Available online at: http://publikasi.mercubuana.ac.id/index.php/ijiem

IJIEM (Indonesian Journal of Industrial Engineering & Management)

ISSN (Print) : 2614-7327 ISSN (Online) : 2745-9063

Analysis of Value Stream Mapping (VSM) in the Application of Lean Manufacturing to Minimize Waste at PT. Karya Indah Medika

Ghina Aldra Fatinnisa*, Joumil Aidil Saifuddin

Department of Industrial Engineering, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Jl. Rungkut Madya No.1, Gunung Anyar, Surabaya 60294 Indonesia

ARTICLE INFORMATION

Article history:

Received: 14 August 2023
Revised: 24 November 2023
Accepted: 20 December 2023

Category: Research paper

Keywords:
Waste
Lean manufacturing
Value stream mapping
Current value stream mapping
Future value stream mapping

DOI: 10.22441/ijiem.v5i1.22395

A B S T R A C T

Achievements to minimize waste can be done by adopting a Lean manufacturing approach. Lean manufacturing is a concept that can design production processes to be better, faster, and cheaper with minimal space, small inventory, small labor hours, and avoid waste. This research takes the case study of PT Karya Indah Medika which is a company engaged in manufacturing to produce medical devices, medical device service services, and medical device installation. In the company there is still waste, especially in unnecessary movements and product defects. This study aims to identify waste that occurs in the company and provide recommendations for improvements in order to minimize waste and obtain optimal production time. Value stream mapping is used to describe all processes in the company. The results showed that the initial production time of 17 hours 18 minutes could be reduced to 1 hour 55 minutes. Based on the Failure Mode and Effect Analysis (FMEA) it is known that the root cause of the problem in the highest waste is workers in a hurry so they are not thorough in working with a Risk Priority Number (RPN) score of 294, lack of materials needed for production, placement of tools that are not in accordance with production needs and a warehouse area that is less extensive by 216.

*Corresponding Author
Ghina Aldra Fatinnisa
E-mail: ghinaaldraa@gmail.com

1. INTRODUCTION

Industrial competition in the current global era is increasing very rapidly. This competition requires industry to continue to develop its capabilities to meet the demands of the existing market, so improvements need to be made to maintain quality. Improvements in product quality, production volume, and timely delivery can provide satisfaction to customers. The main pillar of continuous improvement is by reducing waste because waste is a work activity that does not add value (Donoriyanto et al., 2020). Waste is the waste of any human activity that uses resources but does not create added value. Activities in an industrial stream are categorized into 3, namely adding value (value added), needed but not adding value or waste (necessary but non-value added), and not adding value (non-value added) or waste

(Afrianto et al., 2022). According to Novitasari & Iftadi (2020), in essence, in the production process a company must have waste. Waste generally consists of seven types, namely overproduction, waiting, motion, transportation, unnecessary processes, inventory, and defects.

PT. Karya Indah Medika is a company engaged in the manufacturing sector to produce medical devices, service medical devices, and install medical devices. At PT. Karya Indah Medika's production process is considered to be still not optimal because there are still production defects, these defects exceed the company's stipulated 10%. Based on data on PT. Karya Indah Medika resulted in 583 defective products from June 2022 to May 2023 out of a total production of 3230 with a defect percentage of 16.71%. Apart from that, there are still some waste problems that are encountered while on the production floor. There is a waiting time due to delays by production activities or unplanned machine downtime for 1 working day, accompanied by unnecessary movements such as employees forgetting to put production equipment so they have to look for these production equipment which causes losses in terms of long lead times. Then there is an excessive waste of unnecessary processes, namely the high level of rework that occurs in the company, namely with an average of 56 pcs of the total product that requires rework of 561 pcs in June 2022 to May 2023 or with a percentage of 18.31%.

Several studies to reduce waste in companies, especially in minimizing production lead times using Value Stream Mapping (VSM) have been carried out. Sutharsan et al. (2020) in their research proved that VSM can be used as a useful tool in eliminating some waste in a cycle and finding that there is more waste to be removed in the next cycle. Based on the research results, the suggested improvements resulted in a reduction in production lead time from 26.3 days to 24.9 days, and customer demand was easily fulfilled with this production level. Isnain & Karningsih (2020), applying lean manufacturing and the results obtained are that lean tools namely VSM can be used to identify waste and propose improvements to production process activities as well as provide suggestions for improvements to production process activities namely Failure Mode and Effect Analysis (FMEA). Donoriyanto et al. (2020) apply a value stream mapping which then provides recommendations for improving the highest waste to be a priority to prioritize in improving the ivory paperboard production process, including requiring a temperature measuring device that can be replaced periodically which then results in minimizing production lead time, research results show the lead time for the initial process of ivory cardboard is 1293 minutes = 21 hours 33 minutes, then after the repairs are made, the total lead time for the production of ivory paperboard is 1172 minutes = 19 hours 32 minutes. Zulfikar & Rachman (2020) in their research also identified waste and provided the best suggestions for activities or activities in shoe production. Proposed improvements made to the X shoe production process flow at PT. PAI is based on the most dominant waste, namely waiting waste, with the improvement being to attract the 2nd process from the vendor to be carried out by PT. PAI. Accompanied by getting the results of the improvements affecting the total time, cycles, and lead time with a total time from 128123.54 seconds to 63612.84 seconds, cycle time from 15.46 hours to 15.67 hours, and lead time from 300671.73 seconds or 3.49 days to 236277.83 seconds or 2.73 days. Based on the research that has been cited, it can be stated that VSM can be used as an effective tool in reducing waste or achieving lean manufacturing. This study aims to identify the waste that occurs in the company and provide recommendations for improvement to minimize waste and obtain optimal production time.

