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Lean Six Sigma Analyst in Packing House Lembang Agriculture Incubation Center (LAIC)

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Abstract. Agriculture is the main sector in Indonesia, which covers 30,45% of all employment sectors in Indonesia. This makes Indonesia as agricultural country that makes this sector must be very much considered. Agriculture' Supply Chain, starting from Farmer until the yields reaches the consumers, is the main focus. The appearance of a problem in one chain can cause scarcity, loss, and price disparity. So, Lembang Agriculture Incubation Center (LAIC) as one of the distributors who connects farmers and consumers must pay attention to this supply chain. Shipment with the right time, amount and type is a benchmark for success so the packaging process is very much considered especially for vegetables, because vegetables are included in the perishable good group. Process mapping using the Lean Six Sigma method can be applied to analyze the vegetable packaging process by LAIC. This process mapping will pay attention to the current process and look for factors that support and inhibit the packaging process (value added and non value added) then improve if there are problems that must be followed up immediately. Lean Six Sigma analysis is carried out in 5 stages, they are: First stage, Define is done to create a Value Stream Mapping (VSM) packaging process which shows that the length of packaging time is 1054.08 minutes for the value added process and 225.18 minutes for the non value added process. The second and the third, Measurement is done by the Process Activity Mapping (PAM) method to see what processes are non-value added processes that cause the packaging process to be long and will be Analyzed for the cause of the problem using fishbone. Furthermore the fourth, Improvement is done by eliminating waste (non value added) and also adding one additional worker so that the packaging process has a time reduction, namely, 1028.4 minutes of value added process and 79.4 minutes of non value added process. The last stage or the fifth is Controlling which is done by applying a new SOP that has been fixed in the previous stage. So, with the proposed improvement given, there was a 171.46 minute reduction in the vegetable packaging process at LAIC.

1. Introduction

An Agriculture country became one of the Indonesian state designation. There are 30.45% of the total population of 133.94 million labor force in Indonesia in February 2018 to work as a Farmer [2], Due to above statement and supported by large farms, making Indonesia into abundant agricultural produce. Indonesian agricultural products are palawijaya grains, fruits, and vegetables, and many more. The agricultural products meet the domestic needs and also some can be exported abroad. One of the largest vegetable producing areas in Indonesia is Lembang district, West Java. This place



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located at the foot of Mount Tangkuban Perahu that makes the soil and climate suitable for growing types of vegetables. It makes Lembang become one of the manufacturers producing vegetables with good quality for the area of Bandung, Jakarta and also Export. The main commodity of vegetables are tomatoes, potatoes, peppers, onions, beans, broccoli, and others.

Yields of vegetables usually directly sold to traditional markets by Farmer or submit it to Gatherer to be produced again and find a market both local and export markets. Based on the above statement can be seen that the flow distribution or marketing of these vegetables can be divided into two channels, namely short and long distribution. Short Distribution is the marketing groove vegetables where farmers sell their crops directly to end consumers without any other party. As for the length distribution, farmers bring their crops to a third party for being sold to consumers eventually [3].

For selling the crop directly to the traditional markets do not need handling specifically, because the vegetables that harvest today will directly be sold next day in the market. The crops whom delivered to the Gatherer will be produced again in simple handling as cleaned, sorted, packed, even still stored before being put into the market. It causes the freshness of the vegetables will be reduced when processed as above. Vegetables aren't directly sold to the market but still kept for several days. For vegetable shelf life at room temperature (21°C) is less than 7 days [6]. Due to the short life of vegetables, handling and technology needed to maintain the freshness of the vegetables that can be much longer shelf life.

One of Gatherer or also called vegetable distributor in Lembang which has begun to take notice of the above factors are Lembang Agriculture Incubator Center (LAIC) which is an Incubator which focuses on vegetable planting techniques and also handling the harvest before been sold to market. This incubator is built based on cooperation between *Balai Besar Pelatihan Pertanian* (BBPP) with the Taiwan International Cooperation and Development Fund (Taiwan ICDF) to help agriculture development and the local economy. This incubator collect crop farmers, process them, and then sell the crop farmers to the retail market.

Process in Packing House Lembang Agriculture Incubation Center (LAIC) should be fast because the vegetables included in perishable goods, which goods are sensitive with time so it easily damaged and rotten. If handling process of vegetables take a long time, either when receiving vegetables, sorting, washing, packaging or storage time in the Packing House, it causes the age of these vegetables in the market being short. As an issue of concern in this study is about the packaging process performed by LAIC vegetables. The vegetable packing process should be possible with the appropriate time without any process of excessive and not necessary to cause increasing vegetable handling time [10]. This unnecessary must be removed in order for vegetable handling activities in the Packing House Lembang Agriculture Incubation Center (LAIC) can be run efficiently.

