EPiC Series in Computing

Volume 81, 2022, Pages 190–200

Proceedings of 11th International Congress
on Advanced Applied Informatics

Reducing Product Cost for ABC Company Through Lean Production Initiative

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Abstract

Abstract – **This paper describes how ABC company has successfully increased its Process Cycle Efficiency (PCE) to win market competition through Lean Production initiative. By adopting Value Stream Mapping, an in-depth study towards its production process of product A is carefully conducted. This results in careful waste identification and elimination. After the implementation, the company can achieve an improved process cycle efficiency from 15,60% to 29,60% with product cost reduction about 56%. This gives insight for any manufacturing systems that the adoption of lean production especially value stream mapping may help to reduce product cost instead of Product Cycle Efficiency.**

Keywords – **Value Stream Mapping, Product Cycle Efficiency, Cost Reduction, Lean Production Initiative**

1 Introduction

To gain competitive advantage, especially in automotive industry, there is almost no choice for any manufacturer to reduce its manufacturing cost. Therefore, any cost leadership strategy is taken to ensure that its cost is the cheapest against its competitors. This condition is also happened with ABC company with product A, a component of a motorcycle.

ABC company is chosen based on several considerations. First, ABC company is in Indonesia especially in Jakarta. This city has been the biggest Gross Domestic Product (GDP) producer in Indonesia. Second, among various sectors, manufacturing has covered biggest portion or 12,84% of 1,454.564 trillion rupiahs while manufacture of transport equipment is the biggest subsector with coverage of 56.45% of 105.452 trillion rupiahs (Logaritma, 2020). These two reasons have been the main reason why ABC company is selected in hope that if this company can be improved that in long run it will help Indonesian economy. Beside these reasons, the willingness of the management of this company has also been successful factor for enabling this research to be undertaken.

After granted the permission to do the research. Analysis has been conducted by reviewing pricing policy of component A of motorcycle produced by company ABC. This component is chosen because it is critical to the product.

Pricing of this component is considered higher than its competitor making it difficult to penetrate its market. Therefore, its management decided to initiate an improvement project to cut its production

cost, to further reduce its selling price to the customer. After careful study on its cost structure, product A's unit cost was at 138% price index compared the same product from its competitor which is at 100% price index. This has made company ABC's product becomes uncompetitive compared to its competitor with 100% price index.

For carrying this initiative out, the company has formed an improvement team to thoroughly investigate the cost structure. It turned out that from direct material and conversion cost, the company has suffered conversion cost a lot, specifically process cost. Thus, the team went further to investigate the company's manufacturing system. It turned out that the company still uses traditional mass assembly line in its system.

The line has relied on standardization and mass production to improve production efficiency. However, the line also has caused lots of raw materials around its line and pushed lots of work in process (WIP) goods regardless the needs of its next process. This is contradictory with the objective of this kind of system.

As science management has been evolving, this traditional manufacturing system has been replaced by Lean Production initiated by Toyota which is also known as world changing machine and third milestone after mass production (Feng, 2011). By using this type of manufacturing system, company would be able to cut the production cycle short and reduce waste, in turn, reduce cost and improve the production efficiency. One of its tools is Value Stream Mapping which contains data flow chart. By this tool, company can investigate more on its waste and the existence of invalid labor that may happen in its manufacturing system.

As one of Lean Production Initiative's tools, this tool has been popularly used for pursuing reduced lead time but not for reducing cost. However, there is a lack of practices in this field to show how Value Stream Mapping may be used to reduce cost. Implementing this tool for reducing cost in mind is impossible especially as described in reference (Mintz, 2003) and (Womack & Daniel, 1996). In these references, it stated that for a holistic view, this tool is can be used to improve quality, eliminate waste, reduce lead time, improve Process Cycle Efficiency (PCE), and reduce total cost of the process (Hossain & Uddin, 2015).

