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Application of *Value Stream Analysis Tools (Valsat)* to Increase *The Value-Added* Production Process of Robusta Coffee

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Abstract:- BUMDES Manikmandiri has collaborated with residents to improve the agricultural sector's economy. The main focus of coffee products, which is the main problem, is that there is no coffee husk handler, which will eventually become waste. With the change of waste that is not value added to value-added, it is hoped that it will be more useful. The purpose of this study is to identify waste and minimize the waste that occurs. This study uses the VSM and VALSAT methods to provide recommendations for improvement in the coffee production process. This research involves mapping the current condition and weighing waste through questionnaires. After obtaining the average value of waste, calculations are carried out using the VALSAT analysis tool to identify waste during the production process in more detail. From VALSAT, the tool was selected, namely PAM, and then the analysis results were obtained: VA presentation of 38.16%, NNVA of 0.09%, and NVA of 61.75%. From the VSM method, current and future state mapping was obtained, and then obtained in the initial measurement, the PCE reached 38.1%. Meanwhile, in future VSM analyses, efforts will be made to reduce waste and increase the value of value-added activities, which will increase PCE to around 40.08%. Waste coffee peels that are wasted are proposed to become cascara tea products to become value-added.

Keywords**:** Waste; VALSAT; VSM, application, coffee

1. Introduction

The manufacturing world is rapidly developing by optimizing products and minimizing wasted resources. In making products, a production process is very important because it affects the final product result. Currently, the development of the agricultural sector in Indonesia is very rapid, considering Indonesia's background in the tropics and abundant natural resources. Coffee is one of the most cultivated plants in the world. The distribution of this coffee is mostly found at the equator or along the equator, also known as *the coffee belt*. In Indonesia, on average, Arabica, robusta and liberica coffee plants are cultivated. Coffee is one of the most consumed beverages in the world. Coffee is not just a way to get rid of drowsiness as a lifestyle; this is what increases the consumption of coffee drinks.

BUMDES Gunungmanik Village, Ciniru District, Kuningan Regency, has collaborated with residents in an effort to improve the agricultural sector's economy. With a coffee plantation area of 20 hectares, it is expected to be a spearhead of increasing the economy of Gunungmanik villagers. Coffee grown in Gunungmanik village is at an altitude of around ±600 meters above sea level, with a temperature range of 24° —27°C, robusta type.(Bunyamin et al., 2022) The conclusion is that coffee plantations in Gunungmanik Village with an average altitude of ±600 meters above sea level with a humidity of 80 and above and a temperature range of 24°-25°C get a good coffee harvest and good quality. In contrast, coffee harvests are poor with a humidity below 80 and a temperature range of 27°C. There are three types of coffee grown in Gunungmanik Village, namely Robusta, Arabica, and Liberica, but the only productive type is Robusta. The problem that farmers often experience is diseases that attack coffee plants; since 2019, the harvest has not been optimal due to too high rainfall. In addition, the transportation process of delivering produce has experienced obstacles in the last three years until now. Then, roasting coffee is still a reliable feeling in the sorting process, which is still manual, relying on human labor, and in the drying process, which relies on the weather. However, not all achieve this roasting process; they only reach the stage of *green bean*. The main problem is that no coffee husk handler will eventually become waste; most of the coffee husks and shells will be wasted. Therefore, *waste non-value added* (NVA) must be handled to make *value added* (AND).

For this reason, with the change of *waste* that is *not added* to *the added value*, it is hoped that it will be more helpful. Therefore, this study uses the concept of *Lean manufacturing* with *value stream mapping tools* to understand the general overview of the production process flow and *value stream analysis tools* to find the right tools to get the appropriate results. The goal to be achieved is to know and minimize *waste* in the coffee production process. It was also getting an innovation from discarded coffee husks into *Value Added.*

2. Method

The author conducting this research is using a quantitative research model. Quantitative research is research that uses or relates to numerical data. In this study, the use of *Lean manufacturing* with *value stream mapping tools* to make *non-value added* into *value added* in the process. In addition, it also uses the *value stream analysis tools* method to identify *detailed mapping tools* as a tool used to identify waste in more detail. *Lean manufacturing* is a production system that uses energy efficiently and significantly reduces waste to meet consumer needs accurately. Goal *Lean manufacturing* eliminates waste (activities that do not add value) from the process so that activities along the value stream can generate added value [1].

