

LEAN PRODUCTION IMPLEMENTATION ON COFFEE BEANS BUSINESS

Nurullaily Kartika^{1*}, Faiz Prawira Setiawan²

¹Department of Management, Faculty of Economics and Business, Airlangga University

²Department of Agricultural Engineering and Socio-economics, Kobe University

Address: ¹Jl Airlangga No.4-6 Surabaya

²1-1 Rokkodaicho, Nada Ward, Kobe, Japan

*E-mail: nurullaily@feb.unair.ac.id

ABSTRACT

The purpose of this study is to analyze the application of Lean Production implementation in Kopi Pak Tani. Waste and a big map of the production process originated from Kopi Pak Tani will be used as data. While the big map of the production process is obtained by observation. The background of this research is to achieve a competitive advantage in the production process in order to compete with other competitors. This research applies the qualitative method which consists of 2 different ways for gaining data. First, data obtained by the interview process will proceed to the data reduction method, data presentation method, and conclusion determination method. Second, data from observation will through VALSAT Process Activity Mapping Analysis. The results of this study will become a guideline to implement a lean business process by looking at the mapping analysis of process activity. Furthermore, from this study, the discovered wastes are in lead time, inventory, defect, and transportation.

Keywords: lean, Value Stream Mapping, waste, Process Activity Mapping.

JEL Classification: D20, M11

Article History:

Received :June 2, 2020; Revised :November 16, 2020; Accepted :November 27, 2020; Available Online :
December 6, 2020

DOI: [10.20473/jmtt.v13i3.19577](https://doi.org/10.20473/jmtt.v13i3.19577)

INTRODUCTION

Efficiency is key to the manufacturing industry. Lean manufacturing improves efficiency, reduces waste, and increases productivity. Lean manufacturing is designed to minimize the waste of material and labor while maintaining or increasing levels of production. These reasons are important for practitioners and scientists to know about lean production's practice in real business.

Coffee becomes one of the most profitable businesses. It proved by a huge number of shops and cafes which have coffee in their menu. In the report from kemenperin.go.id and CNN Indonesia, the growth of domestic coffee consumption is increasing on average 7% per year. Besides, GAEKI (Indonesian Coffee Exporter Association) states that Indonesia has the opportunity to export coffee to the coffee connoisseurs such as the USA, Japan, Austria, Belgium, Norway, and Finland, whose coffee consumption per capita is far above Indonesia,

©2020 Nurullaily Kartika, Faiz Prawira Setiawan. Published in Jurnal Manajemen Teori dan Terapan. Published by Universitas Airlangga, Department of Management. This article is published under the [Creative Commons Attribution \(CC BY 4.0\) licence](https://creativecommons.org/licenses/by/4.0/).

which is only 1.2 kgs per capita/year. Based on those phenomena, the growth of coffee market has its opportunity to grow continuously.

Kopi Pak Tani is engaged in manufacturing agribusiness. It was established in 2016 in Surabaya city. This company selecting and processing raw coffee beans (green beans) from farmers and change it to roasted beans. Furthermore, the company also grinding coffee beans. Processing workshop is located in the Rungkut area, Surabaya. As a manufacturing company, Kopi Pak Tani has a complex production flow which is starting from processing the coffee fruit (from picking, sorting, washing and fermentation, drying, and reporting processes, which are carried out in the farmers' location in Bondowoso district, in order to obtain quality green beans) and then, processing the green beans, which has 5 activities include storing, sieving, roasting, milling, and packaging. Green beans processing activity is completed in Surabaya. The first activity of the production process is storing raw coffee beans that are still in the form of green beans, the second is filtering coffee beans then roasted it when grinding coffee beans become the last process before packing activity.

The aim of the study is to minimize and even avoiding waste. Moreover, the study proposes an improvement in the existing production process which conforms to the principles of lean production.