Therefore, there are two objectives in this paper. First, it is to demonstrate how ABC company could increase its PCE while reducing its cost which is cutting 38% as its target to have the same cost with its competitor by modernizing its manufacturing system using Lean Production with Value Stream Mapping as its tool. Every manufacturer needs to increase this PCE measure because by increasing this PCE, it means fewer non-value-added activities which will not only decrease lead time but also reduce cost. Second, it is to provide another perspective of using this tool to enrich the knowledge of the use of Value Stream Mapping.

2 Lean Production

Some experts from International Motor Vehicle Program have introduced Just-In-Time program by Toyota as Lean Production initiative (Han et. al., 2013). This initiative ensures that any company only produce demanded product without excess production factors at the right time, right quantity, and right quality, therefore, it may benefit economically from it. These excessive production factors may include invalid labor and any waste relating to defecting or fixing, over processing, motion, transport, inventory, over production, and waiting (Ying, 2009).

To achieve that goal, a value stream mapping tool is applied. This tool elaborates more on the flow of logistics and information of company's overall manufacturing system (Roos et. al., 2004). By this tool, a drawing of overall flow of logistics and information can be made by using unit measure, activity graph, logistics and information flow for tracing the path of production from sellers to buyers (Hua & Xia, 2009).

As drawn in the figure 1. This method is done by drawing value stream mapping. By doing this the company can have better and holistic view on what happens in its company regarding to producing a certain product (Rohani & Zahraee, 2015).

The use this tool firstly by many researchers is to seek for opportunities to shorten the lead time between supplier to customer for a certain product delivered to customer. However, beside this goal, there are also have other impacts and benefit for company that implements this tool. One of this benefit is related to cost reduction as focus on this research.

Regarding to cost reduction, there are many other methods that can be deployed. One of these tools is about target costing. This tool involves collaboration between accountants and marketer of the company to set price that is acceptable for its customer to buy then from this price setting then the company tries to set up reasonable budget to ensure the target cost is reached.

Another tool that can also be deployed is activity-based costing (ABC). This tool requires company to thoroughly investigate activities used to produce the product.

However, what makes these tools do not used in this research is due to strategic reason that this company has faced. As many researchers and practitioners understands that since company ABC is part of motorcycle industry as manufacturer than price is important especially for price-sensitive buyers.

Therefore, this condition especially has pushed any companies like company ABC to search any effort to make sure good pricing to give much benefit for its customer in form of competitive price. By this reason lean production initiative is chosen instead of previous two methods in field of accounting body of knowledge.

As many theorists may know those two methods will investigate internally instead of externally. This condition may mislead and hinder the company to reach its goal because improvement and innovation can be generated both internally and externally (Andreadis et. al., 2017).

Then the capability of value stream mapping is chosen because it is not used only for internal investigation but also external investigation. By combining these two poles, new and fresh idea and breakthrough can be generated. of course, this effort is done by basing the belief in theory that has been tested that shorter lead time will lead to reduced cost (Wasim et. al., 2013).

Every cent from cost reduction in manufacturing sector is important since they face highly fierce competition. Therefore, this value stream mapping is conducted not only to solve the problem but also contributes the development of theory to prove that this tool is not only good for reducing lead time but also cost of the product.

To conduct this tool, then a research framework and methodology are developed to guide the team to conduct the improvement for the benefit of the company even in costing perspective (Kumar et. al, 2018).

As shown in figure 1, a value stream mapping template is created and used by the team during their observation in the production process not only internally but also externally from site of supplier as starting point to customer as ending point. Belokar, 2012 also shows how this tool is used in the field of automotive manufacturing fields. While Jonny & Nasution, 2013 shows the use in healthcare industry. These references are studied to show how this tool has been widely accepted (Abdulmalek & Rajgopal, 2017).

Among the relationship of supplier and customer, there are so many activities that have been created to produce a product using raw materials from supplier to finish goods to end customer. This is done in order critically evaluate the nature of work during this relationship.

