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Lean Manufacturing Analysis Using Value Stream Mapping to Reduce Waste (Case Study: CV XYZ)

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ABSTRACT

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CV XYZ is a plastic manufacturing company that produces various household products and cosmetic containers. As a company that applies a production system combining make-to-order and make-to-stock, CV Bintang Jaya faces challenges in meeting high demand, especially for Viva brand cosmetic containers, which contribute 28.79% of total demand. Internal data show a one-day delivery delay during the period from October to December 2025 due to production process times exceeding the available capacity. This study aims to identify the types of waste that occur, analyze the main factors causing delays, and provide improvement proposals to minimize production lead time. The method used is the Lean Manufacturing approach, with Value Stream Mapping (VSM) as the main tool to map the flow of materials and information. Data were collected through field observations (Gemba), interviews, and work time measurements using a stopwatch time study. The analysis stages include developing a Current State Map to identify non-value-added activities and bottlenecks, followed by the creation of a Future State Map and the preparation of an A3 report as a systematic improvement plan. The expected outcome of this study is a reduction in total production lead time through the elimination of waste such as waiting time and work-in-process inventory, enabling the company to improve operational efficiency and ensure timely delivery to customers.

Keywords:

Lean Manufacturing, Value Stream Mapping, Waste, Lead Time

1. Introduction

Industrial competition requires manufacturing companies to produce products with consistent quality, competitive prices, and the ability to meet customer demand on time. The performance of demand fulfillment depends not only on machine capacity, but also on the smooth flow of the production process and the control of non-value-added activities. High productivity reflects a company's ability to optimally manage labor, raw materials, machinery, and time in order to generate maximum output with minimal input [1]. If the production flow is not properly managed, the impacts can be seen in increased production lead time, accumulation of work-in-process (WIP), and delayed orders. Lean manufacturing focuses on creating customer value by minimizing waste that consumes time, labor, space, and materials without adding value to the product. By reducing waste and organizing processes to become more stable and streamlined, companies can improve efficiency while strengthening their competitiveness.

CV XYZ is a manufacturing company engaged in the production of plastic household equipment and cosmetic containers, such as pet bowls, cosmetic containers, bedpans, baskets, and various other plastic products. In general, the products manufactured by the company are distributed to wholesale stores, retail outlets, and regular customers in the surrounding areas. The company's main activities focus on the injection molding and packaging processes, supported by human resources divided into production, warehouse, administration, and marketing functions. In its operations, the company implements a production system that combines customer order fulfillment with the provision of finished goods inventory for certain items. Among the various products produced, several items are ordered more frequently and serve as the main contributors to the company's sales orders, one of which is the Viva branded cosmetic container, which has a relatively higher demand volume compared to other products.

The high level of demand for several main products requires the company to ensure that the production process operates efficiently and is capable of meeting market needs in

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a timely manner. One of the products with a relatively high demand level at CV XYZ is the Viva branded cosmetic container; therefore, this product was selected as the primary object of this study. The high demand for this product causes production activities to be carried out repeatedly and in large volumes. This condition has the potential to generate various forms of waste, such as waiting time, accumulation of work-in-process inventory, and activities that do not add value within the production flow. Therefore, analyzing product demand data is important to determine the level of market demand and to serve as a basis for mapping the production process flow using the Value Stream Mapping approach in order to identify and reduce waste occurring in the production process at CV XYZ. The following presents the product demand data for the past year.

Table 1 Product Demand Data January 2025 – December 2025

No	Product Type	Quantity (Pcs)
1	Cosmetic Container	4.256.488
2	Pet Bowl	865.2
3	Bedpan	702.108
4	Multipurpose Basket	904.32
5	Skincare Container	2.205.411
6	Gallon Cap	930
7	Electrical Socket	468.072
8	Product Box	561.427
9	Bucket	748.829
10	Basin	655.128
11	Tableware	936.23

Table 2 Demand Percentage

Product Type	Quantity (Pcs)	Percentage	Cumulative Percentage	Category
Cosmetic Container	4.256.488	32,17%	32,17%	A
Skincare Container	2.205.411	16,67%	48,83%	A
Sealware	936.23	7,07%	55,91%	A
Gallon Cap	930	7,03%	62,93%	A
Multipurpose Basket	904.32	6,83%	69,77%	A
Pet Bowl	865.2	6,54%	76,31%	A
Bucket	748.829	5,66%	81,96%	B
Bedpan	702.108	5,31%	87,27%	B
Basin	655.128	4,95%	92,22%	B
Product Box	561.427	4,24%	96,46%	C
Electrical Socket	468.072	3,54%	100,00%	C
TOTAL	13.233.213			

