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Waste Assessment Model (WAM): How Does the Company Assess the Waste?

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Abstract

The results of the initial analysis carried out by the author occurred because there were several indications of waste problems at PT XYZ. These problems are the difference in actual time and standard time as well as the quality of production results that do not meet company standards. The purpose of this research is to determine the type of relationship between waste and the type of waste produced in the production process at PT Best Jeans Indo Citra Nusa. This research applies a mixed method research method, combining quantitative and qualitative data through observation, interviews, and literature study. The study population includes all PT XYZ employees, with a sample of 8 people selected using judgment sampling. The analysis was carried out using the Waste Assessment Method, which aims to identify and evaluate waste in the production process. This method consists of the Waste Relationship Matrix and the Waste Assessment Questionnaire. The occurrence of idle time and defects in the production process at PT XYZ can occur because the company still produces waste in every production process. With this research, it is hoped that companies can make efforts to minimize every process that can produce waste.

Keywords: waste; waste assessment method; waste relationship matrix; waste assessment questionnaire; lean manufacturing

1. INTRODUCTION

The growth of the manufacturing industry can make industry competition tighter and more competitive. Meanwhile, to meet customer needs, supervision can be carried out on the quality of goods when produced, timely delivery, and competitive prices (Pegaria, 2013). This makes companies engaged in the manufacturing industry must be a company that has a competitive advantage in order to compete with other companies. To achieve this, all companies certainly need to compete by carrying out the production process as effectively and efficiently as possible. Effective and efficient production needs to be done because of the increasing business competition and the demand from consumers for products with better quality than before. Effective refers to the level of success achieved by the company in achieving its goa ls(Kusnakhin & Senastra, 2019). Efficient can be defined as the maximization and optimal utilization of all resources in the process of producing goods and services (Irene Karly Massie et al., 2018).

PT XYZ is a manufacturing company engaged in the textile industry. The company produces products in the form of raw fabrics, which go through the process of yarn that has been rolled into a beam, weaving process, and weaving machine processing. The problem experienced by PT XYZ is the number of defects in the fabric. According to data and interviews with the

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production manager of PT XYZ, the company very rarely experiences defects that cause the fabric cannot be sold. However, the company has a quality standard where fabrics that can pass inspection are fabrics that have no more than 20% defects that can be sold to consumers. If it exceeds 20%, the goods will not pass inspection and will be separated from other fabrics that do not pass inspection. The company produces fabric with AAA quality which has a percentage of 55.995%, and fabric with AA grades has a percentage of 41.17%. However, the company also has a percentage of fabric production that fails and cannot be shipped, which is 0.856%.

In addition, the company has a problem regarding inconsistent production time where the processing duration for yarn A is always longer than the standard time. Out of 111 machines in the company, 30 machines process yarn A. Yarn A is the most processed product by the machine, so the company needs to pay attention to each production process of yarn A in order to be more efficient. PT XYZ sets the production standard for yarn A at 19 days. But in reality, 27 machines out of a total of 30 machines that process Yarn A have an actual time that exceeds the standard processing time.

Both problems experienced by the company are waste. According to Heizer et al. (2020) is any production activity that does not provide added value in the eyes of consumers. Waste according to Taiichi Ohno is divided into 7 types, namely overproduction, inventory, motion, defects, extra processing, waiting, and overproduction. Overproduction is producing more or faster than necessary (Puteri & Nuryanto, 2016). Defect refers to failures in the production process, such as making defective products or requiring rework (Pratama, 2017). Waiting involves the unproductive time when employees wait for materials, machine readiness, or work orders(Pratama, 2017). Extra processing is doing more work on a product than required (Pratama, 2017). Transportation waste occurs from excessive movement of workers, information, or products (Puteri & Nuryanto, 2016). Inventory waste is having excess raw materials, work-in-progress, or finished products (Pratama, 2017). Motion waste arises from non-ergonomic design, causing excessive movement by operators (Puteri & Nuryanto, 2016).