After having analyzed the relationship then process cycle efficiency (PCE) is conducted to evaluate the overall rate and compared to world class' PCE as bar of benchmark. If there is a gap that analysis can be conducted by separating value-added activities among non-added activities

The focus in dealing to this separation is to investigate longest non-value added. By conducting improvement tool such as fishbone diagram then the root cause of this gap is conducted. This tool is done by asking 5 why by making statements of "caused by" and then verified by making reversed

statements of "effecting that". Conducting this tool is to find the root cause of the gap. By doing so, it can prevent the same occurrence in the future.

Based on this root cause, then an improvement solution can be developed and implemented. This is done by applying ECRS acronym naming eliminate, combine, reverse and simply. Of course, this effort should also be proposed and secure management approval so the improvement can be implemented in the production field.

After conducting the improvement, then future value stream mapping can be drawn to show the impact of improvement initiative that has been conducted. This is done by calculating PCE (Process Cycle Efficiency).

3 Methodology

To achieve ABC company's object for reducing cost while improving Process Cycle Efficiency, its improvement team has deployed Value Stream Mapping as the research framework in this research as shown in the following figure.

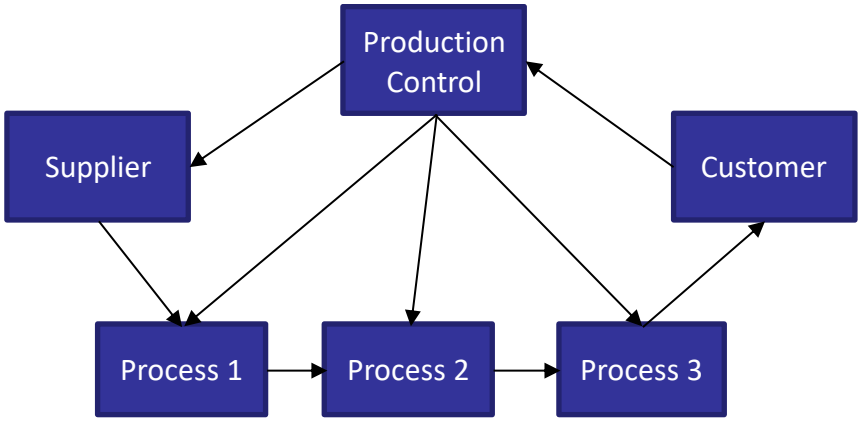

Figure 1: Research Framework

The above research framework is used for drawing value stream in both current and future state to further analyze whether there is any non-value-added activity that can be improve and help the company to benefit from this improvement.

As drawn in the figure, by using this research framework, a holistic and careful analysis should be taken place to track how material and information flow from supplier to production and to customer. By doing so, it absolutely encourages company to do end-to-end analysis instead of sectoral one so that the company can better understand the nature of work taken placed when producing the component especially component A as the object of this research.

To secure the success of this effort, a careful thought research methodology is developed and use in this research as shown in the following figure. The explanation of how to conduct this tool is describe in the following research methodology in form of flowchart. This action is taken to ensure the clarity and makes sure it is clearly understood and practical for the team to follow.

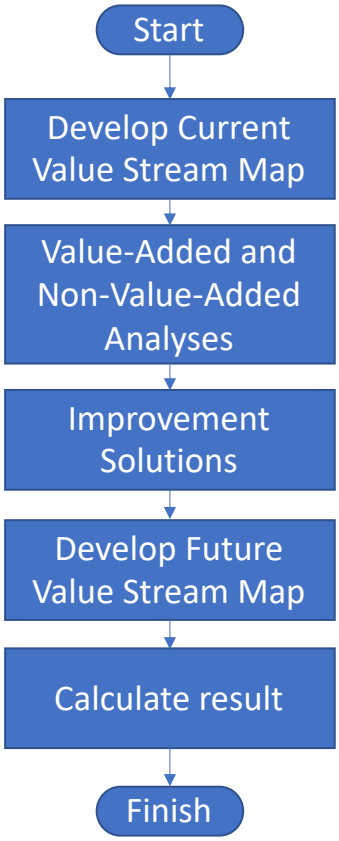

Figure 2: Research Methodology

From the above figure, this research can be done by several steps as follows:

1) Current mapping of Value Stream for product A. This step is taken to map the situation of current manufacturing system from input, process, and output of the system.

