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Lean distribution to minimize waste of time in the stripping process at PT. Pelabuhan Indonesia IV Ambon Branch

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ABSTRACT

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Stripping process at PT. Port Indonesia IV (Persero) Ambon Branch plays a very important role for expeditions to receive goods from outside its area to meet market needs. However, in the process of distributing containers to stripping blocks, there is a delay in delivery thus it does not reach the target as a result of waste. Based on the data, it is identified that the total lead time of the stripping process is 3,670 minutes which has a non-value-added activity of 3,090 minutes. It is still found delay that causes the waste so that it needs improvement by minimizing the waste. The purpose of this study is to calculate the efficiency of identified wastes and the total activity of the initial time and time after improvement. Data analysis tools used lean distribution conducted by field observations, interviews, questionnaires, and documentation with data processing techniques in the form of big picture mapping, waste identification, value stream analysis tools (VALSAT), process activity mapping, fishbone diagrams, 5W+1H methods, as well as calculating the efficiency of the improvement time. The result of this study showed that there are four wastes of seven wastes identified namely waste of transportation, waste on unnecessary inventory, waste of defects, and waste of waiting time. Waste of waiting time is a critical waste with a percentage of 29.8% based on the results of questionnaires with the causative factors namely careless parking, not paying attention to stock/targets, limited places, indiscipline, and negligence. After the improvement by minimizing waste, the lead time is 1,550 minutes with a total efficiency of activities of 42%.

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1. Introduction

PT. Pelabuhan Indonesia IV (Persero) Ambon Branch is a State-Owned Enterprise engaged in port services centered on the City of Makassar since 1992. As the provider of space for expeditions via shipping available in Ambon City in the form of Spill, Temas, Meratus, and Tanto in carrying out the process of sending and receiving goods by using containers, PT. Pelabuhan Indonesia IV always focuses more on retrieving data for each item to be unloaded into containers to reduce constraints that occur between the company and the service user.

The problems that occur can be seen in the unloading block area and the stripping block area in the container distribution process, there is often a delay in the delivery of the containers during the stripping process which results in waste of time so that the implementation of these activities does not reach the specified target (delay) or because of the location of the stripping which has been full due to excessive container accumulation which has resulted in a build-up so that the block loading operator violates the rules by allowing the expedition to carry out the stripping process in the area.

Based on the data, the total lead time of the stripping process is 3,670 minutes with a value-added time of 557 minutes, then in the results of the questionnaire, it is identified that Waste of waiting time has a very high weight value of 0.30 which reaches 29.8% compared to the other identified waste. After that, based on the mapping of stripping activities in detail, it is noted that the non-value-added category has a large total time of up to 3,090 minutes, which means that delays are still found which causes waste of time that occurs during the stripping process.

For this reason, lean distribution tools are used to minimize waste in the stripping process at the container terminal which is caused by several activities that do not add value or waste of lead time. From the activities that do not provide added value, the causes and effects that occur will be identified thus it is necessary to identify the problems and analyze the constraints in detail to implement continuous improvement immediately.

Based on the background that has been stated, the authors are interested in researching with the title: "Lean distribution to minimize waste of time (waste) in the process of stripping activities at PT. Pelabuhan Indonesia IV Ambon Branch ". The objective of this study is to calculate the efficiency of identified wastes and time of total activity before and after the improvement in the stripping process.

2. Theoretical Review

2.1. Lean Distribution

Lean means slender, thin, straight. The lean distribution approach increases flexibility and simplicity to reduce reliance on forecasting and optimal planning to achieve results and focuses on reducing lead times and lot sizes. Lean Distribution is a journey from the complexity and rigor of forecasting-based optimization to the simplicity and flexibility of market-based pull systems [1].