The problem of waste can be minimized with an approach that has been proven effective in increasing efficiency and reducing waste in the production process, namely Lean Manufacturing. The lean manufacturing method aims to change an organization within the company to be more efficient and competitive (Permana & Pujani, 2019). Lean Manufacturing aims to increase the value of a product (goods or services) continuously. To apply the concept of lean manufacturing, companies need to know what waste occurs in the company so that they can find out what methods are suitable for dealing with waste. According to (Bhamu & Sangwan, 2014), Lean Manufacturing not only reduces waste but also improves workflow and customer satisfaction by delivering high-quality products on time. One tool for identifying and assessing waste in a company is the Waste Assessment Method (Rawabdeh, 2005). The Waste Assessment Method (WAM) is carried out to find out the waste experienced by the company, as well as to identify to the company whether there are activities that can be considered waste so that the company can evaluate and develop new strategies when it knows about the waste problems that exist in the company.

In previous studies, Rawabdeh (2005) developed a model for waste assessment in job shop environments and found that motion waste significantly impacted production issues. Amrina & Lubis (2017) applied Lean Manufacturing methods to minimize waste in cement production, identifying defects, overproduction, and inventory as the three largest waste activities. (Ristyowati et al., 2017) discovered that defects in the sewing process were the largest waste in glove production at PT Sport Glove Indonesia. (Permana & Pujani, 2019) implemented Lean Manufacturing to reduce waste in the guardrail production process at PT XXX, identifying waiting, motion, and waiting as the highest wastes. Utama et al. (2016) used the Seven Waste Relationship analysis to determine the interrelationships of waste in the plastic pallet production process at PT XYZ, finding that defect waste had the highest weighting percentage. (Irawan & Putra, 2021) identified that the largest waste in the plastic pallet production at PT XYZ was defect waste, accounting for 22.26%.

2. MATERIALS AND METHODS

2.1 Research Methods

This research is mixed method research, where research focuses on collecting, analyzing, and mixing both quantitative and qualitative data in one study or a series of studies (Sekaran & Bougie, 2016). There are two types of data, namely primary which is taken based on observations and interviews, then secondary data which is taken through literature study. The population in the study was all employees of PT XYZ. The sample in this study used judgment sampling where this sampling method involved selecting subjects who were most profitable and placed or in the best position to provide the required information (Sekaran & Bougie, 2016). The sample in this research was people who understood the production process, the number of respondents selected from each section was a total of 8 people. According to (Simba et al.,

2017) quotes in the journal, 6-12 participants are considered sufficient for developing themes, interpreting values, and meeting data saturation (Guest et al., 2006). Data was found that saturation occurred in the first twelve interview participants, and six participants were considered sufficient (Guest et al., 2006) .

This research uses the Waste Assessment Method, which is an assessment method for waste. WAM consists of three steps: Seven Waste Relationship, Waste Relationship Matrix, and Waste Assessment Questionnaire. The first step is the Seven Waste Relationship which is the initial identification stage of lean problems and identifies waste in the production line. The second step is the Waste Relationship Matrix which is a method used to measure the strength of the relationship between waste and each other based on grouping criteria using a matrix (Rawabdeh, 2005). The final step is the Waste Assessment Questionnaire which is a method used to allocate waste in the production process (Rawabdeh, 2005).

The process of identifying waste in this problem is by using the Waste Assessment Method, which is a model developed to simplify the search for waste problems and identify waste to eliminate them (Rawabdeh, 2005). It starts with the Seven Waste Relationship, which is the relationship between each identified waste either directly or indirectly. Each waste has a relationship with other wastes. These seven wastes can be grouped into three main categories related to people, machines, and materials. The human category contains the concepts of motion, waiting, and overproduction. The machine category includes waste overproduction, while the material category includes transportation, inventory, and defects. Waste Relationship Matrix is a method used to measure the strength of waste relationship with each other based on grouping criteria using a matrix (Rawabdeh, 2005). Meanwhile, Waste Assessment Questionnaire is a method used to allocate waste on the production floor (Rawabdeh, 2005). Another definition states that the Waste Assessment Questionnaitre was created to identify and process waste that occurs on the production line (Setiawan & Rahman, 2021). Each question from the questionnaire represents an activity, condition or behavior on the production floor that may cause waste.