A design survey tool is used by using the value stream mapping template as shown in figure 1. Team conduct a thorough observation to the flow of the product from supplier to customer.

This is especially needed to investigate what value-added and non-value-added activities in the system. After having the map, the team can calculate its Process Cycle Efficiency (PCE) and compared to the world class' process cycle efficiency to recognize whether there is a gap or not. This gap may be caused either by invalid labor or waste which is non-value-added activity. Therefore, a tool of Fishbone diagram accompanied by 5 Whys would be needed to investigate root causes of the waste and possibility to reduce value-added activities. From there, some improvements initiatives may be conducted.

2) Improvement of the manufacturing system

As mentioned in the previous step, improvement initiatives may be needed to counter-measure the root causes found in the previous step.

3) Future mapping of Value Stream for product A

After the implementation of improvement initiatives, then the future map of Value Stream for product A is drawn and Process Cycle Efficiency (PCE) is also re-calculated to demonstrate the result. Once it is satisfied, then the company should standardize it as the modern manufacturing system replacing the traditional one.

By conducting the above methodology, this research can hope good findings and insights to be used to contribute improvement and innovation for the company.

4 Results

4.1 Current Mapping of Value Stream for product A

In this step, the situation of ABC Company's manufacturing system is carefully investigated by the improvement team. The product A manufactured by this company is made by order especially by its main customer to be assembled with numerous parts as a motorcycle unit to be sold to end customer as product.

Due to make order, ABC needs to ensure its delivery time which is still missed and therefore, it got low score by its customer's supplier evaluation. The things might get worse because its unit product costs at 138% price index, a far from its competitor at 100% price index. Therefore, the team is instructed to investigate and improve the manufacturing system to increase the competitive advantage of the company. If the team failed, then it may jeopardize the future of the company.

Having good understanding about the background of the company, the team began to investigate the manufacturing system of product A. It can be seen in the following map.

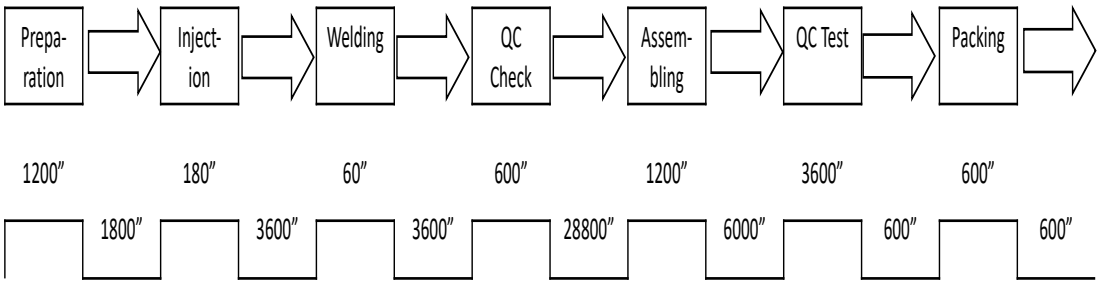

Figure 3: Current Mapping Value Stream Mapping for product A

From the above figure, there are several processes done by the company to produce component A of motorcycle. Those activities involve 1) preparation, 2) injection, 3) welding, 4) QC check, 5) assembling, 6) QC test and 7) packing. As many know although QC is not adding value to the product but because of its role, then this activity cannot be eliminated.

