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IDENTIFYING NON VALUE ADDED ACTIVITIES USING VALUE STREAM MAPPING TO REDUCE WASTE IN THE PVC CEILING INDUSTRY

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Abstract

Production processes in the manufacturing industry still include activities that do not add value and could reduce productivity. This situation was observed in the PVC ceiling production process at PT XYZ, where production targets have not been fully achieved due to waste in the process flow. This study aims to identify NVA activities and formulate process improvement proposals using the Lean Manufacturing approach with the Value Stream Mapping (VSM) method. The research was conducted through direct observation in the production area, interviews with relevant parties, and the collection of company data covering process flow, cycle time, waiting time, and transportation activities. The initial phase of the study began with creating a SIPOC diagram, followed by current-state mapping to categorize activities into VA, NVA, and NNVA. The results show that NNVA activities are dominant, accounting for 115,388 seconds (45.8%) of the total production lead time of 251,660 seconds, particularly driven by waiting time and repetitive transportation activities, as also revealed in the mapping results. Based on these findings, improvement proposals were developed focusing on waste reduction, material handling optimization, and Standard Operating Procedure (SOP) development. However, this study is limited to a future-state recommendation, as the future state was not implemented or simulated; therefore, the effectiveness of the proposed improvements has not been quantitatively validated. The results of this study are expected to assist the company in gradually and sustainably improving production process efficiency.

Key words: Ceiling, Production, Value added, Value stream mapping, Waste.

1. Introduction

The manufacturing industry is one of the sectors contributing to economic growth [1], [2]. Data from the Central Statistics Agency (BPS) shows that the industrial sector accounts for 17.84% of Gross Domestic Product (GDP), with the number of manufacturing industries reaching 30,000 [3]. On the other hand, competition among industries is becoming increasingly fierce, requiring industries to improve productivity to survive [4], [5]. One approach is to reduce non-value-added activities or minimise waste [6], [7], [8], [9]. Waste increases production costs, delays processes, and reduces company productivity [8], [9], [10], making it necessary to adopt an approach to systematically identify and reduce waste [11]. One such approach is Lean Manufacturing [4], [12]. PT XYZ is a manufacturing company specialising in the production of PVC ceilings under the PT XYZ brand. Observations revealed instances of waste, including machine breakdowns, defective products, and process delays, that prevented the full achievement of production targets. Value Stream Mapping (VSM) can be used to identify these sources of waste [8], [9]. VSM is a tool used to map the flow of information and production processes from each workstation; it can also be used to plan improvements to these production processes [8], [10]. Therefore, this study employs VSM to identify dominant forms of waste and propose improvements to enhance the company's productivity. In addition, this study developed recommendations for improvement based on an analysis of Value Added (VA), Non Value Added (NVA), and Necessary but Non Value Added (NNVA).

Previous studies on Lean Manufacturing and Value Stream Mapping (VSM) have extensively explored waste identification and process improvement within manufacturing industries [6], [9], [10], [13]. However, there is a limited amount of research focusing specifically on PVC ceiling production, which involves complex material handling and significant NVA activities. Furthermore, many existing studies propose improvements without quantitatively validating the effectiveness of the proposed future state. This study aims to fill that gap by thoroughly analyzing waste, quantifying the dominance of NVA activities, and clearly outlining the limitations of future-state validation.

2. Research Methods

Activities in the production process are classified into VA, NVA, and NNVA [14]. VA refers to activities that directly transform materials into products and add value from the customer's perspective. NVA refers to pure waste activities that do not add any value and can be eliminated immediately. NNVA refers to activities that do not directly add value but are necessary under current production conditions and cannot be eliminated without process redesign [15]. This study was conducted at PT XYZ, a company that produces ceiling panels. The study focused on the production process to identify activities that generate waste [8]. The research data used were obtained through direct observation, interviews, and company documentation. The data obtained and used included the number of machines and their uses, human resources data, production process flow, value-added activities (VA), non-value-added activities (NVA), necessary but non-value-added activities (NNVA), cycle time data for each process, daily operating time data, machine setup time, material loading and unloading, changeover time, product inspection time, product demand, production target data, actual production data, inventory data, and the company's lead time. In this study, Current State Mapping was used to map VA, NVA, and NNVA. Time measurement was conducted using a direct stopwatch time study in the PVC ceiling production area. The observation was conducted by the researcher, assisted by production operators who understood the actual production flow. The sample consisted of all activities in one complete PVC ceiling production process, from raw material preparation to packaging. The use of Current State Mapping is also intended to simplify the mapping of the current state, thereby facilitating the creation of a VSM [16], It is also used in the initial stages of waste identification [17].