LITERATURE REVIEW

Lean Production

Lean production contributes to waste reduction and business performance improvements. Recently, lean production is also used to lessen inventory costs on a small coffee producer. Lean production aims to achieve and improve effectiveness and efficiency in production. Efficiency through the increasing quality of the product and by reducing all forms of waste in production (Marodin et al., 2018). This is in line with Jacobs and Chase (2018) that state that lean production is all about focusing on how to eliminate waste as much as possible. In the production context, the lean approach is used to achieving production with minimal inventories of raw materials, work-in-process, and finished goods (Jacobs and Chase, 2018). Lean Production is not only focused on how to eliminate waste but also focuses on how to add value activities. This is in line with the philosophy of lean production which is based on synchronization (Hoellthaler et al., 2018). Synchronization means the flow of items - including materials, information, and customers-, always deliver in perfect quality, time, and place (not in the wrong location) (Slack et al., 2013).

Value Stream Mapping

Value stream mapping is a tool to understand the current situation and the future condition of business by identifying the flow of material, product, and information and the implementation of lean production. The successful lean implementation was initiated by VSM. VSM ables to eliminate waste in the process, shorten cycle time, and improve product quality greatly. Value stream is a set of actions that bring a specific product through critical management tasks, i.e. problem solving, information management, and physical transformation (Sundar et al., 2014). According to Jacobs and Chase (2018), value stream mapping (VSM) is a flowcharting tool used to visualize product flows through various processing steps. In other words, value stream mapping is a graphical way to analyze whether the value is being added or not as materials flow through a process. This tool aims to improve the productivity of the manufacturing system. VSM is also a critical tool to implement the lean approach because it would deepen the work systems understanding that leads to deliver value to the customers and reflecting their perspective (Romero and Arce, 2017). Furthermore, VSM is an efficient way to identify and eliminate waste (Stadnicka and Litwin, 2019).

VSM consists of standardized symbols. These symbols are categorized as a process, material, information, and general symbols (Jacobs and Chase, 2018) VSM has a two-part process, i.e. current state and future state. The current state is a basic view of the current process (a view of all the improvement processes that will be measured) whereas, the future state illustrates the value which is obtained from the improvement activities that have been carried out. The main purpose of making future state is to identify opportunities to design more efficient and waste-free operating systems.

Process Activity Mapping

Process Activity Mapping is a key tool to identify lead time, product flows, and information flows. The lean production implementation of the coffee beans business needs to identify process activity in this business. The idea is mapping out every step of activity that occurs throughout a process. Moreover, these data are used to analyze the key problems and understand the causes of these processes in the coffee beans business. Lastly, to fulfill the problem, analysis and action planning development are the final results of this research. Process Activity Mapping (PAM) is one of the tools that belong to the 7 types of Value Stream Analysis Tools (VALSAT) that will be used in this research. PAM will provide an overview of physical flow and information, the time required for each activity, the distance traveled, and the level of product inventory at each stage of production. Furthermore, PAM could be used to identify which activity includes in VA and NVA (Musyahidah et al., 2015), so the firm will make more suitable strategies to gain profit. The steps of PAM are identifying the value

stream, identifying waste, considering the rearrangement of flow patterns and other needed activities, and also identify the effects of eliminating some activities (Hardianza, 2016). PAM will give detailed activities and identify whether a process can be rearranged more efficiently.

Value-added (VA) is an activity that transforms raw material or information to meet customer requirements, whereas, non-value activity (NVA) is an activity that does not add value to the product or service itself from the customer perspectives (Voehl et al., 2013). The value is based on the customer's perspectives. An external customer is willing to pay value-added activity and not for non-value-added activity. NVA could be eliminated without decreasing the value of the product or services. Some examples of NVA activities are reworking and rewriting reports. NVA activities can be classified in two categories. First, NVA comes from an inadequate design, and the second comes from activities that are not required by the external customer or the process.

