

# Waste Reduction in the Sickle Production Process Using the VALSAT Method and Value Stream Mapping

Lovia Vioni Putri Jatmiko<sup>1\*</sup>, Moch. Tutuk Safrin<sup>2</sup>

<sup>1,2</sup> Department of Industrial Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Indonesia.  
Email: [lovijt411@gmail.com](mailto:lovijt411@gmail.com)<sup>1</sup>, [tutuks.ti@upnjatim.ac.id](mailto:tutuks.ti@upnjatim.ac.id)<sup>2</sup>

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## ABSTRACT

This research aims to minimize waste in the sickle production process at PT XYZ by applying Lean Manufacturing techniques, specifically Value Stream Mapping (VSM) and Value Stream Analysis Tools (VALSAT). The study began with direct observation and data collection of production activities to identify non-value-added activities (NNVA) and waste. Types of waste, including defects, excessive inventory, and waiting times, were identified and analyzed using the 5 Whys method to determine their root causes. Process Activity Mapping (PAM) was employed to classify activities into value-adding, non-value-adding, and necessary non-value-adding categories. Improvements were implemented, such as optimizing material transfers with forklifts, reducing waiting times, and strengthening quality control processes. As a result, non-value-adding activities were reduced from 9% to 0%, significantly enhancing production efficiency.

**Keywords:** Lean Manufacturing, Value Stream Mapping (VSM), Value Stream Analysis Tools (VALSAT), Waste Reduction, Process Activity Mapping (PAM).

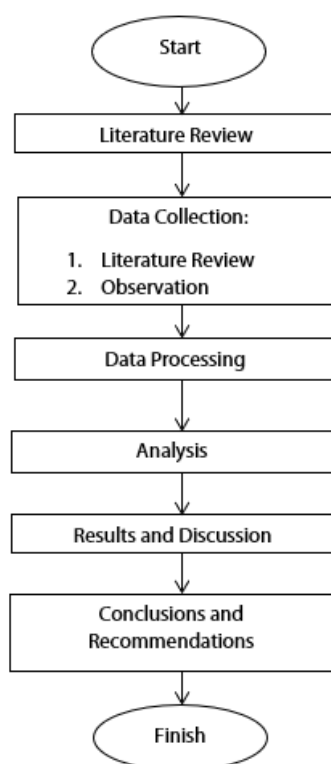
## I. Introduction

The Certified Internship and Independent Study Program (MSIB), initiated by the Ministry of Education, Culture, Research, and Technology (Kemdikbudristek), aims to provide students with real-world work experience through internships at leading companies or organizations, as well as independent study programs focused on skill development. Through this program, students can enhance their competencies by participating in internships aligned with their fields of study and interests, while working on projects relevant to industry needs (Aswita, 2022; Saputra et al., 2022; Suharto et al., 2022; Suryatno & Insana, 2022). The MSIB program offers a credit conversion of 20 credits, enabling students to have their internship and independent study experiences recognized as academic credits. This helps accelerate the graduation process while enhancing their professional portfolios (Aswita, 2022; Saputra et al., 2022; Suryatno & Insana, 2022). Upon completing the program, students receive a certificate as formal proof of the competencies they have gained (Aswita, 2022; Suryatno & Insana, 2022). By combining practical experience with personal development, the MSIB program prepares students to transition more effectively into the workforce (Aswita, 2022; Saputra et al., 2022; Suharto et al., 2022; Suryatno & Insana, 2022).



## II. Research Method

This research adopts the Lean Manufacturing approach to identify and reduce waste in the production process (Anuar & Mansor, 2022; Diah et al., 2018; Moengin & Ayunda, 2021). Data collection involved direct observation of the sickle production process at PT XYZ, focusing on production stages susceptible to waste, such as waiting times, excess inventory, and defective products (Diah et al., 2018). Data analysis was conducted using Value Stream Mapping (VSM) to map the production process flow and identify non-value-adding activities (NNVA) (Anuar & Mansor, 2022; Diah et al., 2018). Additionally, Value Stream Analysis Tools (VALSAT) were utilized to identify dominant waste types by applying weighting and selecting appropriate analysis tools, such as Process Activity Mapping (PAM) (Diah et al., 2018). After identifying the waste types, corrective measures were developed, including reducing NNVA activities, optimizing material flow using tools like forklifts, and minimizing waiting times by reorganizing work processes. All these steps were systematically documented to ensure the improvements were implemented effectively and had a positive impact on operational efficiency. The research process is illustrated in Figure 1 below:



**Figure 1. Research Method Flowchart**

## III. Results and Discussion

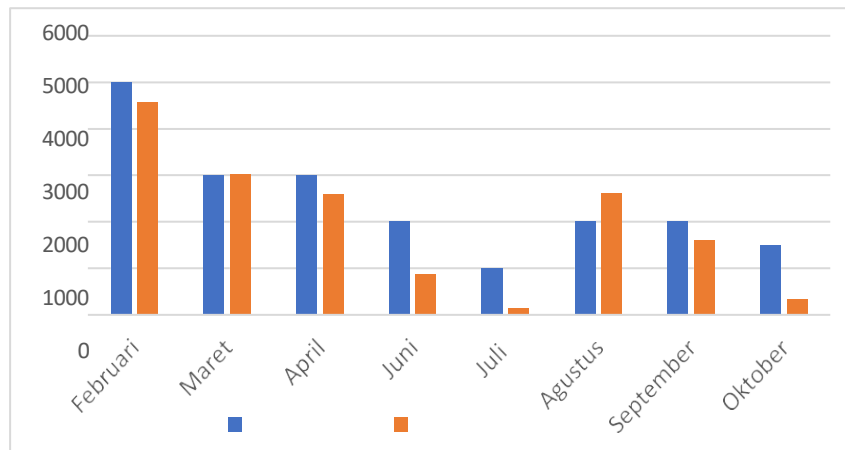
The following production data contains information on production targets and the results achieved.

**Table 1. Sickle Product Production Targets and Results 2024**

No	Month	Target	Realization	Percentage
1	January	5000	4566	91%
2	February	3000	3022	101%

No	Month	Target	Realization	Percentage
3	March	3000	2592	86%
4	April	2000	863	43%
5	June	1000	133	13%
6	July	2000	2620	131%
7	August	2000	1600	80%
8	September	1500	340	23%
9	October	5000	4566	91%

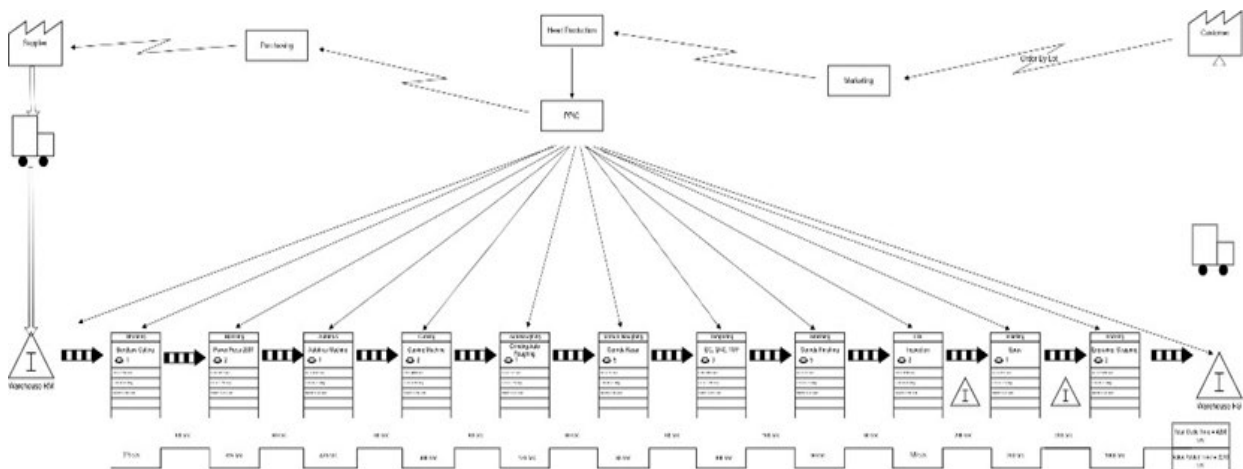
The data is illustrated in the graph shown in Figure 2 below:



**Figure 2. Production Targets and Achievements**

A comparison between the production targets and actual outputs revealed that six out of eight months showed production below the target. This indicates a gap between the planned and actual production, which may suggest inefficiencies or waste in the production process. Further analysis of the underlying processes is required to identify the specific causes of these discrepancies.