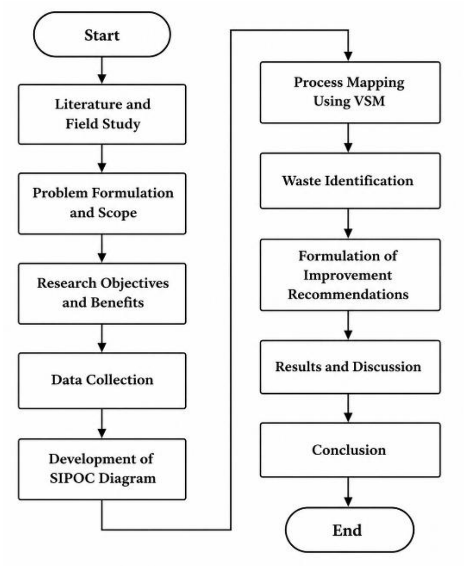

Figure 1. Research Plan

In the initial stage of the study, the interaction activities within PT XYZ's business processes were identified using a SIPOC (Supplier, Input, Process, Output, Customer) diagram [5]. Next, a value stream mapping process was conducted, along with the identification of VA, NVA, and NNVA activities using VSM [8], [9], [15]. The subsequent stage involved analysing the highest levels of waste in NVA activities. Finally, improvement recommendations were formulated to reduce waste occurring in the business processes at PT XYZ (Figure 1).

3. Result and Discussion

The business processes at PT XYZ are generally illustrated in a SIPOC diagram. The supplier is Company X, and the inputs consist of various materials, including flour, calcium, resin, stabilizer, AID, acrylic, PE wax, CPE, ACID, optical, titanium, Blue, ACPL, and dyes. The process consists of several activities, including weighing, mixing, production (heating, moulding, cooling, glueing, sticker application, and sticker bonding), and finishing (cutting, inspection, and packing/distribution). The outputs produced are ceiling panels and trim. The customers include buyers, retailers, and branches (Figure 2).

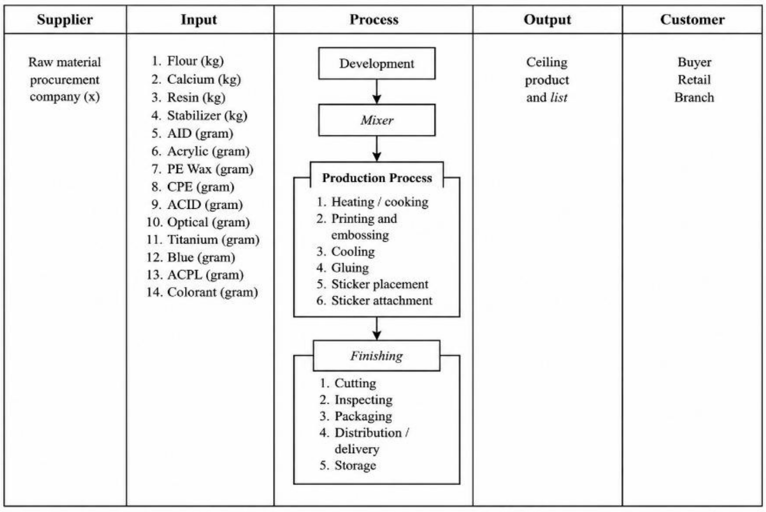

Figure 2. SIPOC Diagram

3.1. Current State Mapping

Current State Mapping was conducted to classify activities into the VA, NVA, and NNVA categories, along with their durations. The results of the Current State Mapping showed that the total duration of the entire process was 251,660 seconds, broken down into 126,743 seconds for VA activities, 2,340 seconds for NVA activities, and 115,388 seconds for NNVA activities (Table 1).

