JURNAL
PAMATOR

Vol. 18, No. 3, 2025, p. 362-379
https://journal.trunojoyo.ac.id/pamator
ISSN: 2654-7856 (Online)
ISSN : 1829 -7935 (Print)

ANALYSIS OF TIME WASTE IN THE X WOVEN SARONG PRODUCTION PROCESS USING WASTE ASSESSMENT MODEL AT PT X

Laxmi Ratnaningsih[1], Enny Aryanny[2]

[1] Industrial Engineering Study Program, Faculty of Engineering and Science, Universitas Pembagungan Nasional "Veteran" Jawa Timur, Jl. Rungkut Madya No. 1, Gunung Anyar, Kec, Gunung Anyar, Surabaya, East Java, Indonesia, laxmiratnaningsih65@gmail.com

[2] Industrial Engineering Study Program, Faculty of Engineering and Science, Universitas Pembagungan Nasional "Veteran" Jawa Timur, Jl. Rungkut Madya No. 1, Gunung Anyar, Kec, Gunung Anyar, Surabaya, East Java, Indonesia, enny.ti@upnjatim.ac.id

DOI : https://doi.org/10.21107/pamator.v18i3.30249

Manuscript received 15th March 2025, Revised 20th June 2025, Published 30th October 2025

Abstract

PT X is a textile manufacturing company known as a prominent producer of woven sarongs. Among its various brands, the X sarong is the flagship product due to its high market value. Despite its large production scale, inefficiencies in the form of waste were detected within the production process. In this study, waste assessment model is applied to detect and categorize different kinds of inefficiencies or waste present in a process. The production flow is visualized using value stream mapping, and the value stream analysis tools are implemented to evaluate each process activity and identify its value added contribution. Root Cause Analysis (RCA) identifies the main causes of inefficiencies, and the 5W + 1H method is applied to formulate improvement strategies. WAM results indicate the highest to lowest waste percentages are: overproduction (22%), defects (20%), inventory (19%), transportation (15%), motion (13%), waiting (8%), and overprocessing (4%). Based on the proposed improvements, 14 non-value-added activities were eliminated, reducing total activities from 133 to 114 and cutting the process time by 139 minutes—from 3,853 to 3,714 minutes. Following the improvements, the Value Stream Mapping (VSM) analysis reveals a rise in Process Cycle Efficiency (PCE), improving from 67.5% to 70%, demonstrating a positive impact in minimizing waste and enhancing production efficiency.

Keywords: *Root Cause Analysis, Value Stream Analysis Tools, Value Stream Mapping, Waste, Waste Asessment Model, 5W +1H*

INTRODUCTION

The textile manufacturing sector encounters numerous challenges stemming from global competition, particularly in maintaining both quality and production volume. To remain competitive in the global market, textile industries must continuously improve productivity in order to produce high-quality products at competitive prices[1]. Enhancing product quality can create added value in line with the expectation of achieving a near-zero defect level[2]. One of the ways to improve product quality amidst global competition is by minimizing waste within the production process. Waste, referring to non value adding activities, lead to increased consumption of resources (energy, manpower, and time), making the production process inefficient[3]. By reducing waste, companies need to optimize every production line to improve overall productivity.

PT X is a company that specializes in textile production, specifically as a producer of woven sarongs, and has developed its production method using mechanical looms (*Alat Tenun Mesin* or ATM) to increase production capacity. Among the various sarong brands produced by PT X, the X sarong stands out as the company's flagship product, known for its high market value in terms of quality, design, and market segment. However, the high production volume has not been matched by an effective and efficient production process, with several types of inefficiencies identified in the production of X woven sarongs. The waste issues identified include overproduction waste, such as warping and dyeing processes being carried out in quantities greater than actual requirements, as well as yarn beams processed beyond the amounts specified in the IKT paturn (design pattern work instructions). Waiting waste arises from machine breakdowns causing delays between production processes and yarn breakage during production. Transportation waste occurs due to a suboptimal factory layout, where the distances between workstations are too far and the use of material handling equipment does not follow proper procedures. Overprocessing waste is found in repeated yarn winding to meet specifications, re-adjusting yarn tension, excessive use of sizing formulas, and repeated inspection processes. Inventory waste is caused by the accumulation of yarn materials in the production area, buffer stock of processed yarn beams piling up, and unused or defective materials that must be discarded. Motion waste results from operators manually splicing broken yarn without tools and working in poor ergonomic positions, such as bending during the manual yarn drawing-in process. Defect waste is seen in yarn defects due to uneven winding, such as yarn breakage, looseness, crossing, and fuzziness, as well as fabric defects including slubs, mispicks, double picks, blurred or misaligned printed patterns, and lack of precision.

Based on these issues, this study was conducted to analyze time-related waste in the X sarong weaving production process using waste assessment model at PT X. Waste assessment model helps in recognizing and analyzing inefficiencies or waste that occur

---

[1] Dwi Prasetyani and others, 'The Prospects and The Competitiveness of Textile Commodities and Indonesian Textile Product in the Global Market', *Etikonomi*, 19.1 (2020), 1–18 <https://doi.org/10.15408/etk.v19i1.12886>.

[2] Nur Fadilah Fatma, Henri Fatma, and Solehah, 'Penurunan Lead Time Manufacturing Dengan Pendekatan Lean Manufacturing Studi Kasus Di PT. MKM Reducing of Manufacturing Lead Time with A Lean Manufacturing Approach Case Study at PT. MKM', *Journal Industrial Manufacturing*, 8.2 (2023), 136–56.