According to Toyota's president, Fujio Cho, waste is anything other than the minimum elements required in the production process, such as tools, materials, and significant working time [2]. (Afif & Sudarto, 2022)

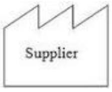
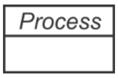
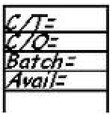
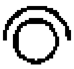
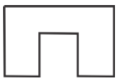
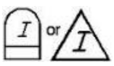
Process Cycle Efficiency (PCE) is an indicator that measures the extent of a process's efficiency. PCE compares time that provides added value *(value added)* and total processing time *(lead time).* The higher the value of this comparison, the more efficiently the process is considered to run [3]. Gasprez stated that process cycle efficiency is a measurement method that helps assess a plant's efficiency level. With this metric, we can evaluate how much time required in the production process contributes to the plant's overall production time. A process can be said to be *Lean* if the PCE value is> 30%

$$Process\ cycle\ efficiency = \frac{value\ added}{total\ lead\ time} \times 100\% \qquad (1)$$

Value Stream Mapping: One of the tools used to analyze l*ean manufacturing in context* is value stream mapping (*value stream mapping/VSM)*. Value streams refer to the entire set of activities, including activities that provide added value and activities that do not offer the added value needed to produce a product. It includes the production flow from raw materials to the final product that reaches the consumer and the design flow from concept to product launch. Value stream mapping is a method to describe the production process in detail by mapping the flow of materials and information at various levels, not only at the level of individual processes but also covering suppliers and customers [4].

The following table 1 describes the symbols or symbols used in the process category map.

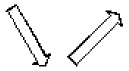
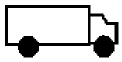
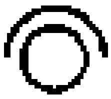
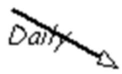
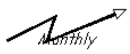
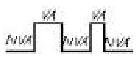
Table 1. Process Map Symbol or Symbol

It	Name	Symbol	Function
1	*Customer / Supplier*		*Suppliers* are usually represented in the upper left of the value flow map as a starting point for depicting material flows. Instead, the customer is typically placed in the upper right and represents the endpoint in the material flow in the image.
2	*Dedicated Process*		Identify processes, operations, machines, or departments in the material flow and avoid unnecessary details of any unwanted process steps.
3	*Shared Process*		Identify operational processes, departments, or workstations that belong to groups that share common *ground in the value stream*. In addition, estimate the number of operators required in the *value stream*.
4	*Data Box*		This symbol contains symbols that reflect the information or data needed to analyze and observe the system.
5	*Operator*		This symbol presents the operator and shows the number of operators needed in the process.
6	*Work Cell*		This shows how many processes are incorporated in the manufacturing working cells, such as cells that specialize in processing a family of products that have something in common or even just a single product.
7	*Inventory*		It describes the existence of stock or inventory between two processes. If there is more than one stock accumulation point, then one symbol is used for each of those stock accumulation points.

Value Stream Analysis Tools (VALSAT) is a method used to select tools from process flow mapping, which will then guide the identification of *waste* in detail. VALSAT is designed to map waste in *detail* in the value stream, focusing on processes that provide added value and processes that do not. VALSAT involves weighing different types of *waste*, and then appropriate tools are selected and used to assist researchers or practitioners in identifying *waste* in individual *value streams* and designing steps to eliminate it. *Value stream analysis tools (VALSAT)* consist of a few simple steps, namely:

1. Identification *of waste workshop* (waste weighting) To identify waste in the production process, the methods include observation and interviews with the parties involved. This interview consists of a number of questions related to *waste.*

Table 2. Overall Symbol or Emblem

It	Name	Symbol	Function
1	*Shipments*		It reflects how raw materials move from the supplier to the factory's final storage warehouse or how the final product moves from the factory storage warehouse to the consumer.
2	*Push Arrows*		It describes how materials move through a process without waiting for the demand or need from the process underneath.
3	*External Shpments*		This shipment occurs from supplier to consumer or from factory to consumer by using an external delivery service outside the factory environment.
4	*Production Control*		Presenting the scheduling of key productions.
5	*Manual Info*		It describes a general flow of information that comes from various sources, such as notes, reports, or communication interactions. The number and type of these data sources can vary.
6	*Electronic Info*		Presenting electronic flows such as through *electronic data interchange* (EDI), the Internet, LAN *(local area network), and* WAN *(wide area network).*
7	*Other*		It indicates information or other important things.
8	*Timeline*		It describes time that is part of the process that provides added value *(cycle time)* and time that is not part of the process that provides added value *(waiting time).* This symbol is used to calculate *lead time* and total *cycle time.*

(source: (Hafiz, 2019))

Table 3. Waste Workshop

It	Waste type	Score
1	Transportation (*waste of transportation*)	

It	Waste type	Score
2	Waste *of waiting*	
3	Overproduction	
4	Waste *of defact*	
5	Waste *of inventory*	
6	Waste *of unnecessary motion*	
7	Waste *of processing*	

Score description :

5 = occurs frequently (once a day)

4 = frequent (once every 2 days)

3 = almost often (once every 4 days)

2 = occurs occasionally (once a week)

1 = almost occasionally (once a month)

0 = not at all

Identification *of value stream analysis tools (VALSAT)* The table shows the following *tools* used in VALSAT.