Table 1. Current State Mapping

No.	Stage	Activity	Time (s)	Cycle time (s)				Category		
				VA	NVA	NNVA		VA	NVA	NNVA
				Process	Delay	Inspc.	Trans.			
1	Weighing	Delay	240		240				√	
2		Transportation from the warehouse to the weighing process	2.957				2.957			√
3		Set up the weighing machine	389			389				√
4		Weighing process	428	428				√		
5	Mixin	Delay	150		150				√	
6		transport from the weighing station to the mixer	444				444			√

No.	Stage	Activity	Time (s)	Cycle time (s) VA	NVA	NNVA		Category VA	NVA	NNVA
				Process	Delay	Inspc.	Trans.			
7		Set up the mixer	51.000			51.000				√
8		Mixing	10.443	10.443				√		
9		Transportation of raw materials to the furnace for each machine	231				231			√
10		Material processing in the furnace for each machine	51.768	51.768				√		
11		delay	360		360				√	
12		Set up the production machinery	63.840			63.840				√
13		Transportation from each machine to the heating process	1.560				1.560			√
14		Heating	49.788	49.788				√		
15		transport from the heating process to the drawing process	84				84			√
16		delay	900		900				√	
17		Drawing	12.708	12.708				√		
18		Transport from the drawing process to the cooling process	43				43			√
19	Production	Delay	40		40				√	
20		Cooling	79	79				√		
21		Transportation from the cooling process to the bonding process	40				391			√
22		Delay	50		50				√	
23		Glueing process	40	40				√		
24		Transportation from the lamination process to the sticker application process	18				18			√
25		Delay	180		180				√	
26		Sticker application	208	208				√		
27		Transportation from the sticker application process to the bonding process	767				767			√
28		The bonding process	393	393				√		
29		Cutting machine setup	159			159				√
30		Transportation from the bonding process to the cutting process	754				754			√
31	Finishing	Cutting	29	29				√		
32		Transportation from the cutting process to the inspection process	83				83			√
33		Delay	120		120				√	
34		Inspection	124	124				√		

No.	Stage	Activity	Time (s)	Cycle time (s)				Category		
				VA	NVA	NNVA		VA	NVA	NNVA
				Process	Delay	Inspc.	Trans.			
35		Transportation from the inspection process to the packaging process	208				208	√		√
36		Delay	60		60				√	
37		Packaging	735	735				√		
38		Delay	240		240				√	
		Total number	251.660	126.743	2.340	115.388	7.540	126.743	2.340	115.388

3.2. Value Stream Mapping

The production process operates 24 hours a day (3 shifts) with a 1-hour break for each shift. Therefore, the actual time spent working is 21 hours (75.600 seconds). The production process begins with the weighing of raw materials, which requires 1 worker and has an operating time (C/T) of 428 seconds, a scale setup time or changeover time (CO) of 389 seconds, and a delay of 240 seconds. Moving raw materials from the warehouse to the weighing station takes 2,957 seconds. After weighing, the mixing process follows. Transporting raw materials from the weighing process to the mixing process takes 675 seconds. The mixing process has an operation time of 10.443 seconds, a machine setup time of 51.000 seconds, and a delay of 510 seconds. The next stage involves the production process, which includes heating, drawing, cooling, glueing, sticker application, and sticker bonding. The time required from heating to sticker bonding is 114.984 seconds, machine setup takes 63.840 seconds, there is a delay of 1.170 seconds, and transportation takes 2.863 seconds. This is followed by the finishing process, which comprises three stages: cutting, inspection, and packing. The cutting process takes 888 seconds, the machine setup takes 1.045 seconds, and there are 8 workers in the cutting process, with each worker operating one machine. The results of the cutting process are shipped to customers via truck and ocean vessel. Thus, the total time for VA is 126.743 seconds, while the time for NVA is 2.340 seconds (Figure 3).