Waste

The basic of lean production is to identify and eliminate wastes. Lean production has value-added and non-value-added. Value-added activities are essential activities that add value to the customers, while non-value-added work or waste is non-essential activities that add time, effort, cost but no value. Waste can be defined as any activity which does not add value. In Japanese words, this waste can be called Muda. Muda means waste or any activity (such as rework and waiting time) that customer is not willing to pay. Slack et al (2013) state that Toyota has identified seven types of waste, and those are over-production, Waiting time, transport, process, inventory, motion, and defectives. Firstly, over-production can be defined as producing more than is immediately needed by the next process or the end customer. This often happens when the firm engages more resources to deliver to the customer (Voehl et al., 2013). It will affect some problems such as extra workers, machines, energy, material, etc, and all of them will increase the cost. Secondly, waste in time can occur when the employees have to wait for the material to be delivered or waiting machine to process, or in the other word, these wastes come from equipment and labor activity. Delays increasing lead time and retention time (Dennis, 2015). Lead time is the time between the customers placing and receiving their order, whereas retention time is processing time in most manufacturing operations. Thirdly, transportation wastes usually come from equipment that is used to move materials such as a forklift, carts, and rolling racks. The wastes could come from some factors, for example, because of poor purchasing practices and inadequate facility layout. Fourthly, the process is the waste could come from poor component design and maintenance. Next, the waste in inventory is related to keeping unnecessary raw materials, parts, and work in process (Dennis, 2015). Furthermore, Voehl et

al. (2013) state that inventory can appear as finished goods. Moreover, wasted in motion can be categorized in human motion and machine elements. Waste in human motion is related to poor ergonomic design, which affects productivity, quality, and also safety (Dennis, 2015). One of the ways to reduce this waste is by simplification. Lastly, defectives are also called quality waste and often very significant in operations.

RESEARCH METHODS

This research method used is a qualitative case study methodology that provides tools for researchers to study complex phenomena in a real-life context. The aim of this study is to answer 'how' and 'why' questions (Yin, 2003). Research on the implementation of lean production strategy on Kopi Pak Tani coffee beans business applies a qualitative approach with observation and interviews method. Data analysis techniques, data reduction, and the information were obtained through the observations and interviews from the company. All the interviews were recorded and transcribed immediately afterward. Moreover, data reduction is useful to provide the results of observations clearly in a structured way. Data presented in the form of narration or chart, the data can be concluded and withdrawn their certain meaning. The quality of data presentation is very influential to the next steps, as more data are presented clearly. Lastly, the conclusion will be made and re-verified. A valid conclusion is obtainable when the initial conclusion remains consistent even if it has been re-reviewed and a new state has been attained.

RESULTS AND DISCUSSION

Identification of Waste Types

Waiting time

In the coffee processing business, including Kopi Pak Tani, there are many activities where the operator has to wait before starting new activities. Some activities that require waiting time include heating the furnace for the coffee beans roasting process, cooling the coffee beans, and re-drying the coffee beans if the moisture content on the beans is still too high.

Inventory

Inventory is paramount in the manufacturing business, especially for companies serving wholesale, both in the preparation of raw materials and stock of finished goods. In Kopi Pak Tani, supplies on display are still less available to meet the consumers' needs, especially new consumers, so the consumers are forced to delay their purchase and return on the next day to take their coffee or wait for the coffee to be roasted and sent on the day if they are in urgent. The production capacity, which is not large yet, makes the shipment is done twice when customers order more than 10 kilograms.

Defects

At Kopi Pak Tani, there are often raw coffee beans that are unable to pass through the sieving process due to small dirt that is not filtered properly. The step taken to overcome this problem is through manual sorting.

Transportation

Transportation can turn into waste when there is no systematic delivery planning and ordering SOP to get fresh coffee beans. This is what still happened to Kopi Pak Tani. The company relationship with the consumers or distributors has not been set up in integration so that the shipment schedule is still arguably messy.