Table 4. Value Stream Analysis Tools

Waste	*Mapping Tools*						
	PAM	SCRM	PVT	QFM	DAM	DPA	PS
Transportation	H						L
Waiting	H	H	L		M	M	
Overproduction	L	M		L	M	M	
Defect	L			H			
Inventory	M	L	M		H	M	L
Motion	H	H					
Processing	H		M	L			

(Source : (Fitri et al., 2018))

Information:

H (*high correlation and usefulness*) : 9

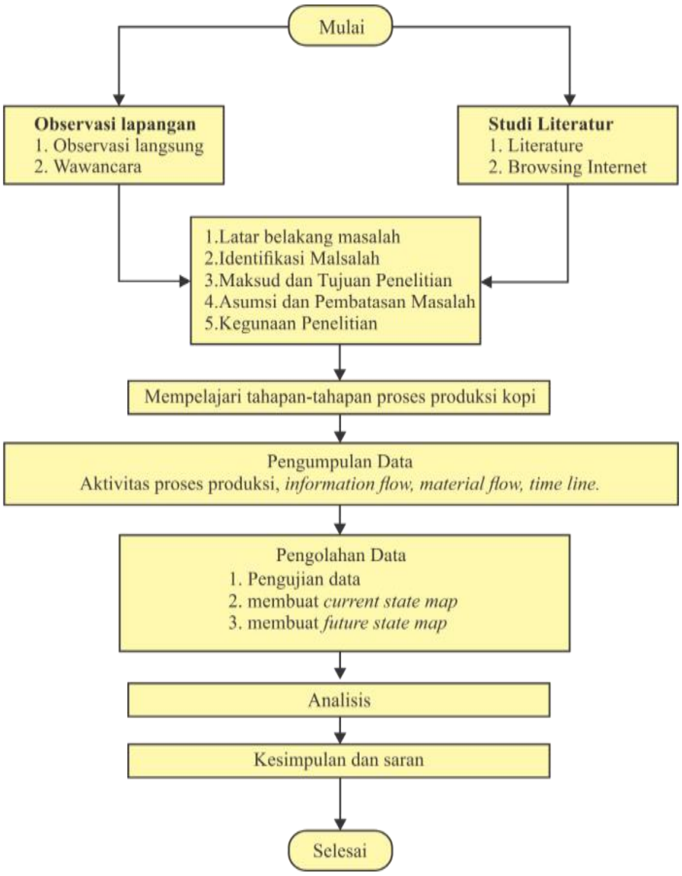
M (*medium correlation and usefulness*) : 3

L (*low correlation and usefulness*) : 1

The calculation involves diverting the result from the weighted average *waste* with the scores listed in the analysis tools table *Value Stream*. These seven tools will be used to understand the situation on the production floor with the help of an election matrix. In choosing a tool that suits the situation, an important step that needs to be taken is weighting *waste*. This weighting has a very crucial role because the accuracy of the weighting *waste* will affect the selection of suitable tools and make it easier to prepare a repair plan [5].

Fishbone diagram: This diagram displays the visual shape of fish bones, which shows a problem and also its causes and effects. The head of the fish is the result, while the bone contains the causes according to the approach of the problem. *Tools:* This is within the scope of manufacturing companies, including people, machines, methods, materials, and the environment [6].

Figure 1 shows *a flowchart* of the research flow to be carried out.



Picture 1. *Flowchart* research

In conducting this research, the author uses a quantitative research model. Here is how to solve the problem, namely:

1. Creating *current state mapping* is used to describe the current process and to identify waste in terms of time and areas for improvement.

2. Calculating *the process efficiency cycle* describes the efficiency level of a process at the moment.

3. Identify *waste workshops.*

4. Identify *waste* with *detailed mapping tools.*

5. Identify cause and effect.

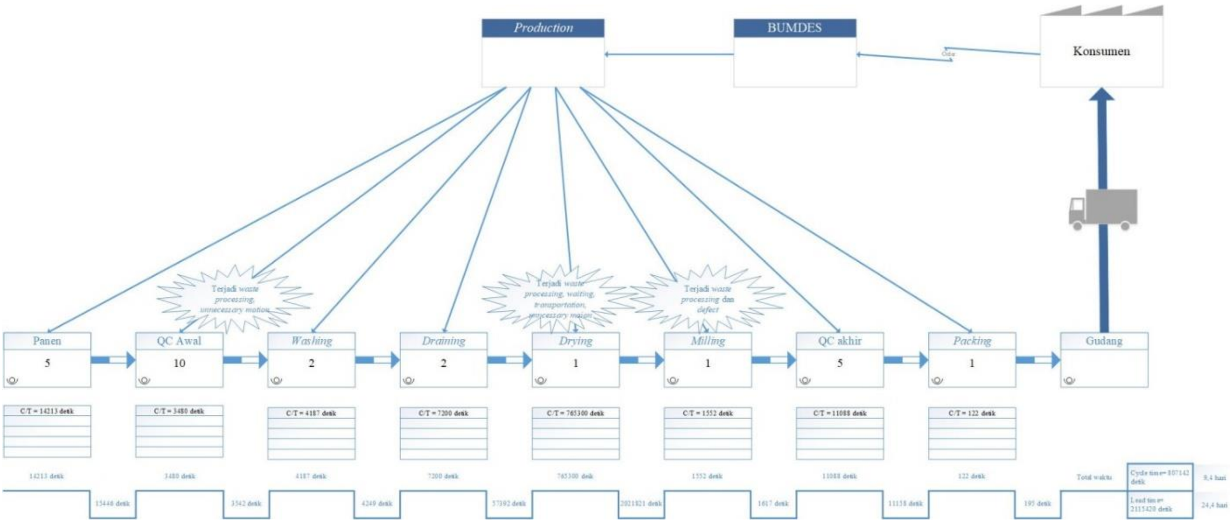
6. Proposed improvement projections and design proposals for all future processes are based on a series of *waste identification* and cause-and-effect identifications.