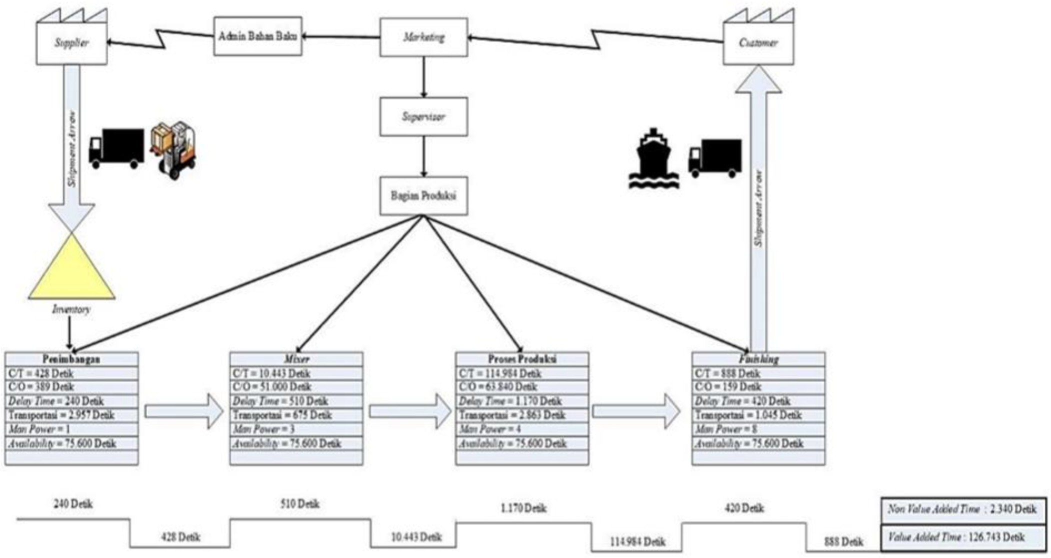

Figure 3. Value Stream Mapping

3.3. Summary of VA, NVA, and NNVA percentages

Based on the Current State Mapping, the Process, Delay, Inspection, and Transportation components were identified. Based on this data, activities were then categorised as VA, NVA, or NNVA (Table 2).

Table 2. Summary of Activities by VA, NVA, and NNVA

Category	Activity	Time (seconds)	Percentage
VA	Process	126,743	50.29%
NVA	Delay	2,340	0.93%
NNVA	Setup	115,388	45.79%
NNVA	Transportation	7,540	2.99%
Total		252,011	100%

Although the NVA portion is relatively small (2,340 seconds or approximately 0.93% of the total lead time), the main inefficiency in the production process is not dominated by NVA activities. Instead, the largest share of time is spent on NNVA activities, which account for 122,928 seconds (48.78% of the total lead time). Therefore, the main production inefficiency is driven by NNVA activities rather than by pure NVA activities. After classifying the activities into VA, NVA, and NNVA, the Process Cycle Efficiency (PCE) was calculated to assess the production process's efficiency. The PCE was calculated by dividing value-added time by total lead time. Based on the calculation, the PCE was 50.29%, obtained by dividing 126,743 seconds of VA time by 252,011 seconds of total lead time. This result indicates that only 50.29% of the production lead time directly adds value to the product, while the remaining time is dominated by NNVA activities, especially setup and transportation.

3.4. Problem identification and proposed solutions

The causes of NVA activity are identified by identifying potential causes, delays, and root causes; improvement proposals are then developed based on the potential root causes that have emerged (Table 3).

Table 3. Identification of the causes of NVA and proposed improvements

Delay	Potential Cause	Suggested improvements
Before the weighing process	Warehouse limitations	Implementation of 5S Implementing the FIFO principle to reduce inventory buildup in the warehouse.
	Limitations on transportation equipment in the warehouse	Adding forklifts to assist with transportation activities in the warehouse.
	Limitations on equipment for retrieving raw materials	Adding vacuum lifters to assist with raw material retrieval in the warehouse.
Mixing	Inconsistent sizes of material bins	Standardizing furnace sizes and adjusting the specifications of each machine.
	Physical workload on employees	Installing a ventilation and air filtration system in the mixing room to ensure employee comfort. Monitoring and controlling employee break times and working hours.