[3] (Ponda et al., 2022)

during process[4,5]. The method reveals the links between the seven waste categories by employing a questionnaire matrix using tools such as the seven waste relationship tool is utilized to analyze how different types of waste are interconnected throughout the production process, including both directly observed waste and those not yet explicitly identified[6], waste relationship matrix is an instrument designed to analyze the connections between various types of waste, based on specific evaluation criteria [7], and waste assessment questionnaire is employed to assess and evaluate different waste types, helping to determine the most dominant waste through the survey findings[8]. The results from the WAM identification are then analyzed using the root cause analysis approach using the 5 Why's technique is applied to uncover the underlying causes of the identified waste[9]. Following this analysis, recommendations for improvement can be formulated using the 5W+1H method[10]. In addition, value stream mapping is utilized to examine how materials and information flow throughout each each phase of production, beginning the initial handling of crude materials and finishing with the finished goods. This method includes two types of analyzing the current flow of value and planning the optimized future flow [11]. Value stream analysis tools are applied to evaluate waste by using detailed mapping techniques that help pinpoint specific areas of waste within the production

---

[4] Afifah Naziihah, Jauhari Arifin, and Billy Nugraha, 'Identifikasi Waste Menggunakan Waste Assessment Model (WAM) Di Warehouse Raw Material PT. XYZ', *Jurnal Media Teknik Dan Sistem Industri*, 6.1 (2022), 30 <https://doi.org/10.35194/jmtsi.v6i1.1599>.

[5] Naziihah, Arifin, and Nugraha.

[6] Septian Aryo Kuncoro, 'Usulan Penerapan Lean Manufacturing Menggunakan Metode Waste Assessment Model (WAM) Pada Industri Makanan (Studi Kasus Di Usaha Mikro Kecil Menengah Nicesy).', *UNISSULA Institutional Repository* (Universitas Islam Sultan Agung Semarang, 2023).

[7] Muhamad Maulana, Endang Suhendar, and Aliffia Teja Prasasty, 'Penerapan Lean Management Untuk Meminimasi Waste Pada Lini Produksi CV. Mandiri Jaya Dengan Metode WAM Dan VALSAT', *Jurnal Optimasi Teknik Industri (JOTI)*, 5.1 (2023), 1 <https://doi.org/10.30998/joti.v5i1.13747>.

[8] Jakfat Haekal, 'Integration of Lean Manufacturing and Promodel Simulation on Repair Production Process Flow of Polysilane Bottle Printing Using VSM, WAM, VALSAT, And RCA Methods: Case Study Packaging Manufacturing Company', *International Journal Of Scientific Advances*, 3.2 (2022), 235–43 <https://doi.org/10.51542/ijscia.v3i2.15>.

[9] Nughthoh Arfawi Kurdhi and others, *Teori Ekonomi Industri* (Bandung: Widina Media Utama, 2023).

[10] Muhammad Asyrof Hidayatullah and Endang Pudji Widjajati, 'Lean Manufacturing Analysis Using Waste Assessment Model (WAM) and Root Cause Analysis (RCA) Methods', *Rekayasa Journal of Science and Technology*, 17.2 (2024), 240–49.

[11] Latifah Hanum Br Sembiring, Riny Chandra, and Safrizal, 'Analisis Supply Chain Management Menggunakan Metode Value Stream Mapping(Studi Kasus : Kinara Bakeri Kota Binjai)', *Jurnal Manajemen Akuntansi (JUMSI)*, 2.3 (2022), 714–22.

process value stream[12]. By applying these three methods, the study aims to provide insight into the sources of waste and potential improvements, thereby contributing to the development of a leaner production process in the textile industry.

RESEARCH METHODS

In this study, it is essential to identify the variables influencing the emergence of waste. The dependent variable in this research is the amount of waste generated during the production of X woven sarongs at PT X. The independent variables include production flow data specific to the X woven sarong manufacturing process, production time data, and data related to the seven categories of waste: overproduction, inventory, defect, motion, transportation, overprocessing, and waiting[13]. Additionally, questionnaire data are utilized to evaluate both the extent and the interconnections of various waste types through two primary tools: waste relationship matrix, which examines the relationships among different forms of waste[14], and waste assessment questionnaire, which measures the level of waste present in production process[15].

Data collection involves three primary methods: observation, questionnaire, and interviews. The observation method is utilized for mapping the production flow of X woven sarongs using value stream analysis that covers the existing process flow as well as the intended future flow [16]. These visualizations allow for the measurement of Process Cycle Efficiency (PCE) for both the current state (before improvements) and future state (after improvements), allowing for a performance comparison[17]. The questionnaire method supports the waste assessment model by collecting data through the WRM and

[12] Mochamad Ismail Zakaria and Rochmoeljati, 'Analisis Waste Pada Aktivitas Produksi BTA SK 32 Dengan Menggunakan Lean Manufacturing Di PT XYZ', *Juminten (Jurnal Manajemen Industri Dan Teknologi)*, 01.02 (2020), 45–56.

[13] Parwadi Moengin and Nadhifa Ayunda, 'Lean Manufacturing Untuk Meminimasi Lead Time Dan Waste Agar Tercapainya Target Produksi (Studi Kasus: PT. Rollflex Manufacturing Indonesia)', *Jurnal Teknik Industri*, 11.1 (2021), 77–92 <https://doi.org/10.25105/jti.v11i1.9699>.

[14] Bambang Suhardi, Maudiena Hermas Putri K.S, and Wakhid Ahmad Jauhari, 'Implementation of Value Stream Mapping to Reduce Waste in a Textile Products Industry', *Cogent Engineering*, 7.1 (2020) <https://doi.org/10.1080/23311916.2020.1842148>.

[15] Eko Setiawan Edi Prasetyo and Tina Hernawati, 'Penerapan Lean Manufacturing Untuk Mengurangi Waste Pada Cat Tanki Dengan Metode WRM Dan WAQ', *Journal Industrial Manufacturing*, 8.1 (2023), 27 <https://doi.org/10.31000/jim.v8i1.8082>.

[16] Jonatan Kurnia and I Gede Agus Widyadana, 'Identifikasi Dan Eliminasi Pemborosan Dengan Menggunakan Kombinasi Metode Value Stream Mapping (Vsm) Dan Cost Time Profile (Ctp): Studi Kasus Di Pt Sabe Indonesia', *Dimensi Utama Teknik Sipil*, 9.2 (2022), 168–83 <https://doi.org/10.9744/duts.9.2.168-183>.