2. LITERATURE REVIEW

Lean Manufacturing is to identify and eliminate waste, improve quality, and reduce costs and production time. The Lean Manufacturing approach is needed to create a smooth and efficient production process. This approach is relatively simple and well-structured so that it is easy to understand to carry out an efficient process that is by the capabilities and resources that exist in the company (Jannah & Siswanti, 2018). According to Ma'ruf et al. (2021), the main principle of the lean approach is the reduction or elimination of waste. Waste can also be interpreted as activities that do not add value to the company. There are seven types of waste, namely: overproduction, defect, unnecessary inventory, inappropriate processing, excessive transportation, waiting/idle, and unnecessary motion. Value Stream Mapping is made in graphical form in the form of a flowchart and is used to analyze and design the flow of materials and information needed to provide products and services to customers. Value Stream Mapping is a very necessary and suitable method because it can be used to identify waste, analyze waste, then look for solutions to make recommendations for improvements to reduce the waste that occurs (Donoriyanto et al., 2020). According to Satria (2018), VSM consists of 2 types, firstly, the current state map is a current product value stream configuration, to identify waste and areas for improvement or improvement. The second, the future state map is a blueprint for the desired lean transformation in the future. The future state map represents a vision of how the condition of the value chain will be at one point in the future after improvements have been made. Value Stream Mapping succeeded in identifying the problem that was occurring in this research caused by 3 sub-processes, namely: waiting service, washing process and service process long (Trimarjoko et al., 2020). The VSM method is said to be one of the methods that applies a visualization image that is most efficient in describing the current state of a system, and is able to identify a long-term vision and be able to develop a company plan to achieve the desired goals (Taufik & Fahturizal, 2021)

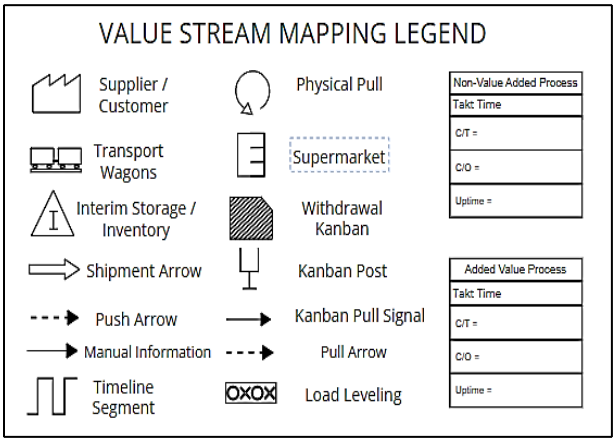

Figure 1. Value stream mapping tools
(Source: Riyadi, 2020)

The Value Stream Analysis Tool (VALSAT) is an analysis that is carried out by selecting detail mapping which is considered the most representative to further identify the location of the waste that occurs in the value stream of the production system in the company. The selection of this tool is done by multiplying the average score of each waste with the VSM suitability matrix (Zakaria, 2020). Cause-and-effect diagrams (also called fishbone diagrams, Ishikawa diagrams) were developed by Kaoru Ishikawa and were originally used by quality control departments to find potential causes of problems in manufacturing processes that usually involve many variations in a process.

In the manufacturing industry, making causal diagrams can use the “5M-1E” concept, namely: machines, methods, materials, measurement, men/women, and environment. The Failure Mode and Effect Analysis (FMEA) is a systematic method that applies tables to assist the process of identifying failures and their effects. Failures are classified based on the impact they have on the target of a system. Whether it's from failures in design, conditions outside the specified specification limits, or changes in the product that disrupt to the function of the product. Using FMEA cannot be separated from using the Risk Priority Number (RPN), which is the result of multiplying the weighting or rating of a failure mode. The total value of this RPN is calculated for each error that may occur. If the process consists of certain groups, the total number of RPNs in the group can show how critical the process group is if an error occurs. The FMEA process has 3 main variables including severity, occurrence, and detection (Donoriyanto et al., 2020).

Implementation of the VSM method is used as a tool to identify waste from a manufacturing system to find the root cause. From the results of the depiction of the current state value stream mapping process for the production of original tea drinks, the initial conditions for the production of 450 ml lead time were 20,255.4 seconds with a value added time of 7,924.4 seconds, so that the process cycle efficiency was 39.12%. After the repairs were made, the efficiency of the process cycle increased to 53.66%. So, it can be concluded that the process is more efficient so that it can be used as a reference in minimizing waste (Satria, 2018). The combination of the VSM and FMEA methods gives the initial total lead time for the production of ivory paperboard, which is 1293 minutes = 21 hours 33 minutes with a production capacity of ± 417 tons. After repairs, the total lead time for the production of ivory paperboard is obtained. That is equal to 1172 minutes = 19 hours 32 minutes. The total RPN is 3269 with an average of 143 (high) so it needs to be improved. Recommendations for improving waste based on waste that has the highest RPN value are a priority for improvement in the ivory paperboard production process, including requiring a temperature measuring device that can be replaced periodically, providing strict supervision of operators regarding temperature control, overall view of machine conditions, stricter checks on raw materials chemistry, and provide training to refresh standard operating procedures (Donoriyanto et al., 2020). Referring to these studies, it shows that the Value Stream mapping method combined with other methods is very effective in identifying, analyzing and improving processes, products and services to obtain better service quality and can increase industry profits and competitiveness.