Delay	Potential Cause	Suggested improvements
Before the production process	Employee negligence	Supervision and control before the production process begins
	Preventive maintenance has not been implemented	Employee training on preventive maintenance to perform machine maintenance
Before the withdrawal process	Inconsistent use of raw materials	Development of SOP regarding standards for raw materials used
	Preventive maintenance has not been implemented	Employee training on preventive maintenance to perform machine maintenance
Before the cooling process	Inconsistent use of raw materials	Development of SOP regarding standards for raw materials used
▪ Before the gluing process ▪ Before applying the sticker	No supervision or control is in place	Formation of a supervision and control team
	No training for operators	Development of a training program on machine operation
	No Standard Operating Procedures (SOP) are in effect	Development of SOP for the use of welding machines
Before the inspection process	No SOP regarding inspection	Development of SOP regarding inspection procedures, workplace regulations, and the company’s reward and punishment system
Before packing	No SOP regarding packing	Development of SOP regarding packaging procedures, workplace regulations, and the company’s reward and punishment system
After Packing	Limited human resources	Hiring additional staff

4. Conclusion

This study uses the Value Stream Mapping approach to identify NVA activities in the PVC ceiling production process at PT XYZ. The results of the Current State Mapping revealed that waste still exists in the production process, primarily in the form of waiting time, delay, excessive transportation activities, and poorly managed support activities. These conditions prevent the production process flow from running optimally, thereby impacting production time. Based on the results of the waste identification, this study proposes improvements focused on reducing waiting time between workstations, improving the material handling system, and developing and implementing Standard Operating Procedures (SOP). These proposed improvements are expected to reduce NVA activities and drive increased production process efficiency. The application of VSM in this study provides an overview of the production process conditions and facilitates the identification of sources of waste. Waste in the production system is primarily dominated by NNVA activities rather than NVA activities, indicating that the main inefficiency is caused by necessary but non-value-added processes within the current production system. The results of this study can serve as a basis for the company to implement gradual and continuous process improvements. Further research is recommended to evaluate the implementation of the proposed improvements quantitatively so that their impact on productivity and operational performance can be further measured. in addition, a more comprehensive follow-up analysis is needed to address NVA and improve productivity at PT XYZ.

Bibliography

[1] R. C. J. Sianipar, P. A. Kotel, and A. P. Pratama, “Kinerja Industri Manufaktur pada Masa Pandemi Covid-19,”

Parahyangan Econ. Dev. Rev., vol. 2, no. 1, 2023.

[2] R. Prabowo, "Kontribusi Industri terhadap Pertumbuhan Ekonomi Nasional," *FACTORY*, vol. 3, no. 2, pp. 55–57, 2025, doi: https://doi.org/10.56211/factory.v3i2.731.

[3] Badan Pusat Statistik, "Produk Domestik Bruto Indonesia Triwulanan 2018-2022," 2022, *Badan Pusat Statistik*. [Online]. Available: https://www.bps.go.id/id/publication/2022/10/10/8cc1ae509d93e0f7a1f8f6d7/produk-domestik-bruto-indonesia-triwulanan-2018-2022.html

[4] T. U. Hasanah, T. Wulansari, T. Putra, and M. Fauzi, "Penerapan Lean Manufacturing dengan Metode Takt Time dan FMEA untuk Mengidentifikasi Waste pada Proses Produksi Steril di Industri Farmasi," *J. Rekayasa Sist. dan Ind.*, vol. 7, no. 2, pp. 89–95, 2020, doi: https://doi.org/10.25124/JRSI.V7I2.435.

[5] I. A. Rosid and K. Amar, "Peningkatan Kualitas Kain Tekstil Solid Dengan Menggunakan Pendekatan Six Sigma Pada Unit Finishing and Printing Di PT. Dan Liris Sukoharjo," in *Seminar Nasional Teknik Industri*, 2018.