### 3.1. Value Stream Mapping



**Figure 3. Current Value Stream Mapping**

The Value Stream Mapping (VSM) shown above depicts the production process flow, starting from the receipt of raw materials in the warehouse to the delivery of finished products to customers. This VSM includes key stages such as cutting, shaping, smoothing, inspection, and packing. It serves as a guide for identifying inefficiencies, such as long lead times between processes and material buildup and supports the development of improvement plans to enhance the overall efficiency of the production process.

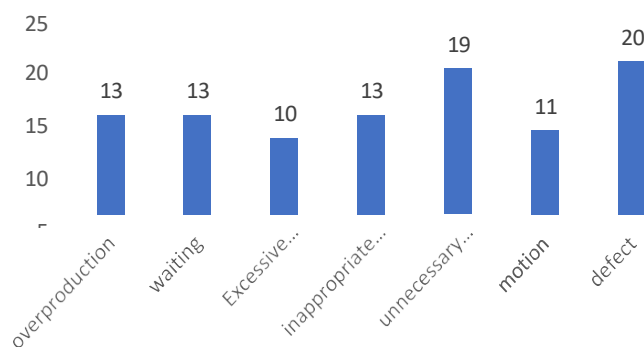
### 3.2. Waste Identification

After gaining an overview of the entire process through Value Stream Mapping (VSM), the next step is to identify waste occurring in the production process. This identification was carried out by distributing questionnaires, which detailed the seven types of waste observed in the production process.

**Table 2. Waste Identification Results**

No	Waste	Poin (1-5)
1	<i>Overproduction</i> Are there stages in the production process where more products are manufactured than required?	3
2	<i>Waiting</i> Are there instances of unnecessary waiting time?	3
3	<i>Excessive Transportation</i> Are there inefficient or time-consuming movements of materials or products between processes?	2
4	<i>Inappropriate Processing</i> How often does the process involve unnecessary steps or extended processing time to achieve the desired results?	3
5	<i>Unnecessary Inventory</i> Is there an accumulation of materials or semi-finished goods that are not immediately needed for production?	4
6	<i>Motion</i> Are there any unnecessary or inefficient operator or machine movements in performing the task?	2
7	<i>Defects</i> How often are defective products detected during or after the production process?	4

The values obtained above will be entered into the Value Stream Analysis Tools (VALSAT) matrix to identify the appropriate tools for waste analysis.



**Figure 4. Waste Questionnaire Summary**

### 3.3. Value Stream Analysis Tools (VALSAT)

Based on the weighted results from waste identification, the data is used as a basis for selecting tools relevant to the Value Stream Analysis Tools (VALSAT) approach. The selection process involves multiplying the average scores from Table 3.4 by the weight values in the VALSAT matrix. The tools with the highest scores are selected, as they are considered the most appropriate for identifying the existing waste.

**Table 3. VALSAT Matrix Calculation**

Waste/Structure	Mapping Tools						
	Process activity mapping	Supply chain respons matrix	Productio n variety funnel	Quality filler mapping	Demand amplify cation mapping	Decision point analysis	Physical structure
<i>Defect</i>	4			36			
<i>Over Production</i>	3	9		3	9	9	
<i>Waiting</i>	27	27	3		9	9	
<i>Innapropriate Processing</i>	27		9	3		3	
<i>Unnecessary Motion</i>	18	2					
<i>Unnecessary Inventory</i>	12	36	12		36	12	4
<i>Excessive Transportation</i>	18						2
<b>Total</b>	<b>109</b>	<b>74</b>	<b>24</b>	<b>42</b>	<b>54</b>	<b>33</b>	<b>6</b>
<b>Ranking</b>	<b>1</b>	<b>2</b>	<b>6</b>	<b>4</b>	<b>3</b>	<b>5</b>	<b>7</b>

From Table 3, it is evident that the highest-ranking tool is Process Activity Mapping, with a total score of 109. This is followed by the Supply Chain Response Matrix with a score of 74, Demand Amplification Mapping with a score of 54, Quality Filter Mapping with a score of 42, Decision Point Analysis with a score of 33, Production Variety Funnel with a score of 24, and finally, Physical Structure with a score of 6.