2.2 Data Collection Techniques

In this study, data collection was conducted through interviews and observations. Unstructured interviews were held twice at PT Best Jeans Indo Citranusa with supervisors from the personnel and production departments to uncover issues like production delays and fabric quality problems. Structured interviews were conducted six times with different knowledgeable individuals, using questions based on the Waste Assessment Method (Rawabdeh, 2005). These methods helped gather comprehensive information on production issues.

Observations were conducted twice to analyze the production process at PT Best Jeans Indo Citranusa. The first observation focused on the entire production process from raw materials to finished products. The second observation aimed to identify any deviations during production and analyze the processing time of thread A. These observations provided valuable insights into the company's production efficiency.

2.3 Data Analysis Techniques

Waste Relationship Matrix

1. The Waste Relationship Matrix contains 31 relationships, each relationship consisting of six questions. So if multiplied there will be a total of 186 questions. Each answer to each question will be given a weight according to the information in Table 1 to show the relationship between existing waste.

Table 1. Waste Relationship Matrix Questions

No	Question	Answer Choices	Weight
1	What is waste? I affect waste j	A. Often	4
		B. Sometimes	2
		C. Rarely	0
2	What is the type of relationship between i and j	a. If I go up then j goes up	4
		b. If I increase then j remains the same	2
		c.Not necessarily depending on the circumstances	0
3	Impact of I on j	a. Appears directly & clearly	4
		b. It takes time to appear	2
		c. Doesn't appear often	0
4	Eliminating the impact of i on j can be achieved by...	a. Engineering methods	2
		b. Simple and direct	1
		c. Instructional solutions	0
5	The impact of i on j mainly affects...	a. Product quality	1
		b. Resource productivity	1
		c. Waiting time	1
		d. Quality and productivity	2
		e. Quality and lead time	2
		f. Productivity and waiting time	2
		g. Quality, productivity and lead time	4
6	How much impact I have on j will increase the waiting time	a. Very high	4
		b. Currently	2
		c. Low	0

Source:(Rawabdeh, 2005)

2. After getting the total weight obtained from each type of waste relationship we will then carry out a conversion from weight to symbol as in table 2.

Table 2. Range divisions of strength of direct relationship

Range	Relationship	Symbol
17-20	Absolutely necessary	A
13-16	Especially important	E
9-12	Important	I
5-8	Ordinary closeness	O
1-4	Unimportant	U
0	No Relations	X

Source: (Rawabdeh, 2005)

3. The next step is to convert symbols into values with the conditions A= 10; E=8; I=6; O=4; U=2; X=0

Waste Assessment Questionnaire

1. This questionnaire contains 68 questions, and each question has its own grouping and is answered with a predetermined number weight, namely if yes, it is given a weight of 1, if it is it is given a weight of 0.5, and if no it is given a weight of 0 (Nurlaelah, et al., 2020). Some questions were modified according to the type of company studied by the author.
2. Grouping Group and count the number of questionnaire questions based on "From" and "To" notes for each type of waste.
3. Give weight to each question in the questionnaire according to the results of the Waste Relationship Matrix questions.
4. Next, divide each weight in one row by the number according to the type of question that has been grouped (Ni).
5. Calculate the total score (sj) and frequency (fj) which are data for each waste whose value is not 0.
6. Enter the questionnaire score results into each weight value in Table
7. Calculate the total score (Sj) and frequency (Fj) which are data for each waste whose value is not 0 in the table
8. Calculate the initial indicator for each waste (Yj). This indicator is only a number but cannot represent that each type of waste is influenced by other types of waste.

$$Yj = \frac{sj}{Sj} \times \frac{fj}{Fj} \quad (1.1)$$

9. Calculate the final value of the waste factor (final yj) by multiplying the initial indicator by the probability factor of the influence between types of waste (Pj) based on the sum

of " From " and " To ". Pj is obtained by multiplying the percentages " From " and " To " in the respective Waste Matrix Values.

$$Yj\ final = Yj \times Pj \quad (1.2)$$

$$Pj = \frac{\%\ Waste\ j\ From}{\%\ Waste\ j\ To} \quad (1.3)$$

10. The final results are entered in the table, after that we can calculate the percentage of Yj Final from each waste with the following formula.

$$Yj\ final\ \% = \frac{Yj\ Final\ w}{Yj\ Final\ Total} \quad (1.4)$$

3. RESULTS AND DISCUSION

3.1 Waste Relationship Matrix

One way to find out the relationship between the seven wastes is to use the waste relationship matrix method. The following are the results of the waste relationship matrix interview questions which are explained in table 3.