[17] Reza Trisnani, Amanda Sofiana, and Tigar Putri Adhiana, 'Usulan Perbaikan Lintasan Produksi Minyak Herba Sinergi Menggunakan Value Stream Mapping (Studi Kasus: PT Herba Emas Wahidatama)', *Seminar Nasional Teknik Dan Manajemen Industri*, 1.1 (2021), 55–65 <https://doi.org/10.28932/sentekmi2021.v1i1.6>.

WAQ to identify the most critical forms of waste and their interdependencies [18]. Lastly, interviews are conducted to perform a Root Cause Analysis (RCA) using the 5 Why's technique [19], followed by the formulation of improvement strategies through the 5W+1H method, which identifies the type of waste (What), its origin (Where), the responsible party (Who), the time it occurs (When), the underlying cause (Why), and proposed solutions (How) [20].

RESULT AND DISCUSSION

The examination of waste occurring during the production of X woven sarongs at PT X is carried out based on the concept of the 7 types of waste. The data collection methods used include direct field observation, interviews with company personnel, and brainstorming sessions with experts in the field of production. The goal of this waste identification is to gain a clear and complete understanding of inefficiencies in the X woven sarong production process, which will guide the development of improvement suggestions.

Current Value Stream Mapping (CVSM)

At this point, an assessment was conducted to examine the current conditions in the X woven sarong production process, starting from the winding, dyeing, warping, sizing, weaving, printing, finishing, and quality assurance processes. According to the current value stream mapping results, producing the X woven sarong requires a total lead time of 3.853 minutes. Of this, Value Added (VA) activities accounted for 2.600 minutes, Necessary Non-Value Added (NNVA) activities took 1.114 minutes, and Non-Value Added (NVA) activities amounted to 139 minutes.

---

[18] Atok Irawan and Boy Isma Putra, 'Identifikasi Waste Kritis Pada Proses Produksi Pallet Plastik Menggunakan Metode WAM (Waste Assessment Model) Di PT. XYZ', *Jurnal SENOPATI : Sustainability, Ergonomics, Optimization, and Application of Industrial Engineering*, 3.1 (2021), 20–29 <https://doi.org/10.31284/j.senopati.2021.v3i1.2098>.

[19] Ratna Novitasari and Irwan Iftadi, 'Analisis Lean Manufacturing Untuk Minimasi Waste Pada Proses Door PU', *Jurnal INTECH Teknik Industri Universitas Serang Raya*, 6.1 (2020), 65–74 <https://doi.org/10.30656/intech.v6i1.2045>.

[20] Hafizh Fikri Kawarizmi and Suseno, 'Mereduksi Waste Pada Proses Produksi Tahu Di UMKM . XYZ Menggunakan Lean Manufacturing', *Jurnal Sains Student Research*, 2.4 (2024), 85–94.

Vol. 18, No. 3, 2025
ISSN: 2654-7856 (Online)
ISSN: 1829-7935 (Print)

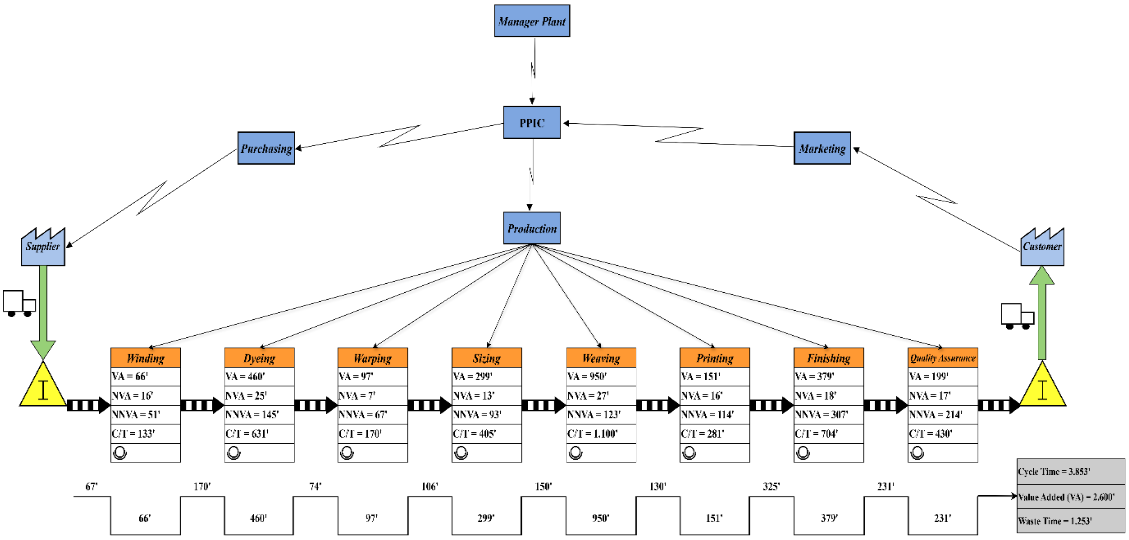

Figure 1. Current Value Stream Mapping

Source: Primary Data, processed 2025

Based on this data, the efficiency within process cycle can be measured based on the equation shown below:

$$\text{PCE} = \frac{\text{Sum of Value Added Time}}{\text{Sum of Cycle Time}} \text{ x } 100\%$$

$$\text{PCE} = \frac{2.600}{3.853} \text{ x } 100\%$$

$$\text{PCE} = 67{,}5\%$$

The calculated Process Cycle Efficiency (PCE) was found to be 67,5%, indicating that the production flow of the X woven sarong is still not running optimally and thus requires improvement.

Waste Assessment Model (WAM)

By using questionnaires, the waste assessment model brings together different parties to uncover and analyze types of waste in a process, which allows for a more comprehensive perspective. To identify waste, two types of questionnaires are used: one that explores the connections between different waste types, and another that evaluates and identifies the leading causes of waste according to the answers given by respondents.