**Table 4. Process Activity Mapping**

No	Activity	Machine	Time (Seconds)	Number of people	O	T	I	D	S	Category
1	Shearing	Bendsaw	315	1	✓					VA
2	Material transfer	Trolley	60	1		✓				NNVA
3	Heating the material	End heating	30	1	✓					VA
4	Blanking	Power press 200 T	285	1	✓					VA
5	Material transfer	Trolley	60	1		✓				NNVA
6	Autotirus		420	1	✓					VA
7	Material Transfer	Trolley	60	1		✓				NNVA
8	Heating the material	End heating	30	1	✓					VA
9	Curving		370	1	✓					VA
10	Material Transfer	Trolley	60	1		✓				NNVA
11	Auto Roughing		120	1	✓					VA
12	Material Transfer	Trolley	60	1		✓				NNVA

No	Activity	Machine	Time (Seconds)	Number of people	O	T	I	D	S	Category
13	Manual Roughing		80	5	✓					VA
14	Material Transfer	Trolley	60	1		✓				NNVA
15	Heating the material	Induction	100	1	✓					VA
16	Tempering Process		200	2	✓					VA
17	Material transfer	Trolley	100	1		✓				NNVA
18	Waiting for grinding setting		30				✓			NVA
19	Finishing Grinding		60	5	✓					VA
20	Material transfer	Trolley	60	1		✓				NNVA
21	OGI		120	2			✓			NNVA
22	Material transfer	Trolley	60	1		✓				NNVA
23	Wait		140					✓		NVA
24	Painting	Spray	200	1	✓					VA
25	Wait		200					✓		NVA
26	Packing		1000	1	✓					VA

The Process Activity Mapping in Table 3.6 should be summarized to identify the number of value-adding and non-value-adding activities. The calculation is based on the percentage of activities related to operations, transportation, storage, and delays.

#### 3.4. Identify Waste Using the 5 Whys

The identification process was conducted to uncover the root causes of the most common types of waste, which ranked in the top three: defects, excessive inventory, and waiting. Identify Waste Through 5 Whys Analysis.

**Table 5. Identification of Waste Using the 5 Whys**

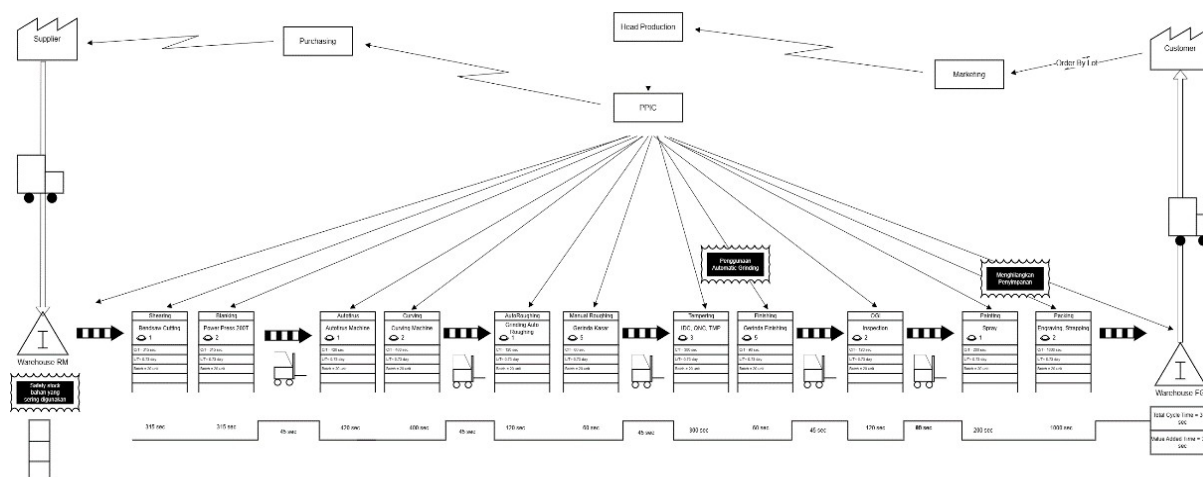
Waste	Why 1	Why 2	Why 3	Why 4	Why 5
Defect	The production process does not follow the SOP.	Limited operator skills.	The machine is not functioning optimally.	The flatbar used is unsuitable.	Quality control is lacking.
Unnecessary Inventory	Production planning is inaccurate.	Poor control over inventory management	The production process is hindered.	Miscommunication occurs between departments.	Maintenance of non-production flows is not well-organized.
Waiting	In-stream processes are not synchronized.	Delays in material delivery.	Inspection is delayed.	Operators have limited skills.	Delays are caused by the setup process.