Based on Table.2, which presents the demand data for each product along with their respective percentages, the data can be used to identify the contribution of each product to the company's total demand and to facilitate analysis using a Pareto chart. In the chart, the bars represent the demand quantity of each product, while the line indicates the cumulative percentage of the total demand. Based on the calculation results, cosmetic containers have the highest demand level at 32.17%, followed by skincare containers at 16.67%, sealware at 7.07%, gallon

caps at 7.03%, multipurpose baskets at 6.83%, and pet bowls at 6.54%. Other products such as buckets, bedpans, basins, product boxes, and electrical sockets also contribute to the total demand, but with smaller percentages. Based on the Pareto (ABC) classification, products included in category A are those with the largest contribution to demand and therefore become the priority in the analysis of the production process. The Pareto chart of product demand types can be seen in Figure 1.

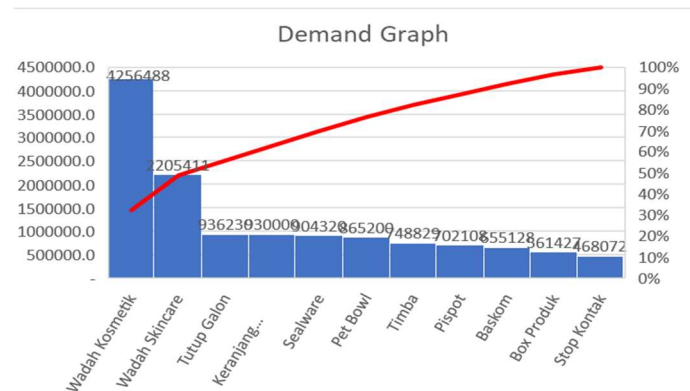


Figure 1 Demand Chart

Based on the results of the ABC classification analysis, the Cosmetic Container product was determined as the highest-priority product (Category A), as presented in Table 1.3, with a total demand during 2025 reaching 4,256,488 units and monthly fluctuations ranging from 332,100 units in September to a peak of 383,275 units in April. Further analysis through the comparison between machine workload (Body Process Time) and the available daily production time of 28,800 seconds (assuming 8 effective working hours) indicates the occurrence of bottlenecks during two major periods, namely March–April with process times of 30,284 seconds and 32,345 seconds, respectively, as well as October–December with the highest workload reaching 33,541 seconds in October. This condition, where the process time exceeds the available capacity, directly impacts delivery performance, as indicated by one-day delays occurring in March, April, October, November, and December. This suggests that the current production capacity is not yet capable of accommodating demand surges when relying solely on regular working hours. Therefore, it is necessary to identify waste and propose improvements through the Lean Manufacturing approach in order to optimize cycle time and minimize these delays.

Table 3 Cosmetic Container Demand Data

Period	Demand per Period	Daily Demand (24 Working Days) (pcs)	Body Process Time (Injection Machine) 8 Working Hours (28,800 seconds)	Available Time / Day (seconds)
25-Jan	341,280	14,220	25,596	28,800
25-Feb	346,915	14,455	26,019	28,800
25-Mar	379,640	15,818	30,284	28,800

25-Apr	383,275	15,970	32,345	28,800
25-May	362,110	15,088	27,158	28,800
25-Jun	351,524	14,647	26,365	28,800
25-Jul	341,200	14,217	25,591	28,800
25-Aug	358,450	14,935	26,882	28,800
25-Sep	332,100	13,838	24,908	28,800
25-Oct	365,800	15,242	33,541	28,800
25-Nov	344,194	14,341	30,883	28,800
25-Dec	350,000	14,583	29,960	28,800
TOTAL	4,256,488			

Based on Table 3, it can be seen that during the January to February 2025 period, the machine process time was still below the available time limit of 28,800 seconds, amounting to 25,596 seconds and 26,019 seconds, respectively, so no production delays occurred. However, in March to April 2025, there was a significant increase to 30,284 seconds and 32,345 seconds, which exceeded the available time capacity and had the potential to cause production delays. Furthermore, during the May to September 2025 period, the process time returned to a stable condition below the available limit, ranging from 24,908 seconds to 27,158 seconds, indicating relatively controlled production conditions. Nevertheless, in October 2025, the highest increase occurred at 33,541 seconds, followed by November and December, which also remained above the limit at 30,883 seconds and 29,960 seconds, respectively. This condition indicates an imbalance in production capacity and the existence of potential bottlenecks that may lead to delivery delays and therefore require further evaluation to improve process efficiency.