Table 3. Waste Relationship Matrix Results

FROM /TO	O	I	D	M	Q	P	W	TOTAL	PERCENTAGE
O	10	6	6	6	6	0	8	42	18.42%
I	2	10	10	10	6	0	0	38	16.67%
D	2	8	10	2	2	0	10	34	14.91%
M	0	2	8	10	0	2	8	30	13.16%
Q	2	4	4	2	10	2	6	30	13.16%
P	2	2	2	2	0	10	8	26	11.40%
W	2	8	8	0	0	0	10	28	12.28%
TOTAL	20	40	48	32	24	14	50	228	100.00%
PERCENTAGE	8.77 %	17.54 %	21.05 %	14.04 %	10.53 %	6.14 %	21.93 %	100.00 %	

Based on the results presented in Table 3 using the Waste Relationship Matrix, it is evident that each type of waste influences and is influenced by other wastes to varying degrees. The table categorizes the types of waste as Overproduction (O), Inventory (I), Defect (D), Motion (M), Transportation (T), Extra Processing (P), and Waiting (W), and quantifies their interrelationships.

- Waste Overproduction (O):
  - Impact on Others: Waste overproduction is the largest waste affecting others, with a total impact score of 42, constituting 18.42% of the total. It significantly

impacts inventory (I), defect (D), motion (M), and waiting (W) but has no effect on extra processing (P).

- Influenced by Others: Overproduction is influenced by other wastes by 8.77%, with a total influence score of 20.

- Waste Inventory (I):
    - Impact on Others: Inventory is the second-largest waste affecting others, with a total impact score of 38, constituting 16.67% of the total. It impacts defect (D), motion (M), and transportation (T) but has minimal impact on others.
    - Influenced by Others: Inventory is influenced by other wastes by 17.54%, with a total influence score of 40.
- Waste Defect (D):
    - Impact on Others: Defect is the third-largest waste affecting others, with a total impact score of 34, constituting 14.91% of the total. It impacts inventory (I) and waiting (W) but has minimal impact on others.
    - Influenced by Others: Defect is influenced by other wastes by 21.05%, making it the second-largest influenced waste, with a total influence score of 48.
- Waste Motion (M):
    - Impact on Others: Motion is the fourth-largest waste affecting others, with a total impact score of 30, constituting 13.16% of the total. It impacts defect (D) and waiting (W) but has minimal impact on others.
    - Influenced by Others: Motion is influenced by other wastes by 14.04%, with a total influence score of 32.
- Waste Transportation (T):
    - Impact on Others: Transportation affects others equally to motion, with a total impact score of 30, constituting 13.16% of the total. It primarily impacts waiting (W) but has minimal impact on others.
    - Influenced by Others: Transportation is influenced by other wastes by 10.53%, with a total influence score of 24.
- Waste Extra Processing (P):
    - Impact on Others: Extra processing has the smallest impact on others, with a total impact score of 26, constituting 11.40% of the total. It impacts waste motion (M) but has minimal impact on others.

- Influenced by Others: Extra processing is influenced by other wastes by 6.14%, with a total influence score of 14.

- Waste Waiting (W):
  - Impact on Others: Waiting is the second smallest waste affecting others, with a total impact score of 28, constituting 12.28% of the total. It impacts inventory (I) and defect (D) but has minimal impact on others.
  - Influenced by Others: Waiting is influenced by other waste by 21.93%, making it the highest influenced waste, with a total influence score of 50.

Overall, the Waste Relationship Matrix highlights the interconnected nature of various wastes, where overproduction has the most significant impact on other wastes, while waiting is the most influenced by other wastes. Understanding these relationships is crucial for identifying key areas to target waste reduction and improving overall efficiency.