2. Literature Review

2.1 Agricultural Supply Chain

Supply Chain is a network of companies that jointly work on creating and delivering a product into the hands of the end consumer. Based on understanding of the above, it can be interpreted that the Supply Chain is a physical network that requires methods, tools or management approach. The physical network needs to be managed in order to run properly. This method is known as Supply Chain Management (SCM), which has a sense as a thorough and complete review of the flow of goods, services and money, including the production process, from raw materials to distribute the materials for retailers and end customers. SCM related to the value chain (value chain), that describes the overall activities required to produce goods or services, starting from design, raw material input, the production process until the distribution to the final consumer as well as marketing services. Based on the above understanding, the agricultural supply chain, which acts as a producer are farmers who harvest their farm, which is then distributed to consumers, whether it is the collector for reprocessing or final consumers such as restaurants, factories or directly to the public [8].

2.2 *Lean Six Sigma Logistic*

Lean is a continuous improvement to eliminate waste and increase the value added products, can be goods or services in order to provide customer value. Six Sigma is a management methodology that attempts to understand and eliminate the negative effects of variations in the process. While the logistics are in place regarding the procurement of goods, quantity and the right time. So, Lean Six Sigma Logistics is the elimination of waste through disciplined efforts to understand and reduce variation, while increasing the speed and flow in the supply chain [5].

2.3 *Operation Process Chart*

Operation Process Chart (OPC) is a diagram illustrating process steps that will be experienced by the raw materials of the sequences of operation and inspection, OPC is in the form of working order in which each work is divided into operation elements in detail. American Society of Mechanical Engineers (ASME) in 1947 set the standard symbols that consists of 5 different symbol to make a map of the operation process [1].

2.4 *Value Stream Mapping (VSM)*

Many companies start the Lean path by analyzing with the value stream mapping. Value stream map similar to operation process chart, the difference can be seen from the focus. While focusing on the process maps that can be applied across all products and items, value stream maps are product centric and, therefore, tend to reach a variety of processes. Map process usually serves as the first step in mapping the value stream. Regardless of differences in this dimension, the goal is generally the same: to identify opportunities to eliminate waste and. Value stream map consists of three parts that look different: map process (Process Map), timeline (Timeline) and the flow of information (Information Flow) accordingly. Map process consists of steps and information related to the process steps [7].

2.5 *Process Activity Mapping (PAM)*

This tool is used to identify lead time and productivity to both physical product flow and information flow, not only within the scope of the company and also in other areas of the supply chain. The basic concept of this tool is to map each stage of the activity that occurred from the operation, transportation, inspection, delay, and storage, and then group them into types of activities that exist ranging from value added activities (VA), Necessary but non-value added activities (NNVA), and non-value added activities (NVA) [4].

3. Methodology

The methodology of this research is mixed methods by using qualitative and quantitative approach as well. Study literature was Literature study was conducted to look at other studies in the field of lean six sigma, specifically its application in Indonesia. Survey and intensive interview was conduct to gain an existing data about lean six sigma activity performance in LAIC.

4. Results and discussion

4.1 *Operation Process Chart of Vegetable Packing*

Vegetable packing process in Packing House Lembang Agriculture Incubation Center (LAIC) consists of five major activities, namely Packing Planning, Checking, Picking, Packing and Delivery. Below is a map of Operations or Operation Work Process Chart (OPC) for vegetable packing activity. Table 4.1 Vegetable Packaging Process Activity Mapping

For a more detailed workflow can be seen in the picture below which shows the elaboration of each process Packing Planning, Checking, Picking, and Delivery. Table 4.2 Vegetable Packaging Process Activity Mapping

Table 4.3 Vegetable Packaging Process Activity Mapping shows the entire process carried out at the fourth stage in vegetables packaging process, namely vegetable packing.

4.2 Define Stages

Once you know what activities are carried out in the process of packaging the vegetables, made a map of the flow value (value stream mapping) to determine the value of each activity, whether belonging to the activity that provides value added, and activities that non-value added or waste. Current based VSM above, it can be seen the total time of the process of packaging the vegetables in the Packing House LAIC is 1279.26 minutes, which is where the value added process takes as long as 1054.08 minutes and non-value added process takes over 225.18 minutes. Activities that spend the most time is the activity Labeling & Save, Packaging Planning, and Delivery.

4.3 Measure Stages

After mapping process using the VSM, it will measure the level of performance of each process based on the processing time of these events. Measure stage will use the Process Activity Mapping (PAM) to see what activities that provide value added, the necessary non-value added and non value added activities in Packaging activities.