Waste Relationship Matrix (WRM)

The analytical method, known as waste relationship matrix serves as an analytical tool to examine how various types of waste are interconnected, using defined evaluation criteria as the foundation for assessment. The matrix layout shows the influence of each waste type in the rows, and the impact received from other wastes in the columns. The matrix's diagonal components reflect the highest levels of connection, indicating that each waste type is inherently linked to itself. By using the WRM, the interplay between various forms of waste becomes more transparent, as shown in the table below.

Table 1. Level of Waste Interrelationship

No	Waste Relationship	Average	Conversion
1	O_I (Overproduction_Inventory)	13	E
2	O_D (Overporduction_Defect)	11	I
3	O_M (Overproduction_Motion)	10	I
4	O_T (Overproduction_Transportation)	14	E
5	O_W (Overproduction_Waiting)	14	E
6	I_O (Inventory_Overproduction)	13	E
7	I_D (Inventory_Defect)	15	E
8	I_M (Inventory_Motion)	10	I
9	I_T (Inventory_Transportation)	10	I
10	D_O (Defect_Overproduction)	12	I
11	D_I (Defect_Inventory)	13	E
12	D_M (Defect_Motion)	10	I
13	D_T (Defect_Motion)	9	I
14	D_W (Defect_Waiting)	14	E
15	M_I (Motion_Inventory)	6	O
16	M_D (Motion_Defect)	9	I
17	M_P (Motion_Overprocessing)	11	I
18	M_W (Motion_Waiting)	14	E
19	T_O (Transportation_Overproduction)	7	O
20	T_I (Transportation_Inventory)	8	O
21	T_D (Transportation_Defect)	9	I
22	T_M (Transportation_Motion)	13	E
23	T_W (Transportation_Waiting)	12	I
24	P_O (Overprocessing_Overproduction)	12	I
25	P_I (Overprocessing_Inventory)	6	O
26	P_D (Overprocessing_Defect)	11	I
27	P_M (Overprocessing_Motion)	12	I
28	P_W (Overprocessing_Waiting)	11	I
29	W_O (Waiting_Overproduction)	5	O
30	W_I (Waiting_Inventory)	8	O

Source: Primary Data, processed 2025

Here is the result of the average weight conversion presented in the matrix in the table below:

Table 2. Waste Relationship Matrix Value

F/T	O	I	D	M	T	P	W
O	A	E	I	I	E	X	E
I	E	A	E	I	I	X	X
D	I	E	A	I	I	X	E
M	X	O	I	A	X	I	E
T	O	O	I	E	A	X	I
P	I	O	I	I	X	A	I
W	O	O	O	X	X	X	A

Source: Primary Data, processed 2025

ISSN: 2654-7856 (Online)
ISSN: 1829-7935 (Print)

The influence scores for each waste type were calculated by translating the WRM's letter codes into numerical values based on predefined criteria, with A assigned a value of 10, E as 8, I as 6, O as 4, and X as 0. The conversion from WRM letter symbols to numerical weights is shown in the following table:

Table 3. Waste Relationship Matrix (WRM)

F/T	O	I	D	M	T	P	W	Skor	%
O	10	8	6	6	8	0	8	46	18%
I	8	10	8	6	6	0	0	38	15%
D	6	8	10	6	6	0	8	44	17%
M	0	4	6	10	0	6	8	34	13%
T	4	4	6	8	10	0	6	38	15%
P	6	4	6	6	0	10	6	38	15%
W	4	4	4	0	0	0	10	22	8%
Skor	38	42	46	42	30	16	46	260	100%
%	15%	16%	18%	16%	12%	6%	18%	100%	

Source: Primary Data, processed 2025

According to the table, the waste type with the highest percentage in the "from" category is overproduction (O), which holds the largest score and accounts for 18%. This suggests that overproduction waste plays a major role in triggering other types of waste. On the other hand, in the "to" category, defect (D) and waiting (W) have the highest percentage values, each scoring 18%. This indicates that defect and waiting wastes are the most impacted by other types of waste.

Waste Assessment Questionnaire (WAQ)

To analyze waste, the evaluation form is structured into two separate categories of questions, referred to as "from" and "to". The "from" group identifies types of waste that act as sources or contributors to other waste types, while the "to" group focuses on those that are impacted or generated as a result of other wastes. A summary of the final results from the Waste Assessment Questionnaire is presented in the table below.

Table 4. Final Results of Waste Assessment Questionnaire (WAQ)

	O	I	D	M	T	P	W
Score (Yj)	0,28	0,27	0,23	0,22	0,29	0,17	0,19
Pj Factor	270	240	306	208	180	90	144
Hasil Akhir (Yj Final)	76	65	71	45	52	14	28
Hasil Akhir (%)	22%	19%	20%	13%	15%	4%	8%
Ranking	**1**	**3**	**2**	**5**	**4**	**7**	**6**

Source: Primary Data, processed 2025

According to the summary of the Waste Assessment Questionnaire results, the dominant waste in the X woven sarong manufacturing process at PT X is overproduction waste, accounting for 22%. This is followed by defect, at 20%; followed by inventory at 19%; transportation at 15%; motion at 13%; waiting at 8%; and the smallest, overprocessing, at 4%.

Vol. 18, No. 3, 2025
ISSN: 2654-7856 (Online)
ISSN: 1829-7935 (Print)

Value Stream Analysis Tools (VALSAT)

Table 5. Results of Value Stream Analysis Tools (VALSAT)

Waste	Weight (%)	PAM	SCRM	PVF	QFM	DAM	DPA	PS
Overproduction	22	22	66		22	66	66	
Waiting	8	72	72	8		24	24	
Transportation	15	135						15
Overprocessing	4	36		12	4		4	
Inventory	19	57	171	57		171	57	19
Motion	13	117	13					
Defect	20	20			180			
Total		**459**	**322**	**77**	**206**	**261**	**151**	**34**
Persentase (%)		**30%**	**21%**	**5%**	**14%**	**17%**	**10%**	**2%**
Rank		**1**	**2**	**6**	**4**	**3**	**5**	**7**

Source: Primary Data, processed 2025

According to the data processed from the value stream analysis tools, as the highest contribution is process activity method, accounting for 30% of the total percentage.