3. RESEARCH METHOD

This research was conducted by taking a case study at PT Karya Indah Medika. The VSM beginning with the description of the Current VSM. To create a current VSM, data on production process flow, production process time data, and the number of workers working in the production area are required. The next stage is the process of identifying and weighing the 7 wastes, which is done by distributing questionnaires to people who understand the circumstances and conditions of the company according to the waste under study. The selection of Value Stream Mapping is done by multiplying the average score of each waste with the Value Stream Mapping suitability matrix. Supporting data needed for the detailed mapping analysis process is data on defective products, downtime, and excess production.

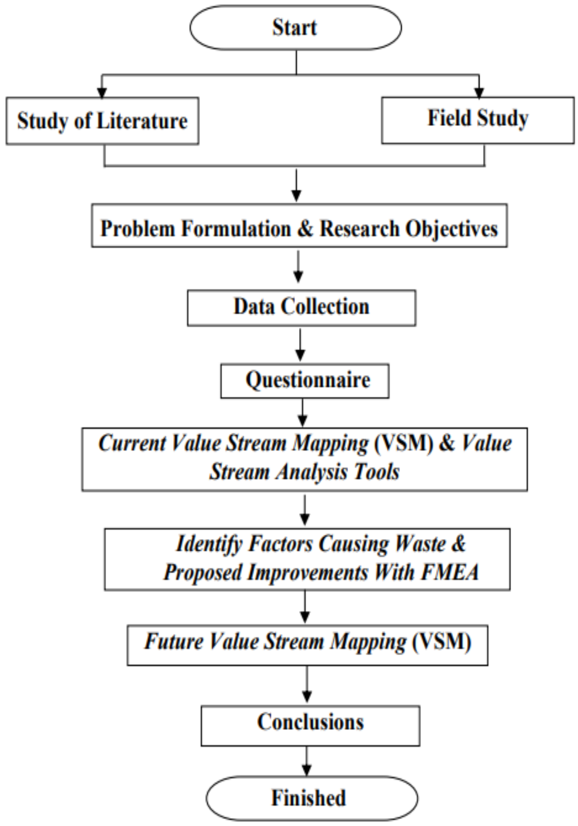

Figure 2. Flowchart

The Fishbone method is used to determine the root cause of waste. To obtain priority repairs that will be prioritized through the FMEA method. At this stage, brainstorming is carried out with the production party to obtain the RPN value. From the highest RPN value, improvements are immediately made to the potential causes, control devices, and effects. The last is to design a FVSM to show the effect of the company's improvements.

4. RESULTS AND DISCUSSION

A. Current Value Stream Mapping

The establishment of current value stream mapping can produce lead time values for the initial production process before repairs. At PT Karya Indah Medika, based on Figure 2. Current Value Stream Mapping, the total production time or production lead time at PT Karya Indah Medika is 62293.3 seconds or equal to 1038 minutes 13 seconds or equal to 17 hours 18 minutes.

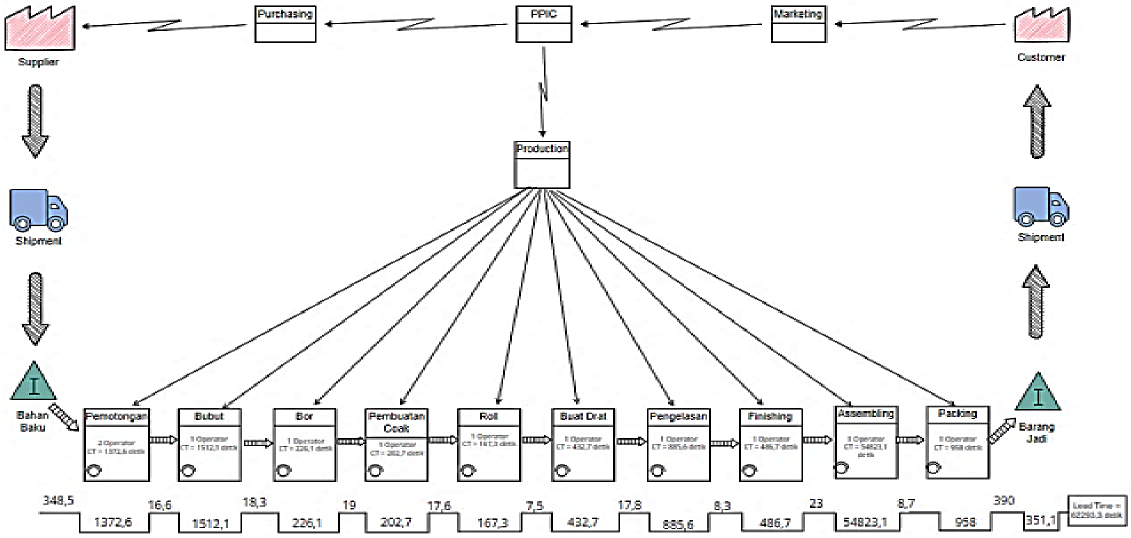

Figure 3. Current value stream mapping
(Source: processed data)

B. Waste Identification

The questionnaires that have been distributed will be recorded and the score calculated and ranked according to the waste that has been obtained through the answers from the respondents. The following are the results of recording, calculating, and ranking the questionnaire regarding waste in the production process at PT Karya Indah Medika (Table 1).