Table 1. Vegetable Packaging Process Activity Mapping

No	Description of Activities	Time (min)					Category
		O	D	T	I	S	
1	Packaging Planning						
A	Turning on the computer		3,15				NNVA
B	Checking the previous delivery quantity		0,34				NNVA
C	Picking stationery		1,15				NNVA
D	Planning next day delivery	18,02					VA
E	Delivery list to retail	0,60					NNVA
F	Waiting for confirmation from the store		29,63				NVA
G	Adjustment for the confirmation store list	9,19					VA
H	Submission to the clerk Packing list			13,90			NNVA
Total		75,97					
2	Checking Vegetables						
A	Checking the list of vegetables		0,50				NNVA
B	Taking the trolley			9,62			NNVA
C	Pushing a trolley to cold storage			2,95			NNVA
D	Open the door of the cold storage		0,76				NNVA
E	Turn the lights on cold storage		0,26				NNVA
F	Check availability of vegetables	13,38					NNVA
G	Confirmation to the Sales & Marketing	8,54					NVA
Total		36,00					
3	Picking Vegetables						

A	Intake of vegetables according list	0,90		NNVA
B	The transfer to cart		0,91	NNVA
C	Laying on the trolley	0,62		NNVA
D	Close the door cold storage		0,70	NNVA
E	Turn off the lights cold storage		0,36	NNVA
G	Transfer the vegetables to the table packing	9,95		NNVA

Table 2. Vegetable Packaging Process Activity Mapping (Continued)

No	Description of Activities	Time (min)					Category
		O	D	T	I	S	
H	Wait vegetables temperature adjust the room temperature		30,00				NVA
	Total		47,81				
4	<i>Packing Vegetables</i>						
A	<i>Cleaning Vegetables</i>						
I	Take the cleaning tool from the shelf			1,44			NNVA
Ii	Take vegetables	0,25					NNVA
Iii	<i>cleaning</i> vegetable	0,74					VA
Iv	Put vegetables	0,29					NNVA
V	Wait vegetables will be prepared		2,34				NVA
	Total					5,06	
B	Row						
I	Take placemat vegetables from the shelves as needed			1,29			NNVA
Ii	Take a placemat	0,35					NNVA
Iii	Take the vegetables that are already dry	0,26					NNVA
Iv	Arrange vegetables on a placemat	2,76					VA
V	Set aside the vegetables already drafted	0,40					NNVA
Vi	Wait vegetables will be weighed		74,77				NVA
	Total					79,83	
C	Weigh						
I	Take the vegetables that have been prepared	0,26					NNVA
Ii	Place the vegetables on the scales	0,34					NNVA
Iii	Adjust the weight of the vegetables with the provisions LAIC	0,66					VA
Iv	Set aside the vegetables which have been weighed	0,37					NNVA
V	Wait vegetables will be wrapping		30,74				NVA

Jumlah		32,37	
D	<i>Wrapping</i>		
I	Take the vegetables that have been weighed	0,25	NNVA
Ii	Place the vegetables on wrapping machine	0,26	NNVA
Iii	Pull the plastic wrapping	0,48	VA
Iv	Trim plastic wrapping	0,64	VA
V	Cut the sealing tape	0,36	NNVA
Vi	Masking tape plastic tip	0,25	VA
Vii	Set aside the vegetables were already in wrapping	0,53	NNVA

Table 3. Vegetable Packaging Process Activity Mapping (Continued)

No	Description of Activities	Time (min)					Category
		O	D	T	I	S	
viii	Wait vegetables will be in labeling		13,73				NVA
Total					16,50		
E	<i>Labelling</i>						
i	Ambil sayuran yang sudah di <i>wrapping</i>			0,98			NNVA
ii	Ambil kertas logo dan <i>barcode</i> sayuran			1,92			NNVA
iii	Take the company's logo label	0,27					NNVA
iv	Attach label logo	0,15					VA
v	Take barcode vegetables	0,35					NNVA
vi	Paste barcode vegetables	0,13					VA
vii	Set aside the vegetables were already in labeling	0,62					NNVA
viii	Wait for the vegetables to be stored		21,09				NVA
ix	Take the finished vegetables	0,46					NNVA
x	Transfer the vegetables to shelves			0,99			NNVA
xi	Place the vegetables in accordance store					0,58	NNVA
xii	grab a pen			1,67			NNVA
xiii	Give the date of production of vegetables	0,86					VA
xiv	Save vegetables for delivery tomorrow					900,00	NNVA
Total					930,05		
5	Vegetables Delivery						
A	Take sterofoam			4,67			NNVA
B	Take the ice cubes			5,79			NNVA
C	Enter the ice cubes in sterofoam	2,34					NNVA

