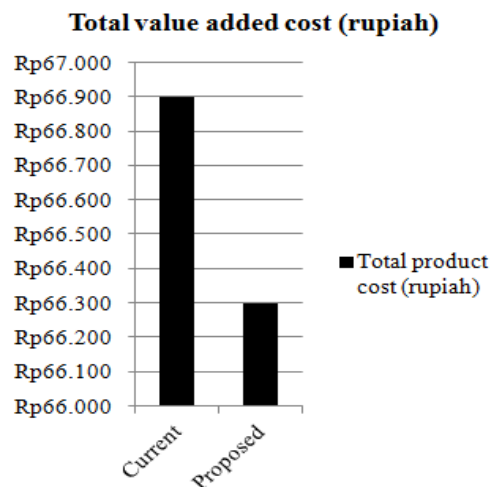


Figure 5. Value Added Cost Comparison

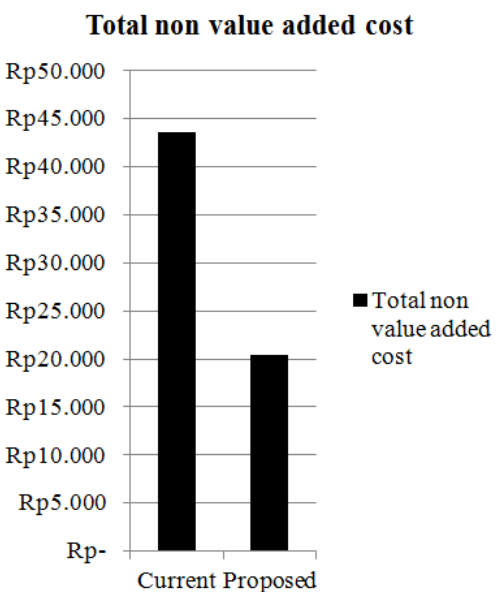


Figure 6. Non Value Added Cost Comparison

5. CONCLUSION

The stages of the design of production processes with lean manufacturing approach outline consists of the design of current cost integrated state map based on the actual conditions, as well as designing the proposed cost integrated state map on the basis of proposals of improvement with reference to the target cost. Case study on the manufacture of products of A PT. XSI produced some conclusions as follows:

1. The production lead time decrease of 11.7 days be 4.7 days or as many as 7 days (59.8%).
2. The total cycle time reduction of 392 seconds to 314.58 seconds or as much as 77.42 seconds (19.75%).
3. The total value added decreased cost/production cost of Rp 66,900 to Rp 65,150 or as much as Rp 1,750 (2.6%)
4. The total non value added decrease cost of Rp. 43,650 until Rp. 20,350 or be as much as Rp 23,300 (53.4%).
5. The travelled distance decline from 426.5 meters to 344 meters or along 82.5 meters (19.34 %).

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PROPOSED VALUE STREAM MAP PRODUK A

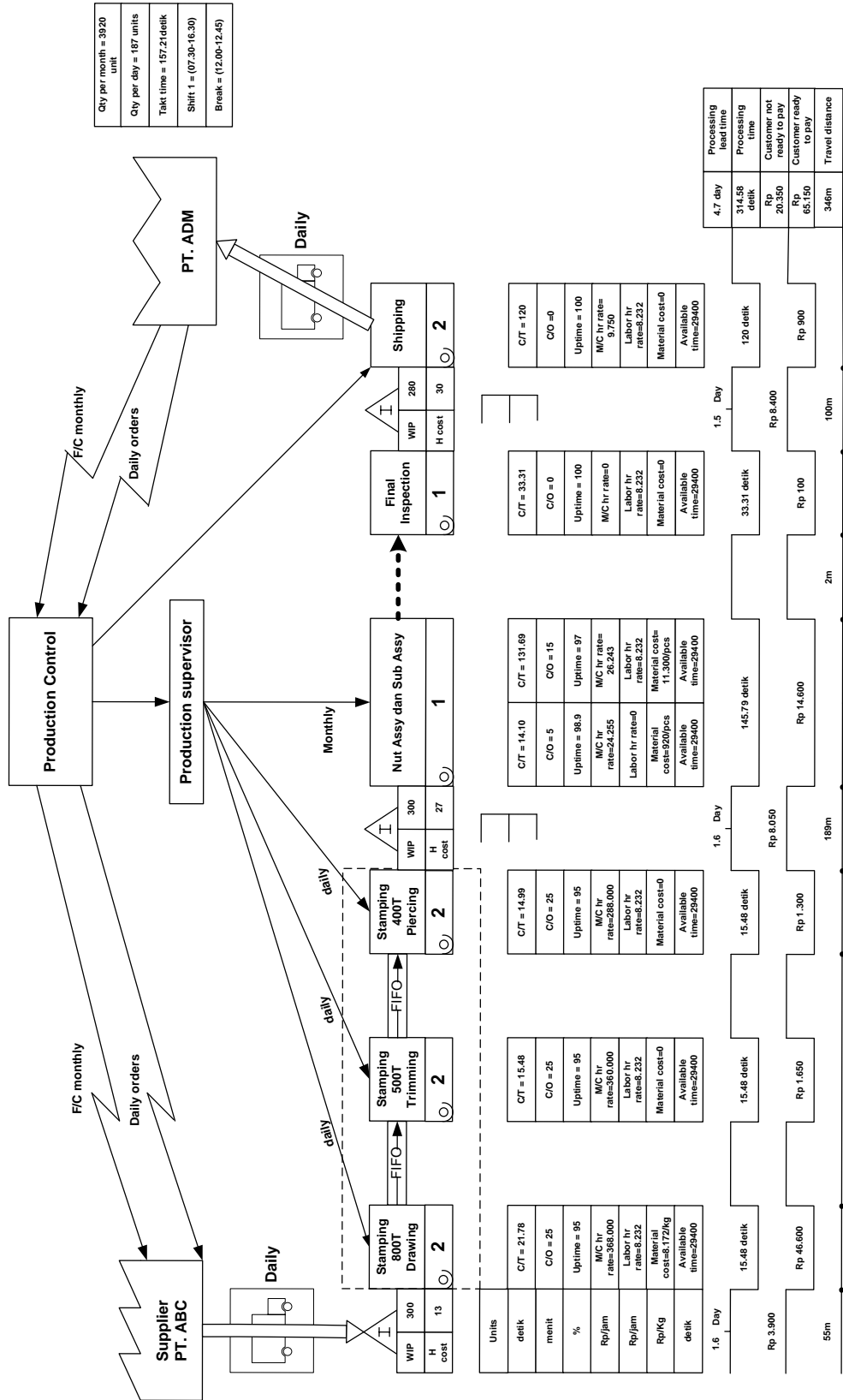


Figure 7. Proposed Cost Integrated VSM