Table 1. Results of the waste questionnaire

No	Waste Type (Waste)	Respondents 1	2	3	4	5	6	7	Average Score	Ranking
1	Unecessary Motion	4	4	4	4	4	4	4	4.0	1
2	Defect	4	3	3	4	4	4	3	3.6	2
3	Waiting	4	4	4	3	3	3	2	3.3	3
4	Excess Processing	4	3	4	3	3	3	2	3.1	4
5	Excess Inventories	3	2	3	4	3	3	2	2.9	5
6	Overproduction	3	3	2	3	3	3	2	2.7	6
7	Unecessary Transportation	1	1	1	2	1	1	1	1.1	7

Based on the table, the waste that has the highest ranking results from weighting is waste unnecessary motion (4.0), the second waste defect (3.6), the third is waste waiting (3.3), and finally the seventh is unnecessary transportation (1.1).

C. Valsat (Value Stream Analysis Tools)

The results of the calculation of the score obtained through the results of the questionnaire are then processed by data. Processing of data resulting from an average score will be processed with the VALSAT to determine what tools will be used. The VALSAT matrix is adjusted to the conditions of waste in the production process at the company. The VALSAT matrix obtained will be processed for data by multiplying the results of the average score of the questionnaire with the value in the column contained in the VALSAT matrix. The results of the calculation of the VALSAT for the seven wastes are as follows (Table 2).

Table 2. Determination of VALSAT tools

No	VALSAT	Weight	Ranking
1	Process Activity Mapping (PAM)	119.0	1
2	Supply Chain Response Matrix (SCRM)	67.4	2
3	Demand Amplification Mapping (DAM)	43.7	3
4	Quality Filter Mapping (QFM)	38.0	4
5	Decision Point Analysis (DPA)	29.7	5
6	Product Variety Funnels (PVF)	21.3	6
7	Physical Structure (PS)	4.0	7

(Source: processed data)

D. Process Activity Mapping (PAM)

After multiplying the correlation value with the average score of the waste, the best tool used to identify the value stream is obtained, namely process activity mapping (PAM). PAM is used to determine the lead time in detail to identify each type of activity and the necessary improvements. The Process Activity Mapping approach is to eliminate activities that do not provide added value, simplify, combine, and look for sequence changes that will reduce waste (Ardiansyah Odi et al., 2019). Table 3, Figures 3 and 4 show the activities taking place during the production process.

Table 3. Time results for each activity

Activity	Frequency	Percentage (%)	Total Time (Second)	Percentage (%)
Operation	19	50.0	5553	8,9
Transportation	13	34.2	1,645	2,6
Inspection	2	5.3	336.3	0.5
Storage	1	2.6	351.1	0.6
delays	3	7.9	54407.9	87.3
Total	**38**	**100**	**62293.3**	**100**
VA	17	44.7	5209.4	8.4
NNVA	15	39.5	1,790	2.9
NVA	6	15.8	55293.9	88.8
Total	**38**	**100**	**62293.3**	**100.0**
Production Time			**62293.3**	

(Source: processed data)

Based on Table 3, it is obtained that the percentage of frequency and time for each activity required to produce at PT Karya Indah Medika consists of a frequency of operation activities of 50% with a time of 8.9%, a frequency of transportation activities of 34.2% and a time of 2.6%. , the frequency of inspection activities was 5.3% with a time of 0.5%, the frequency of storage activities was 2.6% with a time of 0.6%, and the frequency of delay activities was 7.9% with a time of 87.3%. While the percentage of types of activity value added activity frequency is 44.7% with a time of 8.4%. The non-value-added activity of 15.8% with a time of 88.8%. Necessary but non-value added frequency of 39.5% with a time of 2.9%. From these results, there are non-value-added activities that need to be reduced.

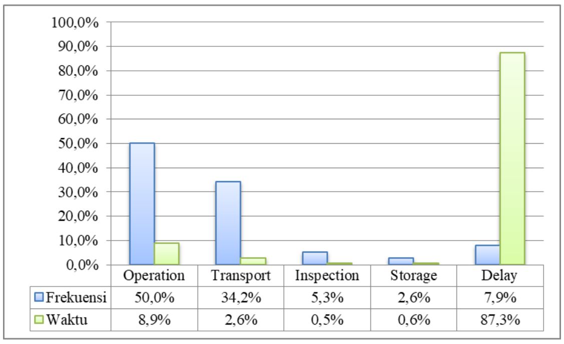

Figure 4. Frequency percentage and time result of each activity (Source: processed data)

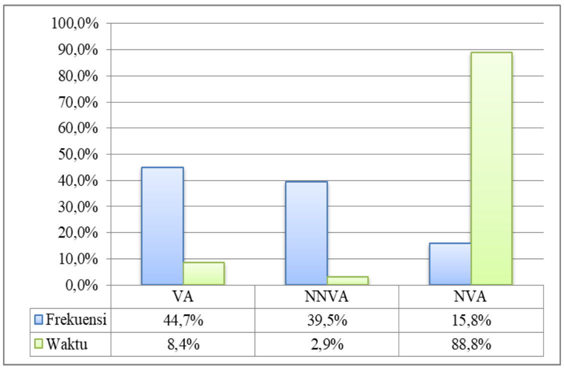

Figure 5. Frequency percentage and time result type of activity (Source: processed data)

E. Fishbone

Waste (waste) in the production process of PT. Karya Indah Medika will identify what causes and consequences arise from the production process so that recommendations for improvements can be determined. The following is an identification of the causes and consequences of the waste that occurs in the production process of PT. Karya Indah Medika uses a cause-and-effect diagram (Figure 6).