Production Process Analysis using Process Activity Mapping

Process activity mapping is carried out to assess the activities of value-added, non-value-added, and necessary non-value-added in the entire production process. Below is table 4.2 explaining PAM in the current state:

Table 1
Process Activity Mapping (Current State)

No.	Activity Descriptions	Tools	Distance (Meters)	Time (Seconds)	Activity category	Grading (VA/NVA/NNVA)
1.	Raw materials retrieval and weighing	Spades, buckets, scales.	-	240	S	NNVA
2.	Raw materials are transferred to sieving machine	Bucket.	2	3	Q	NNVA
3.	Sieving process	Sieving machine	-	900	O	VA
4.	Sieved materials are transferred to roasting machine	Bucket.	1	2	Q	NNVA
5.	Heating the furnace	-	-	180	D	NVA
6.	Roasting process	Roasting machine	-	1800	O	VA
7.	Cooling beans	Tray	3	2100	D	NVA NNVA
8.	Transferring to the grinding machine	Tray	3	4	Q	
9.	Weighing	Scales	-	120	O	NNVA
10.	Milling process	Milling machine	-	2700	O	VA
11.	Packing preparation	Bucket	-	300	D	NVA
12.	Packing process	Packages,	-	240	O	VA
13.	Transferring to final storage	Sealing machine	6	60	S	NVA

Source: Data processed (2018)

Note: Delay (D), Operation (O), Transportation (T), Storage (S), Inspection (I)

Value Added (VA), Necessary non-Value Added (NNVA), non-Value Added (NVA).

From table 1, it can be observed that there is a delay activity categorized as a non-value-added activity, which cooling beans activity that takes 35 minutes. Then, there is packing

preparation, which is unnecessary to be carried out and can also be included as a delay. The appearance of packing preparation is due to the not strategic laying of equipment. Therefore, it can be redesigned by putting the machines in more strategic places and close to the packing post. Based on the table of process activity mapping current stated above, the calculation summary is obtained as table 2 and 3 explain below:

Table 2.
Current State PAM Calculation Summary

Activity	Number of activities	Time (seconds)
<i>Delay (D)</i>	3	2580
<i>Operation (O)</i>	5	5760
<i>Transportation (T)</i>	3	9
<i>Storage (S)</i>	2	300
<i>Inspection (I)</i>	0	0
Total	13	8649

Source: Data processed (2018)

Table 3.
Percentage of Current State PAM

Classification of activities	Number of activities
<i>Value added</i>	4
<i>Non-Value Added</i>	4
<i>Necessary non-Value Added</i>	5
Total	13
% Value Added	30.7%
% Non-Value Added	30.7%
% Necessary Non-Value Added	38.6%

Source: Data processed (2018)

From table 2, the duration of production time in Kopi Pak Tani takes 8,649 seconds or approximately 2.4 hours. The total activity includes 13 activities. From those 13 activities, delay activity amounts to 3 activities, operation activity calculated to 5 activities, transportation activity amounts to 3 activities, and storage activity is as many as 2 activities. While the inspection activity has not been carried out yet.

From table 3, it can be detected that from the production process, the percentage of value-added of 30.7% equals the percentage of non-value-added of 30.7% as well. From this data, it can also be concluded that the occurring non-value-added activity is due to the dominance of waiting activities must be reduced or filled with inspection activity that has not been carried out in the production process to minimize the defective products.

After understanding the description of the production process in the current state through process activity mapping, several things should be considered before arranging PAM design for the future state, which are:

Table 4.
Process Activity Mapping (Future State)

No.	Activity Descriptions	Tools	Distance (Meters)	Time (Seconds)	Activity category	Grading VA/NVA/NNVA
1.	Raw materials	Spades,	-	240	S	NNVA
2.	retrieval and weighing. Raw materials are transferred to sieving machine.	buckets, scales. Bucket.	2	3	Q	NNVA
3.	Sieving process.	Sieving	-	900	O	VA
4.	Sieved materials are transferred to roasting machine	machine. Bucket.	1	2	Q	NNVA
5.	Heatingthe furnace	-	-	180	D	NVA
6.	Roasting process	Roasting	-	1800	O	VA
7.	Inspection of roasting	machine.	3	2100	I	NNVA
8.	result Transferring to grinding machine	- Tray	3	4	Q	NNVA
9.	Weighing	Scales.	-	120	O	NNVA
10.	Milling process.	Milling machine.	-	2700	O	VA
11.	Packing process	Packages,	-	240	O	VA
12.	Final Inspection	sealing	-	180	I	NNVA
13.	Transferring to final storage.	machine.	6	60	S	NVA

Source: Data processed (2018)

Note: Delay (D), Operation (O), Transportation (T), Storage (S), Inspection (I)

Value Added (VA), Necessary Non-Value Added (NNVA), Non-Value Added (NVA).