The process activity mapping analysis is conducted in two stages. The first stage focuses on identifying the frequency and duration of each activity, classified according to five main categories: operation, transportation, inspection, storage, and delay. In the second stage, activities are further grouped into three value classifications: those that add value, those that do not add value but are necessary, and those that add no value.

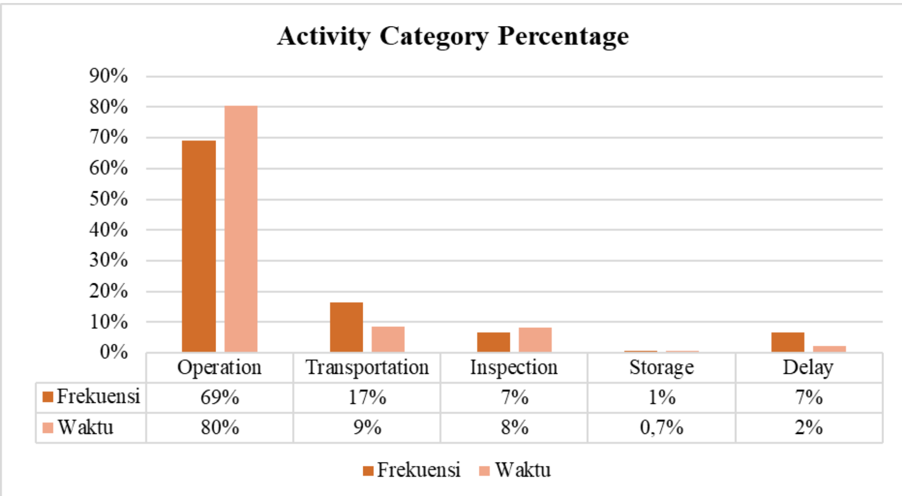

Figure 2. Percentage of of Frequency and Duration for Each of the 5 Activity Categories

Source: Primary Data, processed 2025

Based on the chart, the frequency and time percentages of each activity are classified into five activity categories. The frequency percentage for operation is 69% with a time percentage of 80%, transportation has a frequency percentage of 17% with a time percentage of 9%, inspection has a frequency percentage of 7% with a time percentage of 8%, storage has a frequency percentage of 1% with a time percentage of 0,7%, and delay has a frequency percentage of 7% with a time percentage of 2%.

Vol. 18, No. 3, 2025
ISSN: 2654-7856 (Online)
ISSN: 1829-7935 (Print)

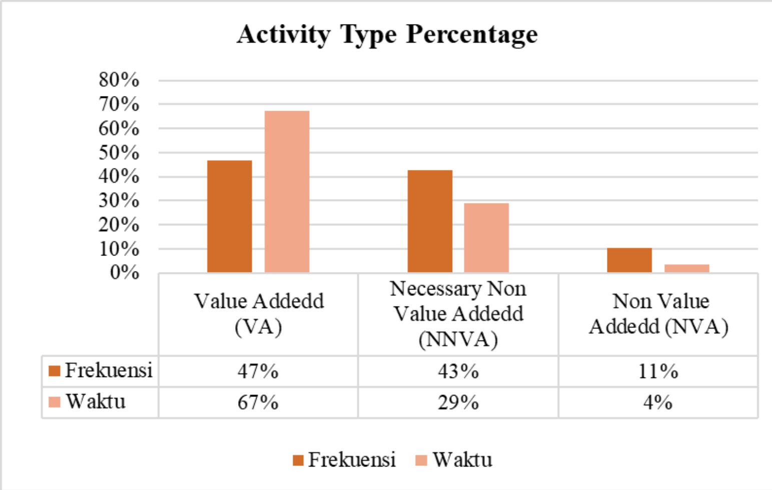

Figure 3. Percentage of Frequency and Duration for Each of the 3 Activity Types

Source: Primary Data, processed 2025

Based on the graph, the percentages of frequency and time for each activity type are as follows: activities that add value constitute 47% of the total occurrences and 67% of the total duration; necessary non-value added activities account for 43% of the total occurrences and 29% of the time; while non-value added activities account for 11% of the occurrences and only 4% of the time.

Root Cause Analysis (RCA)

The development of root causes for this issue is grounded in the identification and prioritization of waste types, as determined through the WAM questionnaire. According to the results from the WAM, overproduction emerges as the most significant waste, representing 22% of the total. Consequently, a deeper investigation is required to uncover the underlying causes of this waste. To determine the root causes, Root Cause Analysis (RCA) is applied using the 5 Why's approach, where the question "Why?" is asked multiple times, generally five, to investigate the reasons behind overproduction in the X woven sarong production. The outcomes of this analysis are presented below.

Table 6. Five Whys Analysis of the Waste Overprocessing

Waste	Sub Waste	Why 1	Why 2	Why 3	Why 4	Why 5
Overpro-duction	Overproduction of yarn that has been processed in winding and dyeing	No daily target or yarn requirement reference based on the next process (warping)	Production planning is not based on actual data or daily production plans	No production scheduling system linked between departments (winding, dyeing, warping)	Production still uses an approach based on capacity, not demand	Operators optimize machine usage even though it is not yet needed for the next process