[6] I. Ramadhani, A. Rasyid, and S. Junus, "Identifikasi Dan Minimasi Waste Produksi Keripik Pisang Keju Menggunakan Metode Lean Manufacturing," *J. Perad. Sains, Rekayasa dan Teknol.*, vol. 11, no. 2, pp. 240–250, 2023, [Online]. Available: https://stitek-binataruna.e-journal.id/radial/index

[7] E. Febianti, K. Kulsum, A. R. Pratama, L. Herlina, B. Kurniawan, and A. W. Muhammad Adha Ilhami Ade Irman Saeful Mutaqin, Yusraini Muharni, "Implementasi Lean Service dengan Metode WAM dan VALSAT untuk Meminimasi Waste pada Loading Steel Plate," *J. Syst. Eng. Manag.*, vol. 1, no. 1, pp. 15–22, 2022, doi: http://dx.doi.org/10.62870/joseam.v1i1.17538.

[8] N. Baldah, H. Amaruddin, and Sutaryo, "Pendekatan Value Stream Mappingpada Optimalisasi Proses dan Peningkatan Produktivitas," *Mak. J. Manaj.*, vol. 7, no. 2, pp. 136–144, 2021.

[9] Andri and D. Sembiring, "Penerapan Lean Manufacturing dengan Metode VSM (Value Sream Mapping) untuk Mengurangi Waste Pada Proses Produksi PT.XYZ," *Fakt. Exacta*, vol. 11, no. 4, pp. 303–309, 2018.

[10] M. Afrianto, N. Budiharti, and S. Haryanto, "Implementasi Lean Manufacturing Untuk Meminimasi Waste Menggunakan Metode Value Stream Mapping Pada PT. MJ di Pasuruan," *J. Valtech*, vol. 5, no. 2, pp. 74–80, 2022.

[11] E. Febianti, Y. Muharni, H. R. Agusti, and Kulsum, "Penerapan Lean Manufacturing Untuk Mereduksi Waste Pada Produksi Spare Part Screw Spindle Set," *J. Ind. Serv.*, vol. 7, no. 1, pp. 76–82, 2021, doi: http://dx.doi.org/10.36055/jiss.v7i1.12338.

[12] W. Sulistiyowati, M. Adamy, and R. Jakariya, "Product Quality Control Based on Lean Manufacturing and Root Cause Analysis Methods," in *Journal of Physics: Conference Series*, 2019, pp. 1–8. doi: 10.1088/1742-6596/1402/2/022038.

[13] F. Sumasto *et al.*, "Peningkatan Value Added dalam Industri Tahu melalui Penerapan Lean Manufacturing dan Analisis Waste," *J. Serambi Eng.*, vol. 8, no. 4, pp. 7338–7347, 2023, doi: https://doi.org/10.32672/jse.v8i4.6876.

[14] M. F. Natawijaya and T. P. Kasih, "The Impact of Lean Tools and Waste Analysis on the Improvement of Process Cycle Efficiency and Manufacturing Lead Time of Pipe Sleeve Fabrication: A Case Study," *Eng. Innov.*, vol. 17, pp. 109–122, 2026, doi: 10.4028/p-R2QkXI.

[15] N. E. Ismail, A. N. Sutomo, and M. Muchtaridi, "Analysis of Waste Minimization in Production Time to Increase Production Effectiveness," *IJPST*, vol. 10, no. 1, pp. 31–36, 2023.

[16] E. B. Kurniawan and N. L. P. Hariastuti, "Implementasi Lean Manufacturing pada Proses Produksi untuk Mengurangi Waste Guna Lebih Efektif dan Efisien," *SENOPATI*, vol. 1, no. 2, pp. 85–95, 2020.

[17] K. Lestari and D. Susandi, “Penerapan Lean Manufacturing untuk mengidentifikasi waste pada proses produksi kain knitting di lantai produksi PT. XYZ,” in *Prosiding Industrial Research Workshop and National Seminar*, 2019, pp. 567–575. doi: 10.35313/IRWNS.V10I1.1519.