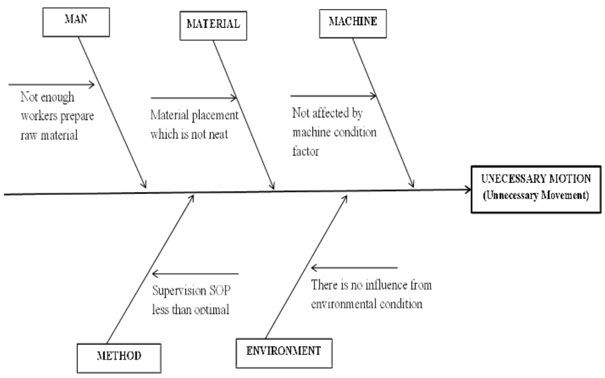

Figure 6. Fishbone unnecessary motion (Source: Processed Data)

Unnecessary Motion with an average score of 4 what happens is that there are problems employees forget to put production tools, materials needed are lacking, and employees make movements that should be avoided or not needed.

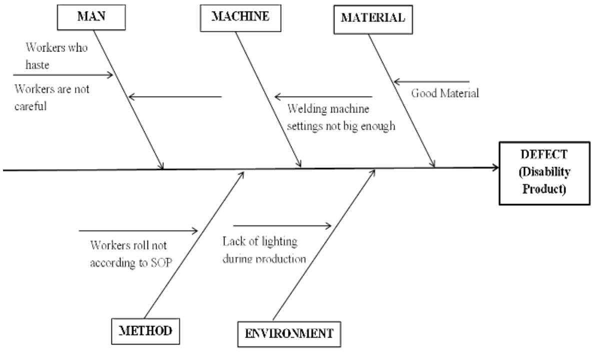

Figure 7. Fishbone defect
(Source: processed data)

Defects with an average score of 3.6, product defects that occur are welds that are not mature enough, the hook is not curved enough, and the wheels are not fully embedded or broken so that the resulting product is of lower quality and does not fit.

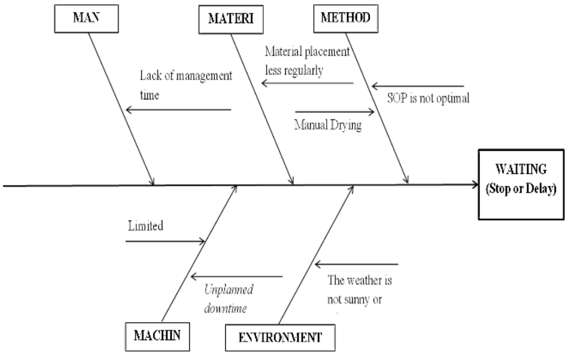

Figure 8. Fishbone waiting
(Source: processed data)

Waiting with an average score of 3.3 because the product process is waiting for packing or the process of stopping production comes from unplanned downtime on the machine which is suddenly caused by a lack of maintenance.

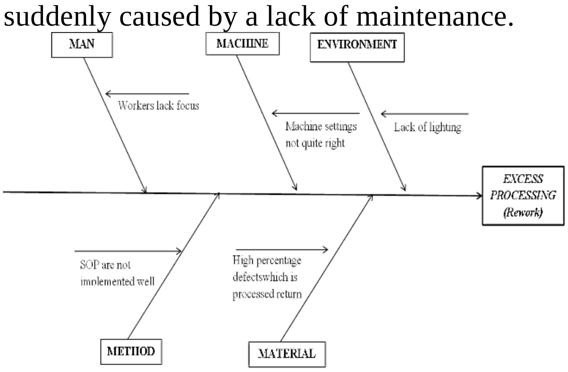

Figure 9. Fishbone excess processing
(Source: processed data)

Excess Processing with an average score of 3.1 due to the high number of defects that can be reprocessed (brokes) found at the work station causes the addition of a production process to process these defects.

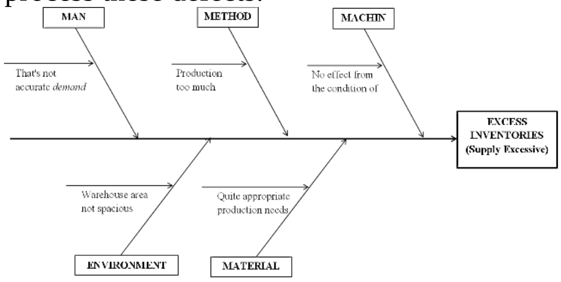

Figure 10. Fishbone excess inventories
(Source: Processed Data)

Excess inventories with an average score of 2.9 occurred due to rework activities which hampered the flow of raw materials accompanied by overproduction which caused the finished material warehouse to exceed its proper storage capacity.