Waste	Sub Waste	Why 1	Why 2	Why 3	Why 4	Why 5
	Beam warping production exceeds production quantity as per IKT (Weaving Work Instructions) design	Operators continue running machines even when the required quantity is sufficient	No production limit per shift that refers to actual needs	No monitoring system to enforce production target limits	Production monitoring does not use real-time output data	Production system focuses on quantity, not target-based production
	Beam warping is processed into sizing even though it hasn't entered the weaving schedule	Operators continue running machines to meet output targets	Machine performance targets are based on output quantity	No performance evaluation system oriented toward efficiency or actual department needs	Lack of coordination between departments regarding actual production needs	Production system is capacity-based, not based on pull system from the next process
	Weaving process produces fabric exceeding the WIP limit due to absence of maximum production rules	No defined maximum output quantity in weaving	No WIP limit planning between departments based on machine capacity	Lack of coordination between production planning across departments	Poor coordination between departments causes unmonitored production planning	Absence of a lean manufacturing system applied comprehensively to all production lines

Source: Primary Data, processed 2025

5W + 1H

The outcomes of the Root Cause Analysis (RCA) provide valuable insights for pinpointing the fundamental causes of the issue, which are essential for developing appropriate solutions or recommendations for improving the production process. Presented below is a 5W + 1H analysis that examines the occurrence of overproduction waste in the X woven sarong manufacturing process.

Table 7. Proposed Improvement Analysis Using 5W + 1H on Overproduction Waste

Waste	What	Where	Who	When	Why	How
Overpro-duction	Overproduction of yarn that has been processed in winding and dyeing	Winding and dyeing production area	PPC Team (Production Planning and Control), Head of Production Section, Winding and Dyeing	During the winding and dyeing production process, especially when demand for X woven	No target reference or calculation of yarn requirements for the winding and dyeing process	The PPC team can prepare daily winding-dyeing production targets based on warping needs planning and the Weaving Work Instructions (IKT) pattern

Vol. 18, No. 3, 2025
ISSN: 2654-7856 (Online)
ISSN: 1829-7935 (Print)

Waste	What	Where	Who	When	Why	How
			Operators and Supervisor	sarongs increases		
	Beam warping production exceeds the quantity based on the IKT pattern (Weaving Work Instructions)	Warping machine	Head of Production Section, Warping Supervisor, and Operators	During the beam warping process	Lack of strict monitoring of the set production quantity	Improve monitoring of the warping process by assigning supervisors to ensure production matches the IKT pattern, and conduct evaluations to eliminate excess production beyond target
	Beam warping continues to be processed in sizing even though it is not yet scheduled for weaving	Sizing machine	Head of Production Section for sizing, and Sizing Operators	During yarn processing in the sizing machine	There are overproduced items that are still processed in sizing without an actual schedule	The head of production should revise the focus of production monitoring to match actual production schedules per department, and perform interdepartmental synchronization of the production plan
	Weaving process produces fabric exceeding WIP limits due to lack of a defined maximum production quantity	Weaving machine	PPC Team (Production Planning and Control), Head of Production Section, Weaving Supervisor, and Operators	When the daily production target is set and yarn inventory increases	Lack of coordination and control over yarn stock and finished fabric in each department	The head of production and PPC should set a maximum fabric production limit based on actual inventory data, production capacity, and next process requirements

Source: Primary Data, processed 2025

Vol. 18, No. 3, 2025
ISSN: 2654-7856 (Online)
ISSN: 1829-7935 (Print)

Improvements in Process Activity Mapping

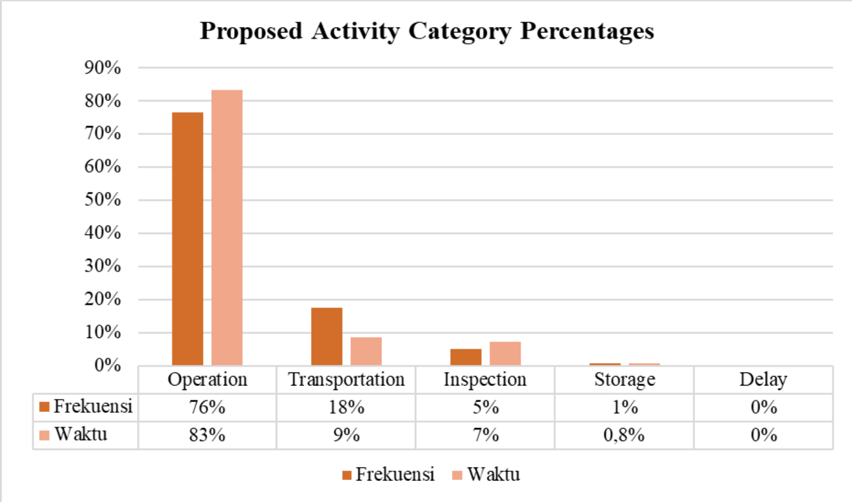

Figure 4. Proposed Frequency and Time Percentages for Each of the 5 Activity Categories

Source: Primary Data, processed 2025

According to the graph, the distribution of frequency and time for the five suggested activities is: operation make up 76% in frequency and take up 83% of the total time; transportation covers 18% in frequency and 9% in time; inspection constitutes 5% in frequency and 7% in time; storage represents 1% in frequency and 0,8% in time; meanwhile, delay accounts for 0% in both frequency and time.

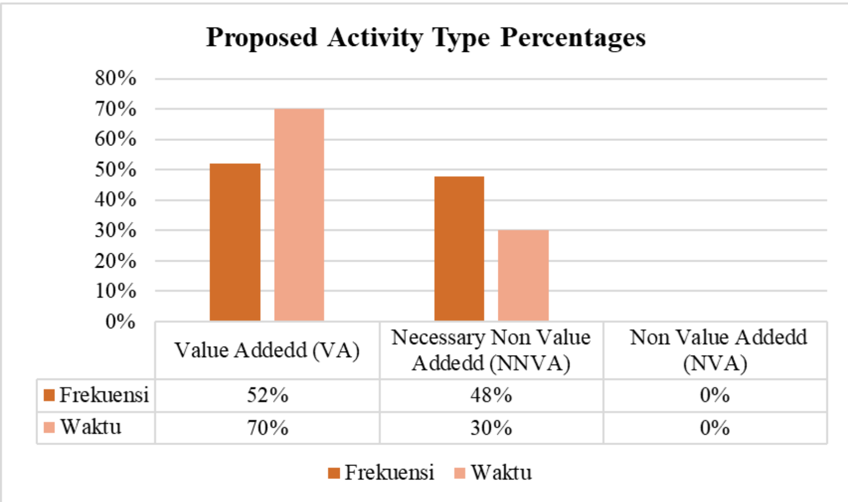

Figure 5. Proposed Frequency and Time Percentages for Each of the 3 Activity Types

Source: Primary Data, processed 2025

According to the graph above, the distribution of frequency and time among the three activity types is as follows: activities that add value constitute 50% of the total occurrences and 70% of the total duration; necessary non-value added activities account for 48% of the total occurrences and 30% of the time; while non-value added activities have no contribution in terms of frequency or time.