3.2 Waste Assessment Questionnaire

From the results of research conducted by the author using the Waste Assessment Questionnaire method. The following is the calculation for the Waste Assessment Questionnaire which is in table 4.

Table 4. The original weights as obtained from the WRM

No	Question	Question Type	Initial value for each waste						
			O	I	D	M	Q	P	W
1	Man	For Motion	6	10	2	10	2	2	0
2	Man	From Motion	0	2	8	10	0	2	8
3	Man	From Defects	2	8	10	2	2	0	10
4	Man	From Motion	0	2	8	10	0	2	8
8	Material	For Waiting	8	0	10	8	6	8	10
9	Material	From Waiting	2	8	8	0	0	0	10
10	Material	From Transportation	2	4	4	2	10	2	6
11	Material	From Inventory	2	10	10	10	6	0	0
32	Machine	From Process	2	2	2	2	0	10	8
33	Machine	For Waiting	8	0	10	8	6	8	10
34	Machine	From Process	2	2	2	2	0	10	8
44	Method	For Transportation	6	6	2	0	10	0	0
45	Method	From Motion	0	2	8	10	0	2	8
46	Method	From Waiting	2	8	8	0	0	0	10
66	Method	From Overproduction	10	6	6	6	6	0	8
67	Method	From Process	2	2	2	2	0	10	8
68	Method	From Defect	2	8	10	2	2	0	10

Based on the Waste Relationship Matrix in the table, it is entered based on the types of questions contained in the Waste Assessment Questionnaire questions.

Table 5. Division of Table 4 by Ni values and summary

No	Question	Question Type	Ni	Value for Each Waste						
				Wo.k	Wi.k	Wd.k	Wm.k	Wt.k	Wp.k	Ww.k
1	Man	For Motion	9	0.667	1,111	0.222	1,111	0.222	0.222	0,000
2	Man	From Motion	11	0,000	0.182	0.727	0.909	0,000	0.182	0.727
3	Man	From Defects	9	0.222	0.889	1,111	0.222	0.222	0,000	1,111
4	Man	From Motion	11	0,000	0.182	0.727	0.909	0,000	0.182	0.727
8	Material	For Waiting	6	1,333	0,000	1,667	1,333	1,000	1,333	1,667
9	Material	From Waiting	6	0.333	1,333	1,333	0,000	0,000	0,000	1,667
10	Material	From Transportation	4	0.500	1,000	1,000	0.500	2,500	0.500	1,500
11	Material	From Inventory	5	0.400	2,000	2,000	2,000	1,200	0,000	0,000
32	Machine	From Process	7	0.286	0.286	0.286	0.286	0,000	1,429	1,143
33	Machine	For Waiting	6	1,333	0,000	1,667	1,333	1,000	1,333	1,667
34	Machine	From Process	7	0.286	0.286	0.286	0.286	0,000	1,429	1,143
44	Method	For Transportation	3	2,000	2,000	0.667	0,000	3,333	0,000	0,000
45	Method	From Motion	11	0,000	0.182	0.727	0.909	0,000	0.182	0.727
46	Method	From Waiting	6	0.333	1,333	1,333	0,000	0,000	0,000	1,667
66	Method	From Overproduction	3	3,333	2,000	2,000	2,000	2,000	0,000	2,667
67	Method	From Process	7	0.286	0.286	0.286	0.286	0,000	1,429	1,143
68	Method	From Defect	9	0.222	0.889	1,111	0.222	0.222	0,000	1,111
Total Score (sj)				46	66	72	58	46	26	68
Total Frequency (fj) = Waste that has a value that is not 0				**57**	**62**	**68**	**59**	**44**	**42**	**51**

In Table 5 there are results from several data obtained. The first is the Wj.k value multiplied by the average value of answers from the Waste Assessment Questionnaire obtained from interviews with PT XYZ. For example, the calculated value of Wo.k is 0.667. These results were obtained from the results from Wj.k from Table 4.36 and the average value of answers from the Waste Assessment Questionnaire which can be seen in the attachment. The following is the calculation.

$$Wo.k = 0{,}667 \times 1 \quad (1.5)$$

The second value is Score Sj, obtained from the sum of each column. The third value is the Total Frequency Fj obtained from the number of cells from each waste that has a value other than 0.