Also from the above figure, the manufacturing system used to manufacture product A consists of 7 production processes with transportation including idle as shown as arrow happened during the production of product A. These processes include preparation, injection, welding, QC Check, Assembling, QC Test and Packaging. From the figure, there are two types of activities found in the manufacturing system. First are value-added (A) activities with processing time under process diagrams and second are non-value-added (B) activities which are transportation and idle time under transportation diagram. Using this figure, Process Cycle Efficiency (PCE) can be calculated by formula (1) as shown in the table 1 below.

$$PCE = (A / (A+B))*100\%. \quad (1)$$

By using formula (1), as shown in table I, process cycle efficiency of current map is at 15,6% with value-added time at 7,020 seconds and non-value-added time at 37,980 seconds totaling 45,000 seconds below world class PCE at 35%. Therefore, it can be a signal for area of improvement for the team. World class PCE has been served as a good benchmark for many practitioners because it can signal for researchers whether the process needs to be improved or not as in this research paper. The goal is actually to exceed the world class PCE but as many know improving it is also sufficient to deliver impacts for the company that implements this initiative.

Activities Type Size	Time
Value-added	7,020’
Non-value added	37,980’
Total	45,000’
PCE	15,6%

Table 1: Current PCE

After having known the current map of the manufacturing system, the team came to know that the idle time between QC Check to Assembling was the biggest non-valued-added activity happened totaling 28,800 seconds or 8 hours or 1 working day or 69% of process time. Therefore, team decided to investigate the problem as shown in figure below.

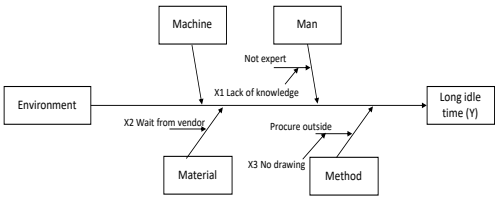

Figure 4: Root cause long idle time from QC Check to Assembling for product A

From the above figure, long idle time (Y) from QC Check to Assembling for product A was caused by lack of knowledge from the staffs (X1), waiting other component to be sent to assembling (X2) and no drawing (X3) causing the company procuring the component from other vendor. Furthermore, the team has discussed the counter-measure solutions needed for solving this problem with its cost-benefit analysis as follows:

Alternative	Impact on PCE
Alternative vendor (S1)	18.5% with cost down 7,46%
Make in-plant (S2)	29,6% with cost down 11,3%
Selected Solution	S2 Make in plant

Table 2: Cost Benefit Analysis

After long process of negotiation with its principal, as shown in table II, ABC Company has decided to make the component in-plant in order to reduce dependency of other vendors. By doing

this, the company can eliminate waiting time from other vendor (X1) and up-skilling its staffs to make the component in-plant.

4.2 Future Mapping of Value Stream for Product A

Having the problem solved by the team and management, then ABC company decided to standardize the new process as future map of value stream for product A as shown in the following figure.

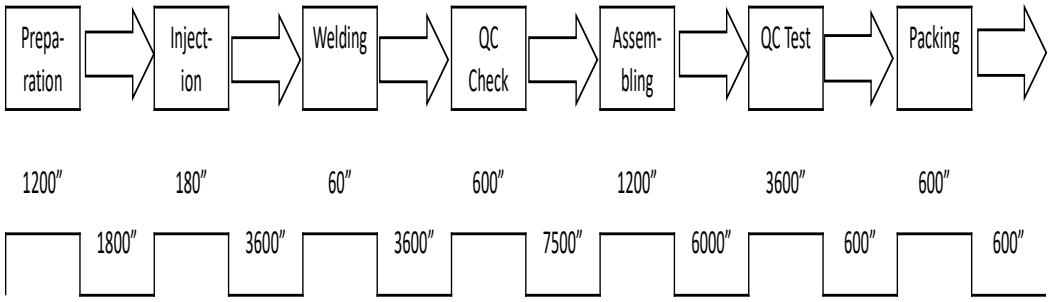

Figure 5: Future Mapping Value Stream Mapping for product A

As shown in figure 2, after solution has been implemented, the idle time has reduced from 28,800 to 7,500 by independency of ABC company in producing itself the other component needed for product A. By doing this, process cycle efficiency can be increased to 29,6% as shown in the following table and calculation.