### 3.5. Process Activity Mapping (PAM) Improvement

**Table 6. Process Activity Mapping (PAM) Improvement**

No	Activity	Machine	Time (Seconds)	Number of People	O	T	I	D	S	Category
1	Shearing	Bendsaw	315	1	✓					VA
2	Material Heating	End heating	30	1	✓					VA
3	Blanking	Power press 200 T	285	1	✓					VA
4	Material Transfer	<i>forklift</i>	45	1		✓				NNVA
5	Autotyris		420	1	✓					VA
6	Material Heating	End heating	30	1	✓					VA
7	Curving		370	1	✓					VA
8	Material Transfer	<i>forklift</i>	45	1		✓				NNVA
9	Auto Roughing		120	1	✓					VA
10	Manual Roughing		80	5	✓					VA
11	Material Transfer	<i>forklift</i>	45	1		✓				NNVA
12	Material Heating	Induction	100	1	✓					VA
13	Tempering Process		200	2	✓					VA
14	Finishing Grinding	Automatic Grinding	60	5	✓					VA
15	Material Transfer	<i>forklift</i>	45	1		✓				NNVA
16	OGI		120	2			✓			NNVA
17	Material Transfer	<i>forklift</i>	45	1		✓				NNVA
18	Painting		200	1	✓					VA
19	Packing		1000	1	✓					VA

Certain material transfer stages in the production process, such as those in rows 5, 10, 14, 20, and 22 of Table 3.6, can be streamlined for greater efficiency, as demonstrated in Table 3.9. Material transfer activities are often classified as Non-Value Adding (NNVA) activities because they primarily involve moving goods without directly contributing value to the product (Chao et al., 2022; Patil et al., 2021). Efficiency can be improved by consolidating multiple material transfer steps into a single process, such as using a forklift to directly transport materials from one stage to the next (Chao et al., 2022). This method reduces the time and effort involved in transfer activities. For example, utilizing forklifts to transport materials directly from one process to the next eliminates the need for repeated transfer steps at various stages. This approach minimizes wasted time and ensures smoother material flow within the production process. In the finishing grinding process, no setup time is recorded because an automatic grinding machine is used. The use of automatic grinding machines eliminates the setup time typically required for manual machines, enhancing efficiency and reducing the overall time needed for the finishing process. In the painting and packing stages, waiting time is recorded and categorized as Non-Value Adding (NVA). Waiting times in both processes can be addressed by improving the production flow. In the painting stage, waiting times can be minimized by optimizing paint drying times with faster drying technology or by streamlining the flow of raw materials to the painting area. Similarly, in the packing stage, waiting times can be reduced by automating the packing process or synchronizing the flow of finished products to prevent unproductive delays.



**Figure 5. Future State Value Stream Mapping**

## IV. Conclusion

This independent study successfully improved students' understanding of Lean Manufacturing, particularly in minimizing waste, enhancing efficiency, and generating added value. Students identified the primary sources of waste, including defects (20%), excess inventory (19%), and lead times (13%), which were analyzed using the 5 Whys method. The main causes were found to be insufficient operator skills, inaccurate production planning, and inconsistent workflows. Through the application of Value Stream Mapping (VSM), students analyzed the Current State Value Stream Mapping to identify non-productive activities and developed a Future State Value Stream Mapping. Consequently, non-value-added activities were reduced from 9% to 0% with the support of Process Activity Mapping (PAM). The proposed improvements involve reducing material transfer activities by using forklifts, incorporating quality checkpoints to minimize defects, and optimizing the painting and packing processes to improve efficiency and establish a smoother production flow.

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