7. Creating *Future state mapping* is part of value *stream mapping*, and it involves depicting the transformation of a future design proposal.

8. Calculate *the process efficiency cycle*, describing the efficiency level in the future, based on the total *cycle time* and *lead time* on *the future state mapping.*

3. Discussion

Current state mapping After collecting data that supports the mapping of value streams, the next step is to design current *state mapping* for the coffee production process. The following is *the current state mapping* of the coffee production process, which can be seen in Figure 1 and Figure 2.



Picture 2. Current State Mapping

Based on *the current state mapping*, it can be seen that the total *cycle time* in the coffee production process is 807,142 seconds or 9.3 working days, and the *lead time* is 2,115,420 seconds or 24.4 working days. Where in this coffee production process, several processes result in *a longer lead time*, such as the *drying* process, which still relies on the weather, and the initial QC process, which should be done at the same time as the *washing*

Calculate *process efficiency cycle.*

$$Process\ Cycle\ Efficiency = \frac{807142}{2115420} \times 100\%$$

$$= 38{,}1\%$$

The efficiency value in the coffee production process at this time is 38.1%.

Identify *waste workshops*

Waste workshop identification (waste weighting) This action is carried out to collect score information regarding the possibility of waste *(seven waste)* in the coffee production process. Information about potential waste in the coffee production process can be obtained through observation, interview interactions, and filling out questionnaires aimed at individuals who have a deep understanding of the ongoing coffee production process.

After the questionnaire was filled out by parties related to the coffee production process as many as 3 respondents and the accumulated results were obtained as follows:

Table 5. Questionnaire Results

It	*Waste*	Respondents			Average Score
		1	2	3	
1	*Transportation*	2	1	4	2,3
2	*Waiting*	3	2	3	2,6
3	*Overproduction*	1	1	2	1,3
4	*Defects*	1	2	4	2,3

5	*Inventory*	1	2	3	2
6	*Unnecessary Motion*	3	1	2	2
7	*Processing*	1	1	1	1

Identification ***of Value Stream Analysis Tools (VALSAT)*** The results of the conversion of the seven waste weighting score with the *VALSAT matrix* are as follows:

Table 6. Weighted Score Conversion Results in *VALSAT Matrix*

Waste	**Waste *Score***	***Mapping Tools***						
		PAM	SCRM	PVF	QFM	DAM	DPA	PS
Transportation	2,3	20,7						2,3
Waiting	2,6	23,4	23,4	2,6		7,8	7,8	
Overproduction	1,3	1,3	3,9		1,3	3,9	3,9	
Defect	2,3	2,3			20,7			
Inventory	2	6	2	6		18	6	2
Motion	2	18	18					
Processing	1	9		3	1			
Total Score		80,7	47,3	11,6	23	29,7	17,7	4,3
Ranking		1	2	6	4	3	5	7

Based on the results of the selection of the VALSAT tools, it was obtained *that the detailed mapping tools* with the *highest score* were *processed activity mapping (PAM),* with a total score of 80.7. So *that the tool that will be used to identify waste further is* process activity mapping (PAM).

Process Activity Mapping (PAM) The basic idea of this tool is to describe every step of the activity that occurs, starting from the operation, transportation, inspection, delay, and storage, then classifying it into available activity types, ranging from *value-adding activities, necessary nonvalue adding activities* and *nonvalue adding activities.* With the understanding *that operation* and *inspection* are value-added activities (VA), while *Transportation* and *storage* are non-value-added but necessary activities (NNVA), *delay* is a non-value-added activity (NVA). The results of the PAM proportion can be seen in Table 7

Table 7. Process Activity Mapping

It	Code	Time (seconds)	Activity					Information
			O	T	I	S	D	
1	A1	612		V				NNVA
2	A2	14213	V					VA
3	A3	621		V				NNVA
4	B1	3480			V			VA
5	B2	62		V				NNVA