In table 4, points that belong to the category of non-value added are 2 activities, which are heating the furnace and transferring the finished goods to final storage. From table 4 above of process activity mapping in the future state, it is also obtained a summary of activity calculation and percentage as follows:

Table 5.
PAM Future State Calculation Summary

Activity	Number of activities	Time (seconds)
<i>Delay (D)</i>	1	180
<i>Operation (O)</i>	5	5760
<i>Transportation (T)</i>	3	9
<i>Storage (S)</i>	2	300
<i>Inspection (I)</i>	2	2280
Total	13	8529

Source: Data processed (2018)

Table 6.
Percentage of PAM future state

Classification of activities	Number of activities
Value added	4
Non-value added	2
Necessary non-value added	7
Total	13
% Value added	30.7%
% Non-value added	15.4%
% Necessary non-value added	53.9%

Source: Data processed (2018)

From table 5, design for a future state is obtained with a total activity of 13 activities, details as follow: delay activity considers only 1 activity, operational activity amounts to 5 activities, transportation activity as many as 3 activities, storage activity is calculated to 2 activities, and finally 2 activities of inspection activity. The total production time obtained is 8,529 seconds or approximately 2.37 hours.

In table 6, the percentage calculation of value-added activities is obtained as many as 30.7% equals the value of the current state condition. There is a percentage reduction in the non-value-added activities, hence it becomes 15.4%, while there is an addition of magnitudes in the percentage of activities that are necessary non-value-added, therefore it becomes 53.9%.

Table 7.
Comparison of Current State and Future state Production Processes

	% Current State	% Future State	Explanation
Non-Value-Added-Activities	30.7%	15.4%	Percentage in future state is reduced because of cooling beans activities are carried out simultaneously with the inspection, therefore it changes from the beginning of non-value-added activities into necessary-non-value-added activities, the elimination of packaging preparation by moving tools to more accessible places.

Source: Data processed (2018)

CONCLUSION

Lean production reduces waste and increases the efficiency of the company's production line, which has a huge impact on the business. The implementation of lean production in Kopi Pak Tani has become one of the examples of how businesses reducing waste and increasing efficiency. The Industrial implication of this study is analyzing lean production and waste indicators in the coffee sector, and also to understand how business practices and monitors the important variables of the production process in coffee's business. The

managerial implication is to understand how to improve the internal flow of companies, operational capability, and adapting to changing internal and external conditions of the company.

The study provides information regarding the waste in Kopi Pak Tani including waiting time, supply, defects, and transportation. The waste of waiting time is due to the heating furnace activity of roasting machines, cooling process, and re-drying. Then, waste of supply occurs because of the absence of SOP that regulates the purchasing process in large quantities of new consumers, so that the supply on display is not able to fulfill the consumers' demand, the waste of defects occurs since there is still small dirt discovered in raw coffee beans that have to go through the sieving process manually, and waste of transportation occurs as a result of waste in supply, which new consumers who suddenly purchase coffee in large quantities urge to be delivered on the same day. However, since supply is not sufficient enough, the rest of the order is forced to be sent on the next day.

Based on the analysis results applying process activity mapping, there is still a lack of inspection activity on the production process. The absence of an inspection process leads to undetectable defects at later days. Also, there is a waste of waiting time that takes quite a time, around 35 minutes in cooling beans activity. Cooling beans activity cannot be eliminated since it will make the coffee packages inflate due to coffee beans still contain gas. It is also observed that the packing preparation time is too long, which lasts for 5 minutes due to the less strategic placement of the equipment. And the implementation of lean production strategy by referring to the table of process activity mapping in future state whose production process has been modified to become leaner.