Table 6. Summary of the assessment analysis and a rank of the different types of waste in the company

No	Question	Question Type	Average WAQ	Value for Each Waste						
				Wo.k	Wi.k	Wd.k	Wm.k	Wt.k	Wp.k	Ww.k
1	Man	For Motion	1	0.667	1,111	0.222	1,111	0.222	0.222	0,000
2	Man	From Motion	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
3	Man	From Defect	1	0.222	0.889	1,111	0.222	0.222	0,000	1,111
4	Man	From Motion	0.3125	0,000	0.057	0.227	0.284	0,000	0.057	0.227
8	Material	For Waiting	0.75	1,000	0,000	1,250	1,000	0.750	1,000	1,250
9	Material	From Waiting	0.875	0.292	1,167	1,167	0,000	0,000	0,000	1,458
10	Material	From Transportation	0.125	0.063	0.125	0.125	0.063	0.313	0.063	0.188
11	Material	From Inventory	0.9375	0.375	1,875	1,875	1,875	1,125	0,000	0,000
32	Machine	From Process	1	0.286	0.286	0.286	0.286	0,000	1,429	1,143
33	Machine	For Waiting	0.125	0.167	0,000	0.208	0.167	0.125	0.167	0.208
34	Machine	From Process	1	0.286	0.286	0.286	0.286	0,000	1,429	1,143
44	Method	For Transportation	0.3125	0.625	0.625	0.208	0,000	1,042	0,000	0,000
45	Method	From Motion	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
56	Method	For Defects	1	1,200	2,000	2,000	1,600	0.800	0.400	1,600
57	Method	From Inventory	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
58	Method	For Transportation	1	2,000	2,000	0.667	0,000	3,333	0,000	0,000
59	Method	For Motion	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
60	Method	For Transportation	0.4375	0.875	0.875	0.292	0,000	1,458	0,000	0,000
61	Method	For Motion	0.625	0.417	0.694	0.139	0.694	0.139	0.139	0,000
62	Method	For Motion	0.25	0.167	0.278	0.056	0.278	0.056	0.056	0,000
63	Method	From Motion	1	0,000	0.182	0.727	0.909	0,000	0.182	0.727
64	Method	From Motion	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
65	Method	From Motion	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
66	Method	From Overproduction	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
67	Method	From Process	0.5	0.143	0.143	0.143	0.143	0,000	0.714	0.571
68	Method	From Defect	0	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Total Score (Sj)				**24,881**	**35,883**	**40,038**	**28,910**	**25,622**	**16,959**	**41,755**
Total Frequency (Fj)				**47**	**48**	**54**	**45**	**34**	**34**	**43**

In Table 6 there are results from several data obtained. The first is the Wj.k value multiplied by the average value of answers from the Waste Assessment Questionnaire obtained from interviews with 8 PT XYZ workers. For example, the calculated value of Wo.k is 0.667. These results were obtained from the results of multiplying Wj.k from table 5 and the average value of answers from the Waste Assessment Questionnaire which can be seen in the attachment. The following is the calculation.

$$Wo.k = 0{,}667 \times 1$$

The second value is Score Sj, obtained from the sum of each column. The third value is the Total Frequency Fj obtained from the number of cells from each waste that has a value other than 0.

Table 7. Waste Assessment Questionnaire Results

	O	I	D	M	Q	P	W
Score Yj	2,242	2,376	2,264	2,630	2,323	1,894	1,932
Acting Factor	0.016	0.029	0.031	0.018	0.014	0.007	0.027
Yj Final	0.036	0.069	0.071	0.049	0.032	0.013	0.052
Yj Final (%)	11.22 %	21.52 %	22.02 %	15.05 %	9.97 %	4.11 %	16.11 %
Ranking	5	2	1	4	6	7	3

The results of the waste assessment questionnaire show that defects are the main waste at PT XYZ, reaching 22.02%. The main problem is damage to raw materials and finished products, both due to human and machine errors. Inventory is in second place with a total of 21.52%, related to warehouse irregularities and limited factory areas, causing buildup and other waste such as defects. Waste waiting reached 16.11% due to broken machines, forcing workers to wait. Motion in fourth place (15.05%) was caused by warehouse problems, and difficulty in moving employees. Overproduction in fifth position (11.22%) is related to ordering raw materials too quickly, causing piles and other waste. Transportation and extra processing respectively reached 9.97% and 4.11%, with the smallest waste results at PT XYZ.