The concept of lean distribution aims to reduce lead time, where a short lead time will reduce costs and improve customer service in the distribution system carried out by the company [2]. The Lean Distribution approach is an approach that can identify the wastes that occur in the process of distributing containers from the unloading block to the stripping block to reduce waste of time which results in many obstacles that can occur [3]. By using the lean distribution approach, it can be seen that in the process of distributing containers, there is a waste of lead time. The analysis showed that the improvement to reduce the waste should be implemented. Seven wastes from lean distribution in Mughni [4] include:

(1) Waste of Overproduction
    Waste occurs due to excess production in the form of finished goods or works in-process, but there are no orders from the customer.
(2) Waste of Unnecessary Inventory

Waste occurs due to unnecessary inventory which is the accumulation of finished goods and works in process (semi-finished goods) and excessive raw goods at all stages of production, thus requiring storage.

(3) Waste of Defects
Waste that occurs due to poor quality or damage so that repairs are required. This will result in additional costs in the form of labor costs, components used in repairs, and other costs.

(4) Waste of Transportation
Waste that occurs due to poor production layout, poor workplace organization that requires moving goods from one place to another. For example, a warehouse location that is far from production. Errors in the production layout arrangement can result in ineffective production which will cause high processing time, and non-value-added movement thus the output is not optimal.

(5) Waste of Unnecessary Movement
Waste occurs because of unnecessary movements of workers and machines and does not provide added value to the work. For example, placing a component out of reach of the operator, requiring movement from the working position to pick up the component.

(6) Waste of Waiting
When a person or machine is not doing the job, the status is called waiting. Waiting can be due to an unbalanced process so that some workers and machines have to wait to do their work, damage to machines, a late supply of components, loss of work tools, or waiting for certain decisions or information. This can be minimized by measuring the time required to produce each product. This measurement must be carried out for each activity in the production line, to detect which processes that have the potential to cause waiting processes.

(7) Waste of Inappropriate processing
Occurs in situations when there is a mismatch in the production operation process/method resulting in the use of tools that are not suitable for their function, procedural errors, or the operating system. For example, repeated inspection processes, approval processes that have to go through a lot of people, the cleaning process. All customers want high-quality products, but the most important thing is not a repeated inspection process but how to guarantee product quality in the manufacturing process. The solution is to find the root cause of a problem and take action (countermeasure) following the root cause.

2.2. 5W + 1H method

5W + 1H method is an action plan that contains any improvement action. This principle contains 6 kinds of questions as follows:

(1) What is the main target of improvement?
(2) Where is the plan will be implemented?
(3) When is the plan will be best implemented?
(4) Who will work on the plan by identifying the organizational structure to determine the position responsible for implementing improvement?
(5) Why is the plan required?
(6) How are the steps in implementing the plan?

3. Method

3.1. Variables and Operational Definitions

The research variables include the dependent variable and the independent variable which are formulated as follows:

$$Y = f(x_1, x_2, x_3) \qquad (1)$$

Information:
Y = Waste of Waiting (%)
x_1 = Waste of Transportation (%)
x_2 = Waste of Unnecessary Inventory (%)
x_3 = Waste of Defect (%)

(1) Waste of Transportation (%)
Waste of transportation is not considered a dependent variable because it has activities that have no added value and can affect waste of waiting. After all, it has an impact on the waiting time that occurs. The result of the waste of transportation efficiency is based on the waste of waiting time thus waste of waiting is influenced by activities in the waste of transportation.
(2) Waste of Unnecessary Inventory (%)
Waste of unnecessary inventory is not considered to be dependent because it has activities that have no added value and can affect waste of waiting. After all, it has an impact on the waiting time that occurs. The efficiency result of waste of unnecessary inventory is based on the result of waste of waiting time thus waste of waiting is influenced by activities in the waste of unnecessary inventory.
(3) Waste of Defects (%)
Waste of defects is not considered to be dependent because waste defects have activities that do not have added value and can affect waste waiting because they have an impact on the waiting time that occurs. The efficiency results of the waste of defect are based on the waste of waiting time thus waste of waiting is influenced by activities in the waste of defects.

3.1. Data Analysis Method

The method in this study is quantitative in identifying the waste that occurs during the stripping process so that it can be seen that the waste is very high and critical. The completion of this analysis also uses the lean distribution method. The following is a flowchart of research steps presented in Fig. 1.