Activities Type Size	Time
Value-added	7,020’
Non-value added	16,680’
Total	23,700’
PCE	29,60%

Table 3: Cost Benefit Analysis

From table 3, after solution implemented, process cycle efficiency for product A could be increased to level of 29,60%, although it was still below world class PCE but it has generated the need improvement for ABC company. From cost perspective, this improvement has reduced product cost by 44% far from 38% as targeted in the previous step. Compared to its competitor, product A’s cost is at 94% far below 100% price index of same product from its competitor.

5 Discussion

From the previous section, the condition of competitive disadvantage of ABC company for product A was greatly caused by its dependency of other vendors for the component needed by product A. This condition has increased the product cost 38% higher than its competitor which is at 100% price index triggered by low process cycle efficiency at 15,6% from its current state condition.

After conducting thorough investigation, the team has proposed make in-plant solution to both up-skill its staff and eliminate unreliable vendors causing its low process cycle efficiency below world class process cycle efficiency at 35%.

This has ensured the management to give its blessing for the team to go for it. Therefore, after up-skill the staff, ABC company could independently produce component needed for product A.

Finally, the standardization is taken to ensure this improvement sustained for the company. It can be seen from its future state stating that the process cycle efficiency at 29,6%. Although it is still below 35%, it has proven the improvement with 44% cost reduction far from 38% targeted giving its product cost only 94% below 100% of its competitor's pricing.

This result has really been encouraging for the company because by pursuing value stream mapping, the company is not only reaching their goal to reduce the cost but also increase PCE of its production.

Instead of making a match in pricing comparison, the company can lower the cost until below its competitor cost structure. This is not only impossible but also can be said as incredibly action because competitor's economic of scale has been beautifully beaten by the company which is very rare happened in manufacturing sector.

By having this result, it also has shown that reducing cost is not only implementing target costing or ABC costing as known popularly by accountants in accounting fields. This also can be done by improvement initiative using improvement tools that may not be thought before by many researchers.

Therefore, this result is hoped to be proof for knowledge advancement that value stream mapping can be used aside of target costing or ABC costing that have been popularly introduced and applied in accounting field, particularly in management accountant. This way of implementing the tool, in the future, is known as cost value stream mapping (Menon et. al., 2020)

6 Conclusion

From the previous section, it can be understood that by deploying Value Stream Mapping, the company not only can increase its process cycle efficiency but also reduce its product cost. This finding has been the originality and contribution value for the advancement of the knowledge related to this field of knowledge naming lean production initiative. By this finding, it strengthens the novelty in value stream mapping for its ability not only to promote shorter lead time but also lower cost reduction in the harmony of promoting process cycle efficiency.

This finding also supports theory that reducing cost can be done by reducing lead time which has been focus of value stream mapping.

This tool of course can be done by a dedicated improvement team. For their investigation, the company comes to know that its dependency to other vendor caused it both low process cycle efficiency and higher product cost which made it does not have competitive advantages in the eye of its customer. Fortunately, ABC company realize this and act on it.

For managerial implication, this result has contributed to new knowledge for management that to reduce cost in order to competitive price setting, instead of applying target costing as popular tool in field of accounting or by using activity-based costing (ABC) method, this tool also can help to achieve the company's goal.

However, the investigation on this research is so limited to the biggest non-value-added activity by pareto mindset so that for those value-added activity the team decided not to further investigate. Therefore, for future research, it is suggested to go for that and alternatively can adopt design-thinking process for better solving the problem.

By combining many tools, it is not only to find novelty in the perspective of knowledge advancement but also to benefit from it. This has been conducted by many researchers in many fields.

This happens because challenges faced by companies are getting tougher and only by finding breakthrough in methodology can help companies not only to face the challenges but also overcome them and be benefited from those challenges.

Finally, researcher hopes these findings and its implications can contribute more in this endeavor for advancing the knowledge for better life in the future

Acknowledgment

The author would like to thank to the company, its management and team for sharing their thoughts enabling this paper to be written as learning for all

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