It	Code	Time (seconds)	Activity					Information
			O	T	I	S	D	
6	C1	65	V					VA
7	C2	380	V					VA
8	C3	3492	V					VA
9	C4	128			V			VA
10	C5	122	V					VA
11	C6	62		V				NNVA
12	D1	5952	V					VA
13	D2	1248	V					VA
14	D3	49896					V	NVA
15	D4	296		V				NNVA
16	E1	758160	V					VA
17	E2	7140	V					VA
18	E3	1256460					V	NVA
19	E4	61		V				NNVA
20	F1	190	V					VA
21	F2	1004	V					VA
22	F3	357	V					VA
23	F4	66		V				NNVA
24	G1	11088			V			VA
25	G2	70		V				NNVA
26	H1	117	V					VA
27	H2	5	V					VA
28	H3	73				V		NNVA

The Process *Activity Mapping (PAM) results* are then used to create a summary that will facilitate the analysis process. The recap of *process activity mapping (PAM)* can be seen in Table 8

Table 8. Recap of *Process activity mapping*

Activity	Sum	Time	VA	NNVA	NVA
Operation	14	792445	792445		
Transportation	8	1850		1850	
Inspection	3	14696	14696		
Storage	1	73		73	

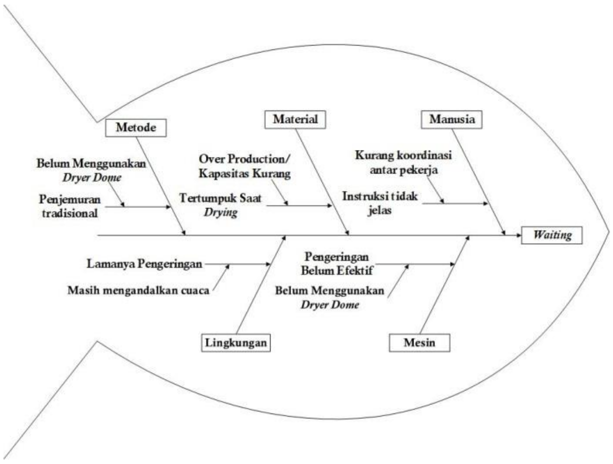
Activity	Sum	Time	VA	NNVA	NVA
Delay	2	1306356			1306356
Sum	28	2115420	807141	1923	1306356
VA, NNVA, and NVA Achievements		100%	38,2%	0,1%	61,8%

Based on the results of the grouping recap from *the process activity mapping*, the results of production activities were obtained in the form of *14 activities with* a time of 792,445 seconds, *inspection of 3* activities with a time of 14,696 seconds, *storage* of 1 activity with a time of 73 seconds, and *delay* of 2 activities with a time of 1,306,356 seconds. For VA presentations of 38.16%, NNVA is 0.09%, and NVA is 61.75%.

Fishbone Diagram: After obtaining the waste sequence through waste weighting, the next cause of *waste* in the coffee production process will be analyzed, namely *waiting*, *transportation*, *defect*, *inventory*, *unnecessary motion, overproduction,* and *processing.* The cause-and-effect diagram of *waste.* These are as follows:

1. *Waiting*

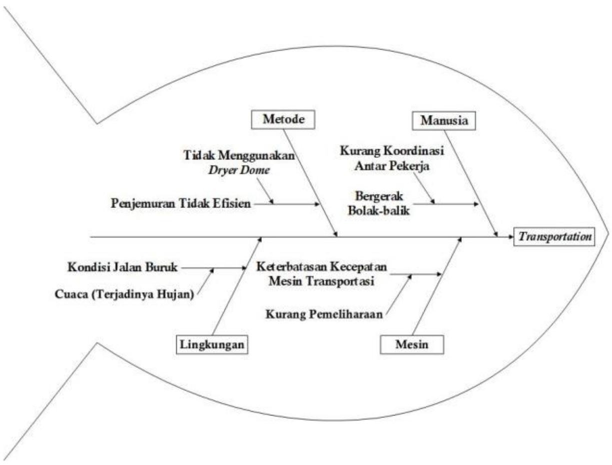
Some of the causes of *waste waiting* can be seen in the following diagram:



Picture 3. Fishbone diagram waste waiting

2. *Transportation*

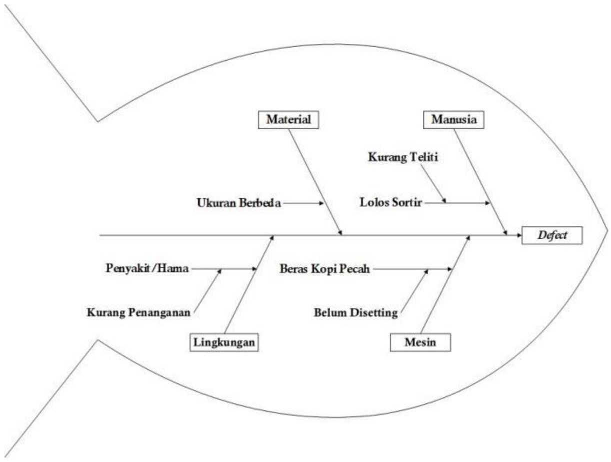
Some of the causes of *waste transportation* can be seen in the following diagram:



Picture 4. *Fishbone diagram waste transportation*

3. *Defect*

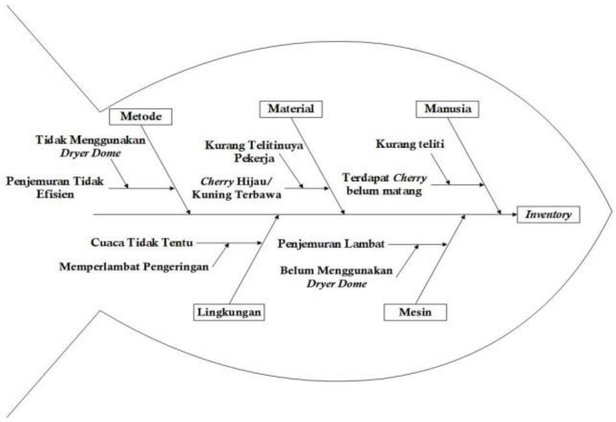
Some of the causes of *waste defects* can be seen in the following diag5ram:



Picture 5. *Fishbone diagram waste defect*

4. *Inventory*

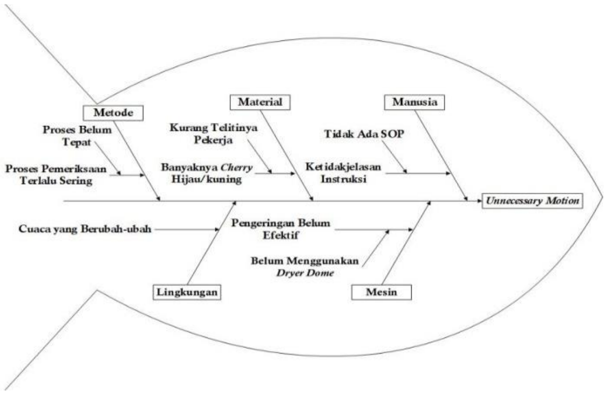
Some of the causes of *waste inventory* can be seen in the following diagram:



Picture 6. Fishbone diagram waste inventory

5. *Unnecessary Motion*

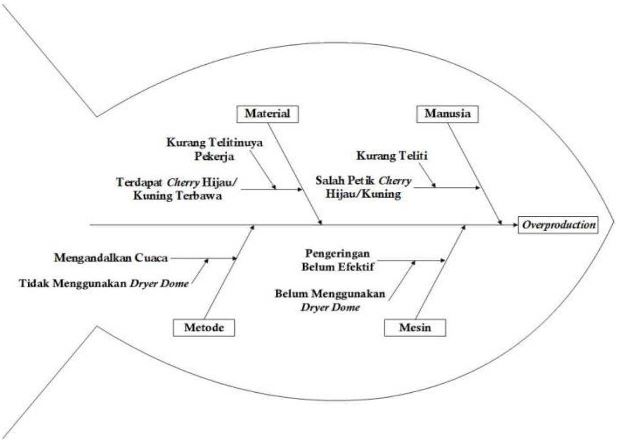
Some of the causes of *waste unnecessary motion* can be seen in the following diagram:



Picture 7. Fishbone diagram wastes unnecessary motion

6. *Overporduction*

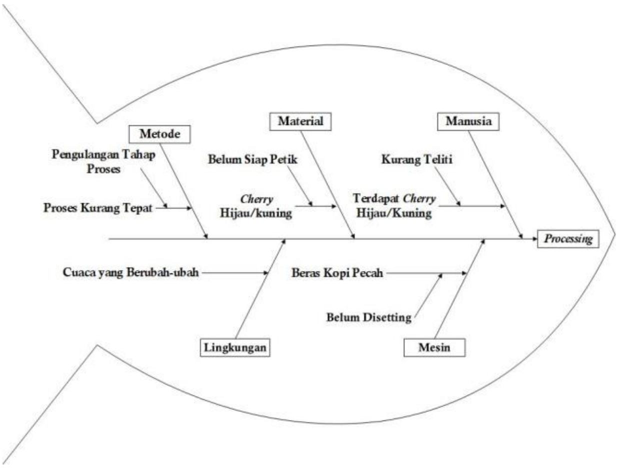
Some of the causes of *waste overproduction* can be seen in the following diagram:



Picture 8. Fishbone diagram waste overproduction

7. *Processing*

Some of the causes of *waste processing* can be seen in the following diagram:



Picture 9. Fishbone diagram waste processing

Proposed improvement projection after looking at the *current state mapping* in Figure 4 and Figure 5 and a series of identifications of *seven waste,* based on the identification of the *fishbone diagram*, it was obtained *that the coolie waste* and also the stages of the production process have almost the same function, the drying process is less effective. Therefore, there must be improvements to be more effective.