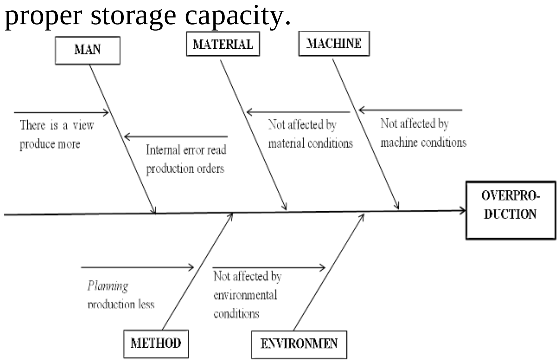

Figure 11. Fishbone overproduction
(Source: processed data)

Overproduction with an average score of 2.7 because production does not match the orders needed due to changing consumer demands, but can still be stored in the warehouse. Even so, it is still classified as waste which results in additional storage costs. Waste of Unnecessary Transportation with an average score of 1.1. This category of waste is not often found in production areas which affect the course of the production process. This is because at PT. Karya Indah Medika is still within the scope of the location so there are no significant problems that disrupt the production process.

F. Failure Mode Effect Analysis (FMEA)

In the Failure Mode and Effect Analysis (FMEA) there are several stages in determining the waste that will be handled first, namely setting process limits to be analyzed, making observations of the processes being analyzed, the results of observations are used to find errors that have the most influence on the process production. Determine the value of Severity, Occurance, Detection from the results of observations that have been adjusted to the rating value scale on Severity, Occurance, Detection. The results of Severity, Occurance, Detection observations will be accumulated to determine the value of the Risk Priority Number. The Risk Priority Number value is used to determine the waste that needs to be handled first, then the most influential waste improvements are proposed. The overall results of calculating the Risk Priority Number value for each waste can be seen in table 4 as follows (Table 4).

Table 4. Risk priority number

Failure Mode (Waste)	Cause of Failure	RPN	Level
Defect	Workers are in a hurry so they are less careful in their work	294	Very High
Unnecessary Motion	Lack of materials needed for production	216	Very High
Unnecessary Motion	Placement of equipment that is not in accordance with production needs	216	Very High
Waiting	Waiting for the coating to dry	216	Very High
Excess Inventories	The warehouse area is not spacious	216	Very High
Defect	Welding machine settings that are not large enough	168	High
Waiting	Lack of time management	168	High
Excess Processing	Machine settings are not appropriate	168	High
Waiting	Unplanned downtime	150	High
Defect	Lack of lighting	147	High
Unnecessary Motion	Supervision SOPs are less than optimal	126	High
Defect	Rolling does not comply with SOP	126	High
Excess Processing	SOPs are not implemented properly	126	High
Excess Processing	High percentage of defects that are reprocessed	126	High
Excess Inventories	Too much production	108	Medium
Excess Processing	Workers lack focus	105	Medium
Waiting	Limited facilities or tools	72	Low
Excess Inventories	Inaccurate demand forecasting	54	Low
Overproduction	Error in reading production order	48	Low
Overproduction	Inaccurate production planning	48	Low
Overproduction	There is a view of producing more	36	Low

(Source: processed data)

Recommendation FMEA is used to determine the waste that must be repaired first. Waste handling is based on the highest RPN. All waste will be ranked according to the value of the RPN. The proposed improvements and waste handling can be seen in Table 5 which includes the improvement of all waste in the production process at PT. Karya Indah Medika

Table 5. Improvements

Failure Mode (Waste)	Cause of Failure	RPN	Level	Improvement Recommendations
Defect	Workers are in a hurry so they are less careful in their work	294	*VERY HIGH*	Do work carefully and not in a hurry
Unnecessary Motion	Lack of materials needed for production	216	*VERY HIGH*	Make a recap of raw material or supporting materials needed for the entire production process
Unnecessary Motion	Placement of equipment that is not in accordance with production needs	216	*VERY HIGH*	Implement PTLF so the process runs smoothly
Waiting	Waiting for Coating Drying	216	*VERY HIGH*	Collaborating with subcon companies
Excess Inventories	The warehouse area is not spacious	216	*VERY HIGH*	Implement PTLF in the inventory warehouse
Defect	Welding machine settings that are not large enough	168	*HIGH*	Perform initial machine settings properly
Waiting	Lack of time management	168	*HIGH*	Provide training for employee time management
Excess Processing	Machine settings are not appropriate	168	*HIGH*	Perform initial machine settings properly
Waiting	Unplanned downtime	150	*HIGH*	Check the overall condition of the machine regularly
Defect	Lack of lighting	147	*HIGH*	Add lighting in production areas
Unnecessary Motion	Supervision SOPs are less than optimal	126	*HIGH*	Optimizing Supervision SOPs within the production scope
Defect	Rolling does not comply with SOP	126	*HIGH*	Provide strict supervision of roll process SOPs
Excess Processing	SOPs are not implemented properly	126	*HIGH*	Optimize SOPs by providing supervision during production
Excess Processing	High percentage of defects that are reprocessed	126	*HIGH*	Minimize errors in each section and optimize SOP
Excess Inventories	Too much production	108	*MEDIUM*	Taking into account consumer demand and warehouse capacity with coordination between divisions
Excess Processing	Workers lack focus	105	*MEDIUM*	Provide rest time
Waiting	Limited facilities or tools	72	*LOW*	Adding production aids
Excess Inventories	Inaccurate demand forecasting	54	*LOW*	Taking into account consumer demand and warehouse capacity with coordination between divisions
Overproduction	Error in reading production order	48	*LOW*	Communication and coordination meetings between divisions were improved
Overproduction	Inaccurate production planning	48	*LOW*	Taking into account consumer demand and warehouse capacity with coordination between divisions
Overproduction	There is a view of producing more	36	*LOW*	Taking into account consumer demand and warehouse capacity with coordination between divisions