D	Arrange the vegetables in sterofom	3,34		VA
E	Close sterofom	1,40		NNVA
F	Take the trolley		3,21	NNVA
G	Sterofom stacking up trolley	2,04		NNVA
H	Push the trolley to the side of the car		7,21	NNVA
I	Move to the top of the car sterofom	2,80		NNVA
J	Sterofom stacking on top of car	3,06		NNVA
K	Tie and close sterofom	5,47		VA
L	Wait permit		13,84	NVA
Total			55,18	

Based on the table above, it can be seen that the activities classification on vegetable packaging process can be seen in the diagram below. There are 10 activities included in the group of processes that do not provide added value (non-value added / waste) which should be considered to improve the performance of the packaging process in the Packing House LAIC vegetables.

4.4 Improve Stage

Improvements that will be applied in Lembang Agriculture Incubation Center (LAIC) focuses on the activity or vegetable packaging process. The following is an improvement over the non-value added (waste) that can be applied in the packaging of vegetables in LAIC activity.

Table 4. Vegetable Packaging Process Improvement Proposal

Classification	No	Non Value Added	Reason of Changes	Improvemnet
Concise Seiri / Sort	1	Waiting for the temperature of vegetables to adjust to room temperature when vegetables are taken and will be packaged	Activities waiting for the temperature of vegetables in accordance with room temperature can be done together with cleaning vegetables	Performed in conjunction with cleaning activities
	2	Waiting for vegetables will be prepared after cleaning		
	3	Waiting for vegetables will be weighed once compiled		
	4	Waiting for vegetables will be wrapping after being weighed	Increase production time and productivity	Adding Packing Officer
	5	Waiting for vegetables will be labeling after wrapping		
	6	Waiting for vegetables will be saved		
	7	Waiting for document delivery.	Accelerate the delivery	Created afternoons
Taking care/ Seiketsu / Standardize	8	Waiting for confirmation from the store at the time of packaging planning activities	The system adopted is Consignment	Fixing Packaging Standard Operating Process (SOP)

9	Checking the list when vegetables is checking	Checking should be carried out after all activities are done
10	Confirmation to the Sales & when picking activity	Not needed if supply already in check before planning

Based on the above table, it can be seen that the improvements that can be proposed is to add an additional employee in the Packing. In addition, other proposals that may be submitted is to renew the Standard Operation Process (SOP). Then a simulation is performed to determine the changes obtained based on the proposed improvement. After simulation is done, it's known how many pack of vegetables can be handled in one day and also processing time and waiting time. For the actual simulation results, the results of pack that can be done is as much as 184 pack vegetables with a time of 114.99 minutes and the process is in the system for 204.95 minutes. And the result of proposed improvement are as much as 504 packs of vegetables that can be handled per day with a time of 77.18 minutes workmanship for the length of time in the system for 161.14 minutes.

From the comparison of both results, it can be seen that with the improvements, it will produce an increase in the number of products per day and vegetables processing time can be cut as much as 37.81 minutes and vegetables in all the process is also reduced as much as 43.81 minutes. With the positive impact does the proposed improvements, the proposal could be implemented. Therefore, made a proposal Future Value Stream Mapping in process improvement.

5. Conclusion

5.1 Conclusion

From all the research that has been done, conclusions can be drawn like this, namely:

- The packaging process at the Lembang Agriculture Incubation Center (LAIC) as mapped in Value Stream Mapping (VSM), namely Planning for Packaging, Checking, Picking, Packing, and Delivery. The stages of vegetable packing activities are cleaning, stacking, weighing, wrapping, labeling, and saving.
- There are 12 processes that are value added, they are processes that must be carried out, 51 processes that are necessary non-value added or processes that are not important but must be carried out and 10 processes that are non value added (waste) or unnecessary.
- The workflow improvements made are at the Packaging Planning stage by reducing the process of waiting for confirmation from retail and also reducing the process of waiting when packing vegetables due to the addition of the Weighing Packing Officer to Labeling & Save. The following is the time difference obtained.

Table 5. Time Difference In The Process of Packing Vegetables, Existing and Proposed

Information	Currents	Improvement	Difference
VA	1054.08 min	1028.40 min	25.68 min
NVA/waste	225.18 min	79.40 min	145.78 min
Total	1279.26 min	1107.80 min	171.46 min

Information:

VA : *Value Added* or processes needed in an activity

NVA : *Non Value Added* or waste is a process that does not add value and can impede the course of a process

5.2 Suggestion

The advice that can be given for the Lembang Agriculture Incubation Center (LAIC) is to consider the proposals given by researchers and for future researchers to make this research as a basis for conducting research related to forecasting vegetable needs and supplies at LAIC.

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