3.2. Data Processing

3.2.1. Big Picture Mapping

The first step is to describe the big picture mapping of the stripping process at the container terminal using a 20 feet container truck. Figure 2 shows the flow of the container distribution process starting from the check-list of each new container arriving at the unloading block (stacking field) to the delivery of goods brought by the expedition with a total processing time of 3,109 minutes and a value-added time of 557 minutes. Figure 2 describes 6 work processes from stripping activities with a lead time of 3,670 minutes and 550 value-added times.

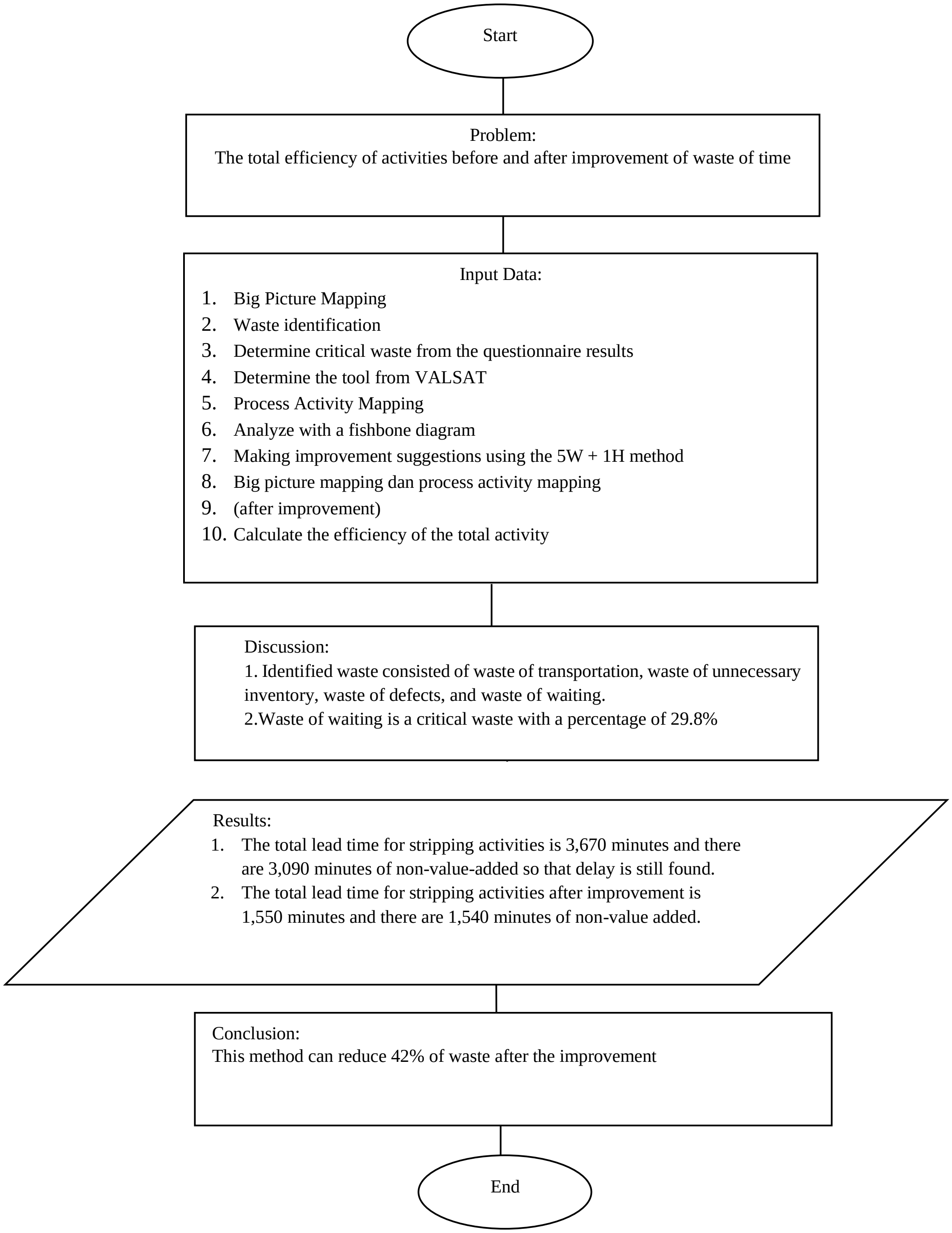

Fig.1. Research steps

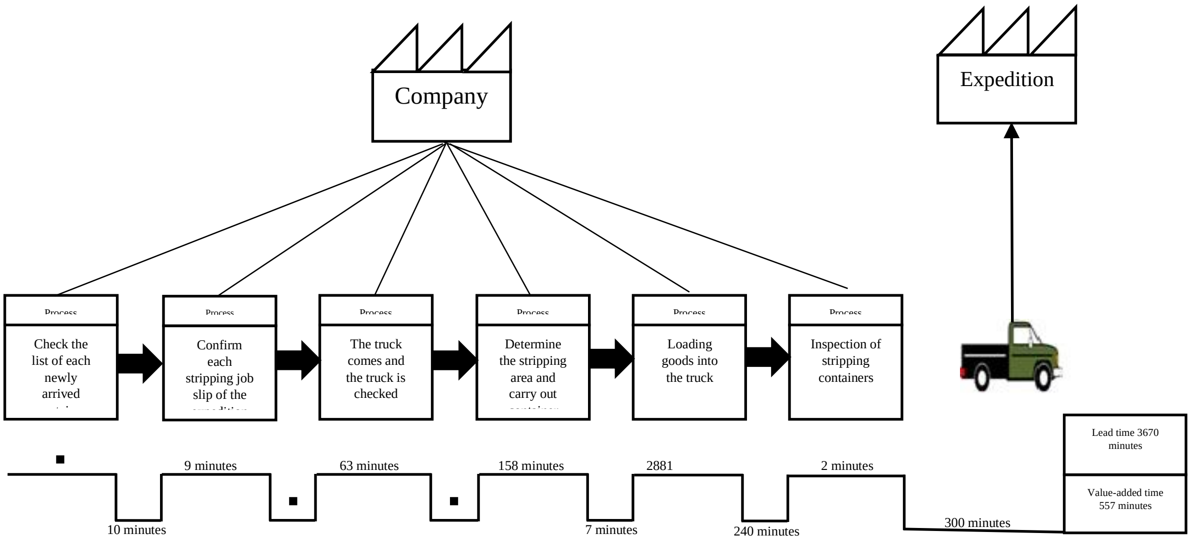

Fig. 2. Big picture mapping of the stripping process

3.2.2. Identification of Waste in the Stripping Process

Table 1. Identification of waste

Code	Activities
	A. Transportation
A1	The head truck rotates repeatedly in the stripping area to find a place to put the container.
	B. Unnecessary Inventory
B1	There is a stack of containers in the stripping area which results in limited space.
	C. Defect
C1	Damage to the reach stacker and other transportation equipment that hinders work.
	D. Waiting
D1	Waiting for the truck that is relocating empty containers to the regional government area.
D2	There was a queue of vehicles while delivering containers from the unloading block to the stripping block.
D3	Waiting for the expedition to carry out the stripping process has delayed other work.
D4	Waiting for trucks from the expedition to come to pick up / finish the goods in containers to avoid accumulation.
	E. Inappropriate Processing
	Not found
	F. Unnecessary Motion
	Not found
	G. Over Production
	Not found

3.2.3. Determining Critical Waste in the Stripping Process

Table 2 shows the weighting of waste based on the questionnaire. In the Pareto diagram, it can be seen the percentage of each identified waste. Waste of defects is included in the low group with a percentage of 18.6%. Waste of transportation has a percentage of 23.6% categorized as high. Waste of unnecessary inventory included as high with a percentage of 28% and waste of waiting categorized as very high has a percentage of 29.8 %.