1. Proposal to Eliminate Initial QC

Based on observations in the coffee production process, the initial QC stage is a waste because this initial QC can also be done after the initial QC, namely at the *washing* stage. Therefore, the initial QC stage should be eliminated during the *washing* stage to reduce *lead time* and make it more effective. This proposal is to reduce *waste* that occurs in *processing, waiting, and unnecessary motion.*

2. Proposal for Making *Dryer Dome*

Based on observations from *current state mapping*, when drying still depends on the weather, and at night, coffee *cherries* will be stored in the warehouse, which will be a waste of time/*delay.* Therefore, the author proposes a modern drying method called *a dome dryer.* The advantage of doing this method is that it can shorten the time to 3 days faster. The energy even occurs with excellent effectiveness because there is no need for transportation/storage activities in the warehouse when the weather cannot be predicted accurately if it rains anywhere; there is no need to bother to secure *cherries* Coffee that is being dried in the sun because it is protected from rain, and is also cleaner because it avoids dust. This proposal is to reduce *waste* in the *waste waiting, transportation, inventory, and unnecessary motion section*

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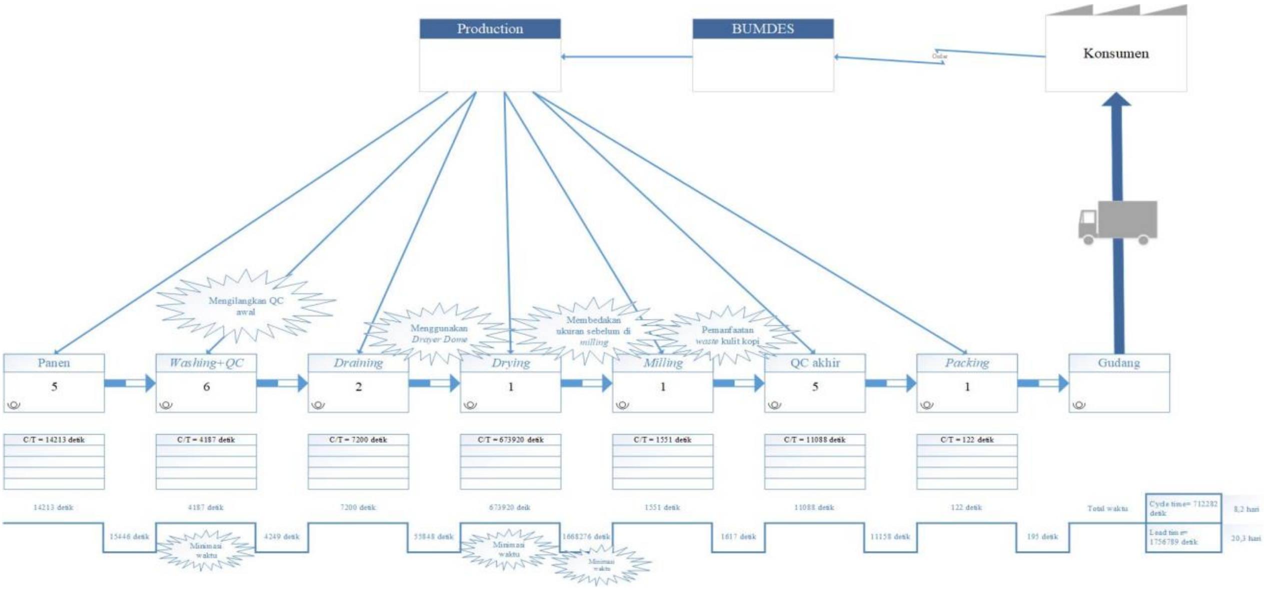
3. Proposal for Making Coffee Grain Size Filtration

Based on the identification of *the fishbone diagram*, *waste defects* occur because the coffee's size is different, resulting in *defects* in the *milling process* (coffee grain grinding). From the analysis results, the author proposes to make a filter of the size of the coffee grain.

4. Proposal for the Utilization of Coffee Peels

Based on the identification of *the fishbone* diagram, this coffee husk is still unused, so the husk becomes *waste* with no added value. This coffee husk is usually sold for 1,000 /kg, even though it can be used as a *cascara*, so the selling value will increase. So, coffee skins that were previously *non-value-added* can become *value-added. This waste* occurs in *processing* and *defects.*



Picture 10. ***Future State Mapping***

Table 9. ***Process Activity Mapping*** **After the Repair**

It	Code	Time (seconds)	Activity					Information
			O	T	I	S	D	
1	A1	612		V				NNVA
2	A2	14213	V					VA
3	A3	621		V				NNVA
4	B1	3480			V			VA
5	B2	62		V				NNVA
6	C1	65	V					VA
7	C2	380	V					VA
8	C3	3492	V					VA
9	C4	128			V			VA
10	C5	122	V					VA
11	C6	62		V				NNVA