Jurnal Pamator
https://journal.trunojoyo.ac.id/pamator

Vol. 18, No. 3, 2025
ISSN: 2654-7856 (Online)
ISSN: 1829-7935 (Print)

Future Value Stream Mapping (FVSM)

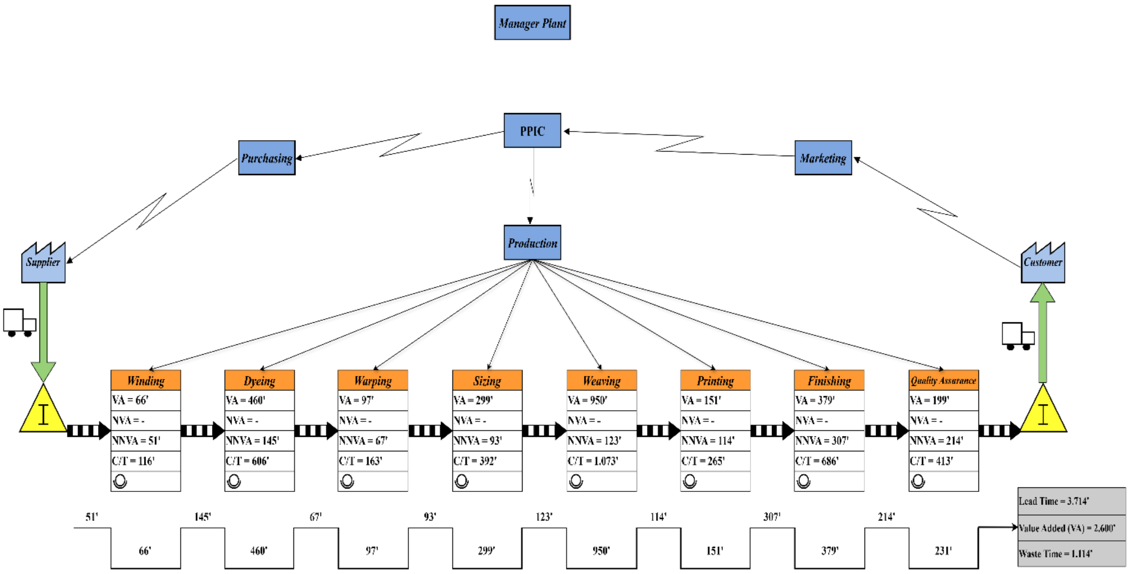

Figure 6. Future Value Stream Mapping

Source: Primary Data, processed 2025

According to the proposed future value stream mapping, the estimated total processing time for producing the X woven sarong at PT X is 3.714 minutes. The Process Cycle Efficiency (PCE) has improved to 70%, reflecting a positive change from the initial PCE prior to implementing the suggested improvements. Additionally, this mapping has decreased waste time by 139 minutes, reducing it from 3.853 minutes to 3.714 minutes.

CONCLUSION

The Waste Assessment Model applied to the production process of X woven sarongs at PT X revealed the ranking of waste types from highest to lowest as follows: overproduction leads with 22%, followed by defects at 20%, inventory at 19%, transportation at 15%, motion at 13%, waiting at 8%, and overprocessing at 4%. Additionally, the Process Activity Mapping (PAM) analysis identified a total of 62 activities classified as Value Added (VA) activities totaling 2,600 minutes, 57 Necessary Non-Value Added (NNVA) activities lasting 1,114 minutes, and 14 Non Value Added (NVA) activities amounting to 139 minutes. The NVA activities are considered waste and should be reduced or removed to enhance overall efficiency.

From root cause analysis conducted on the waste occurring in the X woven sarong production process, several improvement recommendations were proposed, including implementing a demand-driven production system, enhancing coordination through an integrated information system, and performing regular preventive maintenance. These proposed improvements are expected to reduce 14 activities, decreasing the total from 133 to 114 activities, and reduce process time by 139 minutes, from 3.853 minutes to 3.714 minutes. Additionally, the improvements increased the Process Cycle Efficiency (PCE) by 2,5%, from 67,5% to 70%. This increase indicates enhanced production process effectiveness for X woven sarongs following the implementation of the suggested improvements.

BIBLIOGRAPHY

Edi Prasetyo, Eko Setiawan, and Tina Hernawati, 'Penerapan Lean Manufacturing Untuk Mengurangi Waste Pada Cat Tanki Dengan Metode WRM Dan WAQ', *Journal Industrial Manufacturing*, 8.1 (2023), 27 <https://doi.org/10.31000/jim.v8i1.8082>

Fatma, Nur Fadilah, Henri Fatma, and Solehah, 'Penurunan Lead Time Manufacturing Dengan Pendekatan Lean Manufacturing Studi Kasus Di PT. MKM Reducing of Manufacturing Lead Time with A Lean Manufacturing Approach Case Study at PT. MKM', *Journal Industrial Manufacturing*, 8.2 (2023), 136–56

Haekal, Jakfat, 'Integration of Lean Manufacturing and Promodel Simulation on Repair Production Process Flow of Polysilane Bottle Printing Using VSM, WAM, VALSAT, And RCA Methods: Case Study Packaging Manufacturing Company', *International Journal Of Scientific Advances*, 3.2 (2022), 235–43 <https://doi.org/10.51542/ijscia.v3i2.15>