Table 2. The weighting of waste based on the questionnaire

No	Waste	Weighting										Score	Weigh	Rank
		1	2	3	4	5	6	7	8	9	10			
1	Transportation	5	3	4	4	4	3	5	3	3	4	38	0.24	3
2	Unnecessary Inventory	5	5	5	5	4	5	4	4	4	4	45	0.28	2
3	Defect	2	2	4	3	3	2	3	4	4	3	30	0.18	4
4	Waiting	5	5	5	4	5	5	4	5	5	5	48	0.30	1
		Total Score										161	1	-

3.2.4. Tool Selection with Value Stream Analysis Tools (VALSAT)

Table 3. Correlation score of wastes with VALSAT

Waste	PAM	SCRM	PVF	QFM	DAM	DPA	PS
Transportation	9	0	0	0	0	0	1
Unnecessary Inventory	3	9	3	0	9	3	1
Defect	1	0	0	9	0	0	0
Waiting	9	9	1	0	3	3	0

Information:
PAM : Process Activity Mapping
SCRM : Supply Chain Response matrix
PVF : Product Variety Funnel
QFM : Quality Filter Mapping
DAM : Demand Amplification Mapping
DPA : Decision Point Analysis
PS : Physical Structure

The calculation results of four wastes with each tool are shown in Table 4. From the results of calculations, the data were ranked based on the highest to lowest score. Table 5 describes the tools ranking in VALSAT.

Table 4. Calculation of the VALSAT score

Waste	PAM	SCRM	PVF	QFM	DAM	DPA	PS
Transportation	2.16	0	0	0	0	0	0.24
Unnecessary Inventory	0.84	2.52	0.84	0	2.52	0.84	0.28
Defect	0.18	0	0	1.62	0	0	0
Waiting	2.7	2.7	0.30	0	0.9	0.9	0
Total	5.88	5.22	1.14	1.62	3.42	1.44	0.52

Table 5. Ranking tools in VALSAT

Waste	Weigh	Rank
Process Activity Mapping (PAM)	5.88	1
Supply Chain Response Matrix (SCRM)	5.22	2
Demand Amplification Mapping (DAM)	3.42	3
Quality Filter Mapping (QFM)	1.62	4
Decision Point Analysis (DPA)	1.44	5
Product Variety Funnel (PVF)	1.14	6
Physical Structure (PS)	0.52	7

According to Table 5, it can be seen that the tool selected with the highest score is Process Activity Mapping (PAM) with a total score of 5.88. Process Activity Mapping (PAM) is a tool used to map all distribution activities in detail including the physical flow and information that occurs, the time required for each activity, and the traveled distance.

3.2.5. Process Activity Mapping (PAM)

In the second step, the Process Activity Mapping will map the stripping activities in more detail, thus the total activity and the total working time involved in the activity are calculated as presented in Table 6.

Table 6. Process activity mapping of stripping activities

No	Activity	Time (Minute)	TK Total	O	T	I	S	D	Category VA
1	Check the list of containers when brought to each RTG in the unloading block	10	1			I			VA
2	Operators check the expedition's order slip	3	1			I			NNVA
3	Approval from the operator to carry out the Stripping process	1	1	O					NNVA
4	Shows the position of the containers in the loading block to the expedition	5	1	O					NNVA
5	Waiting for the expedition truck to come to Pelindo	60	0					D	NVA
6	Checking the truck before entering the container terminal	2	2			I			NNVA
7	The truck enters the stripping area	1	2		T				NNVA
8	Waiting for the officers to find a place to do the stripping	30	0					D	NVA
9	Waiting for the availability of transportation to transport containers	120	0					D	NVA
10	Containers are transported using RTG in the unloading block	7	1	O					VA
11	The containers are delivered to the stripping area	3	1		T				NNVA
12	The containers are placed using the Reach stacker vehicle	5	1		T				NNVA
13	The containers are unloaded and loaded into the truck	240	2	O					VA
14	Container inspection by stripping area operators	1	1			I			NNVA
15	Waiting for loading process activities from the expedition	2880	2					D	NVA
16	Checklist for containers that have not been stripped	1	0			I			NNVA
17	Check the list of empty containers	1	1			I			NNVA
18	The truck leaves to deliver the goods	200	2		T				VA

