



ANALYSIS OF CONTINUOUS QUALITY IMPROVEMENT USING WASTE ASSESSMENT MODEL AND DEMING CYCLE METHOD (STUDY CASE: TAPIOCA STARCH MANUFACTURING)

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ABSTRACT

This study explains what waste occurs in the manufacturing industry, where there are 7 wastes, namely excess production, waiting time, unnecessary transportation, excessive processes, excess inventory, unnecessary movements, and defective products. As a result of this waste, the company has lost an output of 46 tons in 1 semester. The purpose of this research is to find out the critical waste and the source of the waste that occurs in the manufacturing industry and then reduce the waste using the waste assessment model and the deming cycle method. The method used to identify waste is the waste assessment model. The waste assessment model consists of 2 stages, namely the waste relationship matrix to determine the relationship between waste and a waste assessment questionnaire to identify the causes of waste. The results of this study obtained critical waste from 7 wastes, namely defect waste with a percentage of 27.94% and the cause of the waste is the frequency of machine breakdowns that occur in area 2 production. It can be concluded that the critical waste in this research is defect waste that originates from engine damage in the production area and within a quarter the waste has been eliminated so that it can maximize the production process.

Keywords: waste assessment model, deming cycle, 7 waste, continuous improvement

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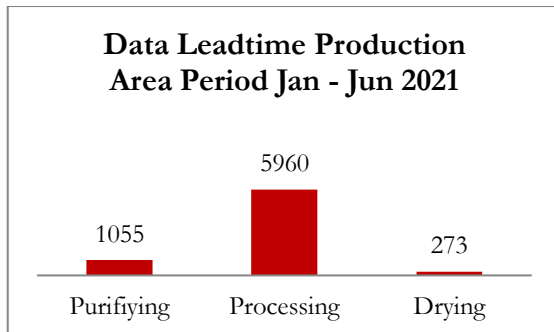


1. INTRODUCTION

Waste is any type of work activity that does not add value to the process of changing inputs into outputs. The waste consists of two forms, namely form 1 and form 2. Form 1 is waste that has no added value but this activity cannot be avoided. While form 2 is waste that does not add value and must be eliminated because this waste can reduce the quality of a production process (Gaspersz and Fontana, 2007). Because of this waste that can reduce the quality of production, it is necessary to use the Lean method to reduce waste that occurs in the production line.

There is 7 waste that occurs in the manufacturing industry. PT ABC is a manufacturing company that produces tapioca flour. Tapioca flour is obtained by processing cassava with a certain starch content and yield. The processing process also goes through several stages, starting from the RM input process, washing, milling and rasping extracting, refining, dewatering, drying, and packaging.

The following is data on the waste that occurs in the tapioca flour company's production line :



Based on the waste data in the company that will be studied and some of the existing literature, the application of identification of 7 wastes in the company to be researched does not implement problem identification based on all aspects of the 7 wastes so that the target for improvement is not appropriate/main, the researcher proposes to conduct research related to the development of the PDCA method by determining the critical waste point with the Waste Assessment Model (WAM) method first and then using the PDCA method in compiling solutions or improvements to critical waste.

WAM is used to check and resolve which wastes should be prioritized in the implementation of improvements (Ali and Fahad, 2007). The WAM stage consists of 2 stages, namely the waste assessment matrix and the waste assessment questionnaire. While the PDCA method is used to reduce critical waste that occurs from WAM. The PDCA method is a model of continuous improvement developed by W. Edward Deming which consists of 8 stages but in general, the stages are plan, do, check, and action (Gaspersz, 2012).

2. METHODS

The stages of the research methodology in this study are described below.

1. Problem Identification

The initial stage carried out in this research is to identify the problem. This stage is needed to find out the problems that occur in the object of research observation.

2. Literature Study

The literature study was conducted to obtain references related to the problems that exist in the object of observation. The literature study is used as a basis for solving problems by existing theories. In this study, the literature study used includes Lean, waste classification, Waste Assessment Model (WAM), and PDCA. Literature studies are carried out continuously according to research needs until the research ends.

3. Field Study

Field studies were conducted to determine the existing condition of the company. Field studies are conducted by observing the production process and the problems that exist in the object of observation. In addition, data collection is carried out to support problem-solving on the object of observation. The information was obtained through observation, interviews, and direct data collection.

4. Problem Formulation

Formulation of the problem is obtained based on the identification of problems that have been done previously. The formulation of the problem used in this study is how to reduce

the waste that arises with the waste assessment tool on lean at PT. ABC .

At the PDCA stage, it is then broken down into 8 steps, the following is an explanation of the 8 steps :

Step 1. Define the problem and determine the theme of improvement

Step 2. Looking for all possible causes

Step 3. Analyze the root cause of the problem

Step 4. Planning corrective action

Step 5. Carry out repairs

Step 6. Study the improvement results

Step 7. Standardize solutions and best practices

Step 8. Make a final report and determine the next improvement plan.