In order to minimize waste of waiting time, it is expected to apply the proposed process activity mapping in the future state that has been listed to implement a new activity, which is the inspection of time activity slots that take up waiting time, for example, during cooling beans activity, an inspection of roasted coffee beans can be done concurrently, so that activity that is initially non-value-added becomes necessary non-value-added, and is also useful for detecting defects early. For re-drying activity due to nonstandard water content, it requires clear and intensive communication during the process of purchasing raw materials at farmers regarding with standardization of raw materials according to the requirement of Kopi Pak Tani, as well as sorting the sourcing of raw materials in order to be well selected to get quality raw materials.

Intensive communication can be practical in the standard operational procedure (SOP) when signing the business contract of raw materials procurement with farmers so that actions that contribute to quality reduction can be avoided from the beginning. In minimizing the waste of inventory, it is suggested to create clear and systematic standard operational procedures which regulate the purchasing process in large numbers by new consumers, so that the production process will not be interrupted by the sudden demand in large quantity, this is also carried out so that waste of transportation does not occur. To minimize waste of defects in roasted coffee beans and ground coffee, as well as broken packaging, inspection is suggested to be performed in a series of production processes as planned in the process activity mapping in the future state. Meanwhile, to reduce waste of defects in raw coffee beans, it is possible to do the sourcing selection process of farmers by routine control and the requirement for intensive communication through standard operational procedures starting from contract signing in order to communicate the raw material standards to meet the requirement of Kopi Pak Tani since the beginning of the business.

Suggestions for further research are more in-depth research should be carried out, including the upstream coffee beans process, which post-harvest coffee beans is processing. Later, the application of more diverse lean tools in order to yield more perfect results since they can be observed from various perspectives of theories underlying them.

REFERENCES

- Dennis, P. 2015. *Lean Production Simplified* (3rd ed.). CRC Press Taylor and Francis Group.
- Hardianza, D. A. 2016. Implementasi Lean Manufacturing dengan Metode Value Stream Mapping pada PT . X. In *Master Thesis Intitut Teknologi Sepuluh Nopember: Vol. PM 147501*.
- Hoellthaler, G., Braunreuther, S., and Reinhart, G. 2018. Digital lean production – An approach to identify potentials for the migration to a digitalized production system in SMEs from a lean perspective. *Procedia CIRP* 67: 522–527.
- Jacobs, F. R., and Chase, R. B. 2018. *Operations and Supply Chain Management, 15th edition (15th ed.)*. Mc Graw Hill Education.
- Marodin, G., Frank, A. G., and Tortorella, G. L. 2018. Lean Product Development and Lean Manufacturing: Testing Moderation Effects. *International Journal of Production Economics* 203: 301–310.
- Musyahidah, B., Choiri, M., and Hamdala, I. 2015. Implementasi Metode Value Stream Mapping sebagai Upaya Meminimalkan Waste. *Jurnal Rekayasa Dan Manajemen Sistem Industri Vol. 3 No. 2 Teknik Industri Universitas Brawijaya* 3(2).

- Romero, L. F., and Arce, A. 2017. Applying Value Stream in Manufacturing : Applying Value Stream Mapping in A Systematic Literature Review Applying Value Stream Mapping in Manufacturing : Applying Value Stream Mapping in A Systematic Review Applying Value Stream Literature Mapping in Manu. *IFAC-PapersOnLine* 50(1): 1075–1086.
- Slack, N., Jones, A. B., and Johnston, R. 2013. Operations Management, 7th edition. In *Pearson Education Limited* (7th ed.). Pearson Education Limited.
- Stadnicka, D., and Litwin, P. 2019. Value Stream Mapping and System Dynamics Integration For Manufacturing Line Modelling and Analysis. *International Journal of Production Economics* 208: 400–411.
- Sundar, R., Balaji, A. N., and Satheesh Kumar, R. M. 2014. A review on lean manufacturing implementation techniques. *Procedia Engineering* 97: 1875–1885.
- Voehl, F., Harrington, H. J., Mignosa, C., and Charron, R. 2013. The lean six sigma black belt handbook: Tools and methods for process acceleration. In *The Lean Six Sigma Black Belt Handbook: Tools and Methods for Process Acceleration*.