The research on (Rawabdeh, 2005) PT There were several findings found after conducting an assessment of the company using the Waste Assessment Method. Where the result is that there are the highest to lowest waste results produced by PT XYZ:

- **Defect** is the first waste that occurs at PT XYZ with a total value of 22.02%. This is in accordance with what is happening in the company and the background of this research. The company's main problem is damage to both raw materials and finished products. This damage occurs either due to human error or machine error.
- **Inventory** is in second place in total value amounting to 21.52%. This is in accordance with what happens in companies that still produce a lot of waste inventory. Several examples of companies have disorganized warehouses due to the limited remaining

factory area. This results in difficulties in storing raw and finished materials. So, there is accumulation in the same place and can result in other waste such as defects.

- **Waiting** is in third place with a total value of 16.11%. The majority of waste waiting in companies occurs due to machine damage. This results in workers waiting to carry out the next task.
- **Motion** is in fourth place with a total value of 15.05%. This was caused by previous warehouse problems, where PT XYZ's warehouse was small so that the road access automatically became smaller. This makes it difficult for employees to move around.
- **Overproduction** is in fifth place with a total value of 11.22%. This is in accordance with the company's situation where the company rarely carries out activities that can result in overproduction waste. In terms of overproduction, the company only has problems ordering raw materials which are considered too fast. So, it becomes a pile of raw materials which can result in other waste.
- **Transportation** is in sixth place with a total waste of 9.97%. This is under the company's situation where the company rarely carries out activities that can result in transportation waste.
- **Extra Processing** is in seventh place with a total waste of 4.11%. This is under the data obtained from the relationship between waste which is obtained in table 4.34. Where extra processing waste has a small percentage that either influences or is influenced by other waste,

There are several suggestions for overcoming the problems of waste defects, waste inventory and waste waiting inventory at PT XYZ. For the first problem regarding waste defects, companies can carry out quality control of raw materials, clean the raw material warehouse, and organize the layout efficiently. Apart from that, it can identify each stage of the production flow that is vulnerable to waste defects for improvement. Ensure all employees understand quality standards and correct work procedures. Suggestions for reducing Waste Inventory by implementing Lean Manufacturing by using the 5S method for restructuring the warehouse. Use a Just in Time (JIT) system to reduce storage levels and prevent damage to raw materials. For the third problem regarding the Waste Waiting Inventory, companies can consider a preventive maintenance plan to optimize equipment performance. Apart from that, they can improve employee skills in breakdown maintenance for quick response and reduce downtime.

It is hoped that implementing these suggestions will help PT XYZ improve operational efficiency, quality, and reliability.

4. CONCLUSION

This research tests and evaluates waste assessment methods to find out how effective these methods are in managing and reducing the impact of human activities on the production process. The research results show that this method provides a better understanding of the type, amount and source of waste produced by a production process specifically at PT XYZ. Data analysis shows that this method is successful in finding waste activities that may not be found by conventional means. This also shows that the application of this method can provide a more comprehensive picture of the waste that occurs. This makes it possible for researchers and policymakers to improve and develop better waste management strategies.

In addition, it has been proven that this technique is useful in finding ways to increase effectiveness in the use of resources and reduce waste during the production process. These results have important relevance for sustainability, where better waste management can help the goal of increasing company revenues, specifically PT XYZ. While these techniques provide powerful results, keep in mind that improvements and adjustments may be necessary due to advances in technology and changes in consumer lifestyles. Furthermore, additional research can be carried out to test and validate this technique in overcoming waste problems and can research to apply the suggestions that have been presented previously.

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