5. Data collection and processing stage

This stage consists of two main stages, namely data collection and data processing. At the data, collection stage is an activity carried out to obtain the data needed relating to research. At this stage, the data collected from the company during the research was carried out. The steps are taken in data collection:

- Definition of the company's general picture.
- Identification of waste by distributing questionnaires using the Waste Relationship Matrix and the Waste Assessment Questionnaire.

Waste identification is used to determine the type of company waste classification. The identification of waste used uses 7 wastes, namely overproduction, waiting, transportation, excess processing, inventory, motion, and defect (Bhalaji et al, 2020).

After knowing the classification of each waste, then identification is done using the method in the Waste Assessment Model. At this stage, data collection is needed by distributing questionnaires that will be used as input in the Waste Relationship Matrix and Waste Assessment Questionnaire. The waste relationship matrix is carried out by discussion based on a questionnaire that has been compiled by Rahabdeh (2005) to determine the relationship between waste. Discussions and brainstorming were carried out with company experts. The waste assessment questionnaire was conducted using a questionnaire aimed at company experts.

c. Selection of critical waste

d. Waste improvement recommendations with PDCA

3. FINDINGS AND DISCUSSION

3.1. Waste Assessment Matrix

After conducting interviews and filling out questionnaires based on aspects of questions (Rawabdeh, 2005), then the score results from the level of the interrelationship between waste will be converted into values.

Table 1. The results of the waste relationship matrix conversion

F/T	O	I	D	M	T	P	W	Total	%
O	10	8	0	0	6	0	0	24	13,48
I	8	10	10	0	0	0	6	34	19,10
D	10	0	10	6	0	10	8	44	24,72
M	0	0	0	10	6	0	0	16	8,99
T	0	0	0	8	10	0	0	18	10,11
P	0	0	10	0	0	10	0	20	11,24
W	6	6	0	0	0	0	10	22	12,36
Total	34	24	30	24	22	20	24	178	100
%	19	13	17	13	12	11	13		

Based on table 1, it is known that the waste that has a large enough influence on other waste "from" is a defect with a percentage of 24.72%. And the waste that occurs caused by other waste "to" is overproduction waste with a percentage of 19.10%.

3.2. Waste Assessment Questionnaire

Waste assessment questionnaire is a questionnaire that contains questions to identify sources of waste that occur in the work environment (Rawabdeh, 2005). The table below shows the results of calculations to find out what is the most dominant waste that occurs in the work environment.

Table 2. Critical waste calculation

	O	I	D	M	T	P	W
A	0,88	0,89	0,84	0,85	0,86	0,82	0,81
B	257	257	417	121	125	126	167
C	226	229	351	103	108	103	135
D	18	18,28	27,94	8,20	8,59	8,21	10,77
E	3	2	1	7	6	5	4

Description :

A : Score (Yj)

B : Pj Factor

C : Final result (Y Final)

D : Persen final result

E : Rank

From table 2 it can be concluded that the most dominant or critical waste that occurs in the work environment is defect waste with a percentage of 27.94% then the second largest critical waste is inventory waste with a percentage of 18.28%.

3.2. Deming Cycle Method

This method consists of 8 steps, after knowing the critical waste that occurs, the next step is to reduce the waste using the Deming Cycle (PDCA) method.

a. Step 1 (Defining the problem and determining the theme of improvement)

PT ABC is a manufacturing company that processes cassava into tapioca flour. The following is a waste defect in the engineering division.

No	Problems	Time (s)	Frekuensi						Total
			Jan	Feb	Mar	Apr	May	Jun	
	screen								
3	HC pump no 4 problem	320	1	0	0	0	0	0	1
4	Maintenance pump HC L150T	211	1	2	0	0	1	0	4
5	Vibrating pillow block replacement	193	0	0	2	0	0	0	2
6	Repair Air Locker 1 & 2 L150T	190	0	1	0	0	0	0	1
7	Rasper 2 foreign sound	145	0	0	0	1	0	0	1
8	Troubleshoot finesieve screw repair	125	1	0	0	0	0	0	1
9	Inclined belt conveyor shift	122	0	1	0	0	1	0	2
10	Replacement mechanical seal pump HC L150T	105	0	0	1	0	0	0	1
Total		3196							

Table 3. Mechanical damage data for the period January - June 2021

No	Problems	Time (s)	Frekuensi						Total
			Jan	Feb	Mar	Apr	May	Jun	
1	Broken vacuum agitator	1392	1	0	1	3	1	15	21
2	Trouble vibrating	393	0	1	3	0	0	0	4

Based on table 3 data on mechanical damage shows the most damage time is damage to the vacuum drum machine where the agitator part of the vacuum is often broken. So the repair theme raised is reducing mechanical downtime due to a broken vacuum agitator in area 2 processing.

b. Step 2 (Looking for all possible causes)

This step is a follow-up step from step 1 to identify all possible causes for the problem identified in step 1.