(Source: processed data)

G. Future Value Stream Mapping

Table 6 explains the reduction in time in the production process at PT Karya Indah Medika. From the problems above, non-value added and necessary but non-value added activities can be suppressed or reduced. Following are the results of the improvements in Table 6.

Table 6. Adjustment of production process time

Activity	Processing time before repair (sec.)	Processing time after repair (sec.)
Raw Material Inspection	116.3	0
The measurement for a 19 mm diameter stainless steel pipe coak is approximately 5 mm wide	49.9	0
Looking for an M8 hand tap to make threads	229.5	0
Look for coarse and fine grinding wheels and install	178.4	0
Take 19 mm diameter stainless steel cap, M12 bolt, M12 galvanized ring, pear ring, M25 stainless steel cover ring, M8 knob, and sticker to the raw material warehouse	384.6	0
Waiting for packing process	54000	0
Take cardboard	385.1	0
Total	**55343.8**	**0**

(Source : processed data)

For more details, see Future Value Stream Mapping for improvements to the production process at PT Karya Indah Medika, which can be seen in Figure 11 .

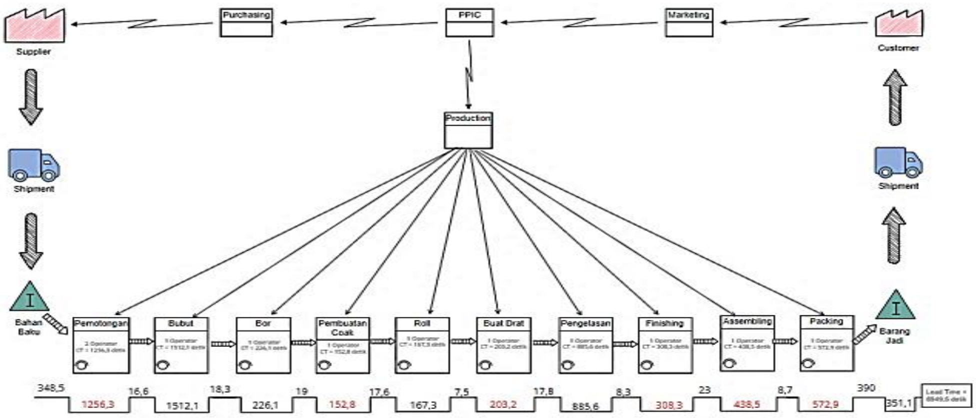

Figure 12. Future value stream mapping
(Source: processed data)

Calculation of time after repair is as follows:

a. Total Value Added = 5209.4 seconds
b. Total Non-Value Added = 0 seconds
c. Total Necessary but Non Value Added = 1740,1 seconds
d. Total Production Time = 6949.5 seconds

The next step is to compare the initial time with the time after repair as follows (Table 7).

Table 7. Comparison of total time

Early time	Time after repair
62293,3 seconds	6949,5 seconds
1038 minutes 13 seconds	115 minutes 50 seconds
17 hours 18 minutes	1 hour 55 minutes

(Source: processed data)

Table 8. Calculation of proposed activities

Activity	Frequency	Percentage (%)	Total Time (Sec.)	Percentage (%)
Operation	18	58.1	5503.1	79.2
Transportation	11	35.5	875	12.6
Inspection	1	3.2	220	3.2
Storage	1	3.2	351.1	5.1
Delays	0	0	0	0
Total	**31**	**100**	**6949.5**	**100**
VA	17	54,8	5209.4	75
NNVA	14	45,2	1740.1	25
NVA	0	0	0	0
Total	**31**	**100**	**6949.5**	**100**
Production Time			**6949.5**	

(Source: processed data)

Reviewing the results of a comparison of the total production time before and after repairs, the VSM tools help streamline production time at this company. The VSM have succeeded in reducing lead time in non-value added activities, namely in raw material inspection activities, measurements for stainless steel pipe coaks with a diameter of 19 mm are approximately 5 mm wide, looking for hand tap m8 to make threads, look for coarse and fine grinding wheels and install, take 19 mm diameter stainless steel caps, m12 bolts, m12 galvanized washers, pear rings, m25 stainless steel ring covers, m8 knobs, and stickers to the raw material warehouse, waiting for the packing process, and taking cartons for packing. Where the initial total production time of 17 hours 18 minutes can be reduced to 1 hour 55 minutes. The VSM is used to prioritize problems to be solved, reduce unnecessary activities, and improve the production process so that it runs optimally with an effective time (Satria, 2018). The main wastes that occur are defects, unnecessary motion, excess inventories, and waiting. The defect percentage is

16.71%, which should be the production standard, which is 10% damaged, unnecessary motion due to a lack of raw materials needed for production and placement of tools that are not in accordance with production requirements, excess inventories due to less extensive warehouse area, and waiting due to lack of parts packing operators. This study corroborates other similar studies (Isnain & Karningsih, 2020; Jannah & Siswanti, 2018; Ma'ruf et al., 2021; Satria, 2018; Sutharsan et al., 2020; Zulfikar & Rachman, 2020).