Hidayatullah, Muhammad Asyrof, and Endang Pudji Widjajati, 'Lean Manufacturing Analysis Using Waste Assessment Model (WAM) and Root Cause Analysis (RCA) Methods', *Rekayasa Journal of Science and Technology*, 17.2 (2024), 240–49

Irawan, Atok, and Boy Isma Putra, 'Identifikasi Waste Kritis Pada Proses Produksi Pallet Plastik Menggunakan Metode WAM (Waste Assessment Model) Di PT. XYZ', *Jurnal SENOPATI : Sustainability, Ergonomics, Optimization, and Application of Industrial Engineering*, 3.1 (2021), 20–29 <https://doi.org/10.31284/j.senopati.2021.v3i1.2098>

Kawarizmi, Hafizh Fikri, and Suseno, 'Mereduksi Waste Pada Proses Produksi Tahu Di UMKM . XYZ Menggunakan Lean Manufacturing', *Jurnal Sains Student Research*, 2.4 (2024), 85–94

Kuncoro, Septian Aryo, 'Usulan Penerapan Lean Manufacturing Menggunakan Metode Waste Assessment Model (WAM) Pada Industri Makanan (Studi Kasus Di Usaha Mikro Kecil Menengah Nicesy).', *UNISSULA Institutional Repository* (Universitas Islam Sultan Agung Semarang, 2023)

Kurdhi, Nughthoh Arfawi, Anggi Fatmayati, Erlina Puspitaloka Mahadewi, Diana Yoseva, I Gede Bayu Wijaya, Rollis Juliansyah, and others, *Teori Ekonomi Industri* (Bandung: Widina Media Utama, 2023)

Kurnia, Jonatan, and I Gede Agus Widyadana, 'Identifikasi Dan Eliminasi Pemborosan Dengan Menggunakan Kombinasi Metode Value Stream Mapping (Vsm) Dan Cost Time Profile (Ctp): Studi Kasus Di Pt Sabe Indonesia', *Dimensi Utama Teknik Sipil*, 9.2 (2022), 168–83 <https://doi.org/10.9744/duts.9.2.168-183>

Maulana, Muhamad, Endang Suhendar, and Aliffia Teja Prasasty, 'Penerapan Lean Management Untuk Meminimasi Waste Pada Lini Produksi CV. Mandiri Jaya Dengan Metode WAM Dan VALSAT', *Jurnal Optimasi Teknik Industri (JOTI)*, 5.1 (2023), 1 <https://doi.org/10.30998/joti.v5i1.13747>

Moengin, Parwadi, and Nadhifa Ayunda, 'Lean Manufacturing Untuk Meminimasi Lead Time Dan Waste Agar Tercapainya Target Produksi (Studi Kasus: PT. Rollflex Manufacturing Indonesia)', *Jurnal Teknik Industri*, 11.1 (2021), 77–92 <https://doi.org/10.25105/jti.v11i1.9699>

Naziihah, Afifah, Jauhari Arifin, and Billy Nugraha, 'Identifikasi Waste Menggunakan

Waste Assessment Model (WAM) Di Warehouse Raw Material PT. XYZ', *Jurnal Media Teknik Dan Sistem Industri*, 6.1 (2022), 30 <https://doi.org/10.35194/jmtsi.v6i1.1599>

Novitasari, Ratna, and Irwan Iftadi, 'Analisis Lean Manufacturing Untuk Minimasi Waste Pada Proses Door PU', *Jurnal INTECH Teknik Industri Universitas Serang Raya*, 6.1 (2020), 65–74 <https://doi.org/10.30656/intech.v6i1.2045>

Ponda, Henri, Nur Fadilah Fatma, and Itok Siswantoro, 'Usulan Penerapan Lean Manufacturing Dengan Metode Value Stream Mapping (Vsm) Dalam Meminimalkan Waste Pada Proses Produksi Ban Motor Pada Industri Pembuat Ban', *Jurnal Heuristic*, 19.1 (2022), 23–42 <https://doi.org/10.30996/heuristic.v19i1.6568>

Prasetyani, Dwi, Ali Zainal Abidin, Nanda Adhi Purusa, and Fahrein All Sandra, 'The Prospects and The Competitiveness of Textile Commodities and Indonesian Textile Product in the Global Market', *Etikonomi*, 19.1 (2020), 1–18 <https://doi.org/10.15408/etk.v19i1.12886>

Sembiring, Latifah Hanum Br, Riny Chandra, and Safrizal, 'Analisis Supply Chain Management Menggunakan Metode Value Stream Mapping(Studi Kasus : Kinara Bakeri Kota Binjai)', *Jurnal Manajemen Akuntansi (JUMSI)*, 2.3 (2022), 714–22

Suhardi, Bambang, Maudiena Hermas Putri K.S, and Wakhid Ahmad Jauhari, 'Implementation of Value Stream Mapping to Reduce Waste in a Textile Products Industry', *Cogent Engineering*, 7.1 (2020) <https://doi.org/10.1080/23311916.2020.1842148>

Trisnani, Reza, Amanda Sofiana, and Tigar Putri Adhiana, 'Usulan Perbaikan Lintasan Produksi Minyak Herba Sinergi Menggunakan Value Stream Mapping (Studi Kasus: PT Herba Emas Wahidatama)', *Seminar Nasional Teknik Dan Manajemen Industri*, 1.1 (2021), 55–65 <https://doi.org/10.28932/sentekmi2021.v1i1.6>

Zakaria, Mochamad Ismail, and Rochmoeljati, 'Analisis Waste Pada Aktivitas Produksi BTA SK 32 Dengan Menggunakan Lean Manufacturing Di PT XYZ', *Juminten (Jurnal Manajemen Industri Dan Teknologi)*, 01.02 (2020), 45–56