No	Factors	Problems	Standard	Notes	Results	Area	PIC	Deadline
1	Material	The pneumatic diaphrag material is not thick enough to break easily	Standard size 30 mm	The thickness of the pneumatic diaphrag material is appropriate	No effect on improvement	Influence on improvement	Engineering team	24 Sept 2021
2	Machine	The pneumatic diaphrag is easily broken because it is only connected by welding and the gap of the bolt to the nut is too short	No standard	Improper connection of the agitator shaft using welding because the load is too heavy	Influence on improvement		Engineering team	24 Sept 2021
		The pneumatic cylinder holder does not match so the diaphrag and cylinder shaft is not functional	No standard	Screw holes and ball joint shaft are not in the same direction			Engineering team	27 Sept 2021
3	Method	Improper vacuum threshing method causes the agitator load to be heavy	MAY/PRC/LUC NBA/PRD/PRC/8/000	At the time of threshing the remaining sticky product is not cleaned			CI	27 Sept 2021
4	Man	The operator has not carried out the vacuum threshing stage	Following the Operational Vacuum Drum procedure	A lot of product builds upon the agitator shaft			Production team	27 Sept 2021
5	Environment	-	-	-	No effect on improvement		-	-
6	Motivation	-	-	-			-	-
7	Money	-	-	-			-	-

Figure 1. Brainstorming

Figure 1 is the result of brainstorming or gathering ideas to find out the cause of the damage and solve the problem of the damage that occurred. 7 factors become the focus of the brainstorming technique used, namely material factors, machine factors, method factors, man factors, environmental factors, money factors and motivational factors. However, not all factors affect the problems that occur, only machine factors, method factors and man factors that affect the problem.

c. Step 3 (Analyze the root cause of the problem)

The next step is to analyze the root causes of the problems that arise. Root cause analysis (RCA) to analyze a system to find out and identify the cause of a problem. The tool used is a why-why diagram or fishbone diagram so that appropriate action on the root cause of the problem found eliminates the problem.

d. Step 4. (Plan corrective action)

The next stage is to determine the steps for planning corrective actions to the root causes of problems that arise. The method used for this planning is the 5W+2H method.

e. Step 5 (Carry out repairs)

This stage is the implementation of the improvement plan that has been made previously. During the implementation phase, it is also necessary to record data in case of deviations during the implementation process.

f. Step 6 (Study of improvement results)

At this stage, an evaluation of the improvements that have been made within 4-6 months after the repairs have been carried out is carried out. In addition, a saving cost calculation is also carried out for the repairs that have been made.

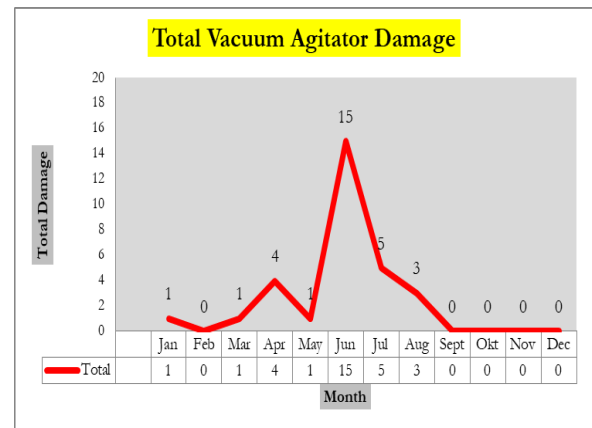


Figure 2. Graph of damage to vacuum agitator

From the results of the evaluation of the trend of damage to the vacuum agitator, it can be seen that in September - November 2021, there is no more damage to the vacuum drum agitator.

g. Step 7 (Standardize the repair solution)

After the repair is judged to be successful or not causing any other impact or damage, then the results of the repairs are made standard so that the results of the repairs carried out are standardized for future use. Standardization is done by standardizing work procedures.

h. Step 8 (Make a final report and determine the next improvement plan)

The last stage is making a report on the improvements that have been made or recording the progress of the improvement. Then look for or determine the next improvement plan for continuous or continuous improvement.

From the data found in the field, the next problem was determined which became the next

improvement, namely the occurrence of waste in process area 2 due to the large number of starch losses that were wasted in piles and waste tanks.

4.CONCLUSION AND SUGGESTION

The result of this research is the identification of critical waste that occurs in the work environment using the waste assessment model method. From the results of research using this method, it was found that the most critical or the most dominant waste from the five departments was defect waste with a percentage of 27.94%. The source of cause of the waste defect comes from the high downtime due to defect/damage to the machine in area 2 processing, namely defect/ damage to the vacuum drum agitator, causing lead time which can hamper the production process.

To reduce waste or waste that occurs in the work environment, the waste assessment model method and the Deming cycle method are used. The WAM method is to identify the 7 wastes that occur and prioritize by making a waste relationship matrix and a waste assessment questionnaire to determine the most dominant/critical waste so that employees can focus on improving the main waste.

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