Information:

VA : Value Added (activities that have added value in the stripping process)
NNVA : Necessary Non-Value Added (activities that do not have added value but still need to be carried out in the stripping process)

NVA	:	Non-Value Added (activities that do not have added value in the stripping process)
O	:	Operation
T	:	Transportation
I	:	Inspection
S	:	Storage
D	:	Delay

Table 7. Total processing time in the process activity mapping (minutes)

Type of Activity	Number of Activities	Percentage
Operation	5	28%
Transportation	4	22%
Inspection	5	28%
Storage	0	0%
Delay	4	22%
Total	18	100%

Table 8. PAM results summary

Category	Number of Activities	Time	Percentage
Value Added (VA)	4	557	15%
Necessary Non-Value Added (NNVA)	10	23	1%
Non-Value Added (NVA)	4	3090	84%
TOTAL	18	3670	100%

To identify the factors that can cause waste, a fishbone diagram was used to analyze. The results of the fishbone diagram regarding the factors of waste are presented in Fig. 3 to Fig. 6.

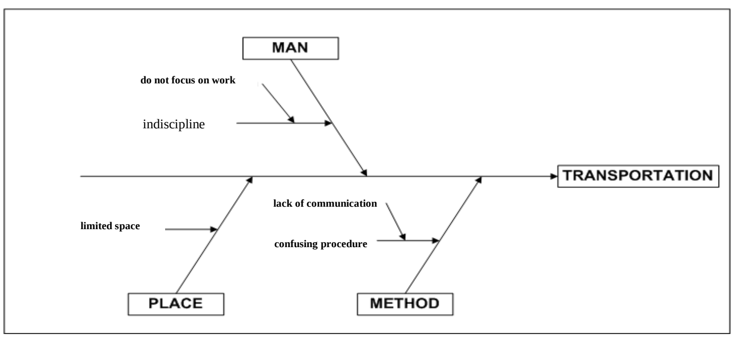

Fig. 3. Fishbone diagram analysis of waste of transportation

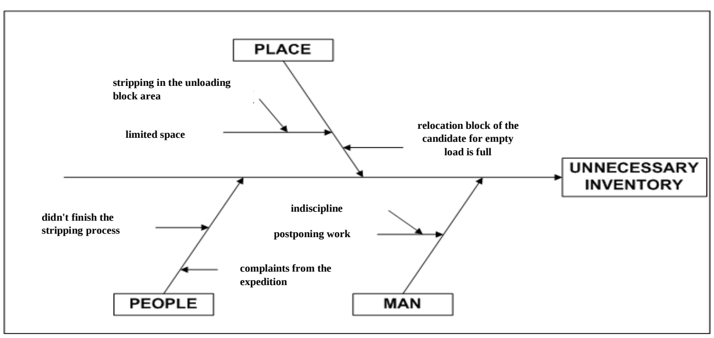

Fig. 4. Fishbone diagram analysis of waste of unnecessary inventory

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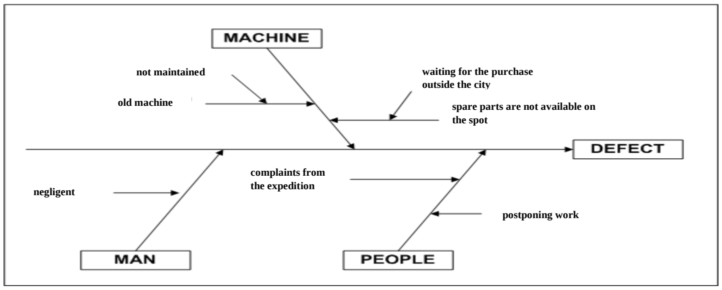