5. CONCLUSION

Based on the research results, it can be concluded that the Value Stream Mapping method used provides a solution to the waste that exists at PT Karya Indah Medika. With the loss of waste, it can help companies achieve optimal production and the Lean Manufacturing concept. Reduced lead time will also minimize the costs that accompany the production process. Where the initial production time of 17 hours 18 minutes can be reduced to 1 hour 55 minutes. For further research, it is hoped that it can continue to implement the layout of factory facilities at PT Karya Indah Medika so that production locations and storage warehouses can be optimal.

REFERENCES

Afrianto, M., Budiharti, N., & Haryanto, S. (2022). Implementasi Lean Manufacturing untuk Meminimasi Waste Menggunakan Metode Value Stream Mapping di PT. MJ Di Pasuruan. *Jurnal Valtech*, *5*(2), 74–80. https://doi.org/10.37631/jri.v4i2.560

Ardiansyah Odi, Akhmad Nidhomuz Zaman, Siti Rohana Nasution, & Sambas Sundana. (2019). Analisis Pengurangan Waste Pada Proses Perawatan Kereta. *Jurnal ASIIMETRIK* *1*(1), 34–42. https://doi.org/10.35814/asiimetrik.v1i1.220

Donoriyanto, D. S., Falah, Y., & Azhar, M. F. (2020). Analisis Waste Pada Aktivitas Lini Produksi Dengan Menggunakan Lean Manufacturing di PT ABC. *Tekmapro*, *15*(1), 25–35. https://doi.org/10.33005/tekmapro.v15i1.129

Isnain, S. K., & Karningsih, P. D. (2020). Perancangan Perbaikan Proses Produksi Komponen Bodi Mobil Daihatsu dengan Lean Manufacturing di PT. "XYZ." *Jurnal Studi Manajemen dan Bisnis*, *5*(2), 122–129. https://doi.org/10.21107/jsmb.v5i2.6667

Jannah, M., & Siswanti, D. (2018). Analisis penerapan Lean Manufacturing untuk Mereduksi Overproduction waste menggunakan value stream mapping dan fishbone diagram. *Jurnal Teknik*, *6*(1), 254–265.

Ma'ruf, Z., Marlyana, N., & Sugiyono, A. (2021). Analisis Penerapan Lean Manufacturing dengan Metode Valsat untuk Memaksimalkan Produktivitas pada Proses Operasi Crusher (Studi kasus di PT Semen Gresik Pabrik Rembang). *Prosiding Sem. Nas. Konstelasi Ilmiah Mahasiswa UNISSULA 5 (KIMU 5)*, *5*(1), 10–20.

Novitasari, R., & Iftadi, I. (2020). Analisis Lean Manufacturing untuk Minimasi Waste pada Proses Door PU. *Jurnal INTECH Teknik Industri Universitas Serang Raya*, *6*(1), 65–74. https://doi.org/10.30656/intech.v6i1.2045

Riyadi, M. 2020. Pengendalian Produksi di Industri Galangan. Sukabumi: CV Jejak (Jejak Publisher).

Satria, T. (2018). Perancangan Lean Manufacturing dengan Menggunakan Waste Assessment Model (WAM) dan VALSAT untuk Meminimumkan Waste (Studi Kasus: PT. XYZ). *JRSI*. *7*(1), 55. https://doi.org/10.26593/jrsi.v7i1.2828.55-63

Sutharsan, S. M., Mohan Prasad, M., & Vijay, S. (2020). Productivity enhancement and waste management through lean philosophy in Indian manufacturing industry. *Materials Today: Proceedings*, *33*, 2981–2985. https://doi.org/10.1016/j.matpr.2020.02.976

Taufik, D. A., & Fahturizal, I. M. (2021). Value Stream Mapping (VSM) Implementation as an Effort to Reduce Delays in the Procurement Process at PT DI. *IJIEM - Indonesian Journal of Industrial Engineering and Management*, *2*(3), 198. https://doi.org/10.22441/ijiem.v2i3.11875

Trimarjoko, A., Fathurohman, D. M. H., & Suwandi, S. (2020). Metode Value Stream Mapping dan Six Sigma untuk Perbaikan Kualitas Layanan Industri di Automotive Services Indonesia. *IJIEM - Indonesian Journal of Industrial Engineering and Management*, *1*(2), 91. https://doi.org/10.22441/ijiem.v1i2.8873

Zakaria, M. I., & Rochmoeljati, R. (2020). Analisis Waste Pada Aktivitas Produksi Bta Sk 32 Dengan Menggunakan Lean Manufacturing Di Pt Xyz. JUMINTEN, 1(2), 45–56.

Zulfikar, A. M., & Rachman, T. (2020). Penerapan Value Stream Mapping Dan Process Activity Mapping Untuk Identifikasi Dan Minimasi 7 Waste Pada Proses Produksi Sepatu X di PT. Pai. *Jurnal Inovisi*, *16*, 13–24.