It	Code	Time (seconds)	Activity					Information
			O	T	I	S	D	
12	D1	5952	V					VA
13	D2	1248	V					VA
14	D3	49896					V	NVA
15	D4	296		V				NNVA
16	E1	668088	V					VA
17	E2	7140	V					VA
18	E3	1000127	V					VA
19	E4	61		V				NNVA
20	F1	190	V					VA
21	F2	1004	V					VA
22	F3	357	V					VA
23	F4	66		V				NNVA
24	G1	11088			V			VA
25	G2	70		V				NNVA
26	H1	117	V					VA
27	H2	5	V					VA
28	H3	73				V		NNVA

(data processing)

Information

Unchanged

Eliminated

Time minimization

For future state mapping, the next action required is to integrate the improvement plan that has been prepared into the future state mapping and calculate the process cycle efficiency *(PCE)*. The following is the *complete future state mapping*.

Process *Cycle Efficiency Calculation:* After improvements are obtained in *the future state mapping*, the next is to perform a process *cycle efficiency calculation* to be able to find out the increase in efficiency, while the calculation of process cycle time based on formula 2.1 is as follows*:*

$$Process\ \ Cycle\ Efficiency = \frac{712282}{1756789} \times 100\% \ = 40{,}5\%$$

***Process Activity Mapping* after Repair** The *process of activity mapping* after the improvement can be seen in Table 9. Table 9 shows that with codes B1 (sorting) and B2 (transfer to *washing)* is, the initial QC process is eliminated because it is less effective if carried out. Furthermore, with the codes D2 (drying) and D4 (transfer to *drying*), it is a *draining process* with activities that are eliminated from the effects of using modern drying methods. Therefore, this process will be more efficient and save energy. Next, with code E2 (coffee grain rafting), the *drying* process is eliminated due to modern drying methods; therefore, this process will be more efficient and save energy. Then, with the codes E1 (drying) and E3 (storing in the warehouse), there is a *drying* process that will minimize the time caused by *modern drying* so that the process becomes faster. And the E3 code changed the category to (VA) *value added.*

The results of the mapping above activities will be recapped to make it easier to understand the point.

Table 10. Recap From *Process Activity Mapping* After the Repair

Activity	Sum	Time	VA	NNVA	NVA
Operation	13	1694112	1694112		
Transportation	6	1492		1492	
Inspection	2	11216	11216		
Storage	1	73		73	
Delay	1	49896			49896
Sum	23	1756789	1705328	1565	49896
VA, NNVA, and NVA Achievements		100%	97,07%	0,09%	2,84%

Based on the results of the grouping recap of the *process activity mapping,* the results of production activities were obtained in the form of *13 operations* with a time of 1,694,112 seconds, *transportation* six activities with a time of 1492 seconds, *inspection* two activities with a time of 11,216 seconds, *storage* one activity with a time of 73 seconds, and *delay* one activity with a time of 49.896 seconds. For VA presentations of 97.07%, NNVA is 0.09%, and NVA is 2.84%. From the explanation above, the presentation of VA values increases, and the presentation of NVA values can be minimized. This means that an increase in effectiveness has occurred so that the production process becomes better.

3. Conclusion

Information from *current state mapping shows* that *waste* in the production process is ineffective at the initial Qc stage because it can be done in the next process; this is part of *waste processing, waiting, and unnecessary motion*. The next waste occurs in the *process* of drying. *This waste occurs because drying is still traditional, relying on the weather; this is part of* waste waiting, transportation, inventory, and *unnecessary motion.* The next waste is a *waste defect; this waste* occurs because of the different sizes of coffee grains, so coffee rice breaks/coffee beans are wasted due to the grinding machine. The next waste is the lack of utilization of coffee husks. Therefore. Information from *current state mapping* that a total *cycle time* of 807141 seconds or 9.3 working days and a total *lead time* of 2115420 seconds or 24.4 working days can be obtained as mapped in *the current state mapping, then process* cycle efficiency (PCE) calculations *can be carried out* which is used to find out how efficient the coffee production process is at this time. So, after calculations were made, it was determined that the efficiency of the coffee production process at *the current* time was 38.1%.

After making improvements, we can get *future state mapping*. From there, we can see a *cycle time* of 712282 seconds or 8.2 working days and a total *lead time* of 1756789 seconds or 20.3 working days mapped in *the future state mapping.* Furthermore, the PCE calculation for the future coffee production process is 40.5%. Here, we can see that PCE has increased efficiency, in which initially, the PCE value was 38.1% to 40.5%, meaning an increase of 2.4%.

Based on the analysis that has been carried out and looking for literature, coffee husks that become *waste* can be used as *cascara tea*. This coffee husk is still unused, so it becomes *waste* that has no added value; this coffee husk is usually sold for 1,000,-/kg even though it can be used as tea, so the selling value will increase. So, coffee skins that were previously *non-value-added* can become *value-added.* This waste is included in *the waste processing* and *defect section.*

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