Fig.5. Fishbone diagram analysis of waste of defects

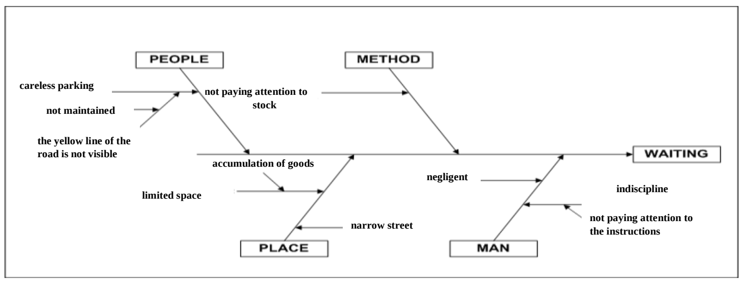

Fig. 6. Fishbone diagram analysis of waste of waiting

3.3. Design of Proposed Improvements for the Stripping Process

Table 9. Design of proposed improvements for the stripping process

Aspect	Description
What	Improving the process of container stripping activities by paying attention to the number of targets to be achieved per day, paying attention to the rules that should be obeyed, and paying attention to other obstacles that cause waste to occur.
Where	Block Unloading (RTG) to Block Stripping (TPS)
When	During the stripping process
Who	Block stripping and block unloading officer operators and the expedition.
Why	To reduce excessive time waste in the process of stripping activities and to avoid complaints arising from the expedition.
How	• Block stripping and block unloading officer operator section 1. Repaint the yellow line of the road as a driving limit. 2. Reinforce any applicable rules and provide more consequences for those who break them. 3. Always control each target container that will carry out stripping activities per day. 4. Ensure that every working procedure is carried out properly and does not confuse workers, one of which is the Handy Talky communication tool that must be used at all times. 5. Paying attention to every empty container to always relocate it at the right time which does not take place during the stripping process. 6. Immediately act quickly to repair tools that are not adequate for stripping activities. • Part of the expedition 1. Complete the responsibility to immediately pay off the container payment invoices to avoid an accumulation of either the unloading block or the stripping block. 2. Obey the rules that apply to the company and will get consequences if you break them. 3. Do not delay completing the stripping because it will burden field workers for limited space. 4. Pay more attention to every vehicle used so as not to park carelessly.

3.4. After Improvement

Based on the results of the calculations, the results of efficiency from the initial time and the time after the improvements made by minimizing time on activities that do not have added value are identified. In the waste of transportation, it was known that the previous time in the stripping process of the 8th activity namely waiting for officers to find a place to do the stripping is reduced from 30 minutes to 10 minutes with an efficiency of 67%. In the waste of unnecessary inventory, the previous time in the stripping process of the 15th activity namely waiting for the loading process from the expedition is minimized from 2,880 minutes to 1,440 minutes with an efficiency of 50%. In the waste of defects, it is known that the previous time in the stripping activity process of the 9th activity namely waiting for the availability of transportation to transport containers is reduced from 120 minutes to 60 minutes with an efficiency of 50%. In the waste of waiting, it is known that the previous time in the stripping process for all activities including non-value-added in the stripping activity process is reduced from 3090 minutes to 1,540 minutes with an efficiency of 50%.

Then the total efficiency of the initial activity time is 3,670 minutes to 2,120 minutes reaching an efficiency of 42% which means that improvements by reducing the time of the process and not eliminating the whole process can greatly help the company to avoid problems that can cause wastes, especially waste of waiting. Waste of waiting is identified as a very critical waste and the company can set the target achieved with the appropriate time.

4. Conclusion

Based on the results of the study using lean distribution tools, it is obtained that a very critical waste is waste of waiting because it has 4 activities that do not provide added value, and based on the results of the questionnaire it reached 29.8% compared to the waste of transportation which reached 23.6%, waste of unnecessary inventory which reached 28%, and waste of defects which reached 18.6%. There is efficiency after improvement by minimizing time of activities that do not add value, it is identified that the efficiency after the improvement of waste of transportation, waste of unnecessary inventory, waste of defects, and waste of waiting is 67%, 50%, the waste defect is 50%, and 50% respectively. The total efficiency of the stripping process reached 42% and it can help the company reduce the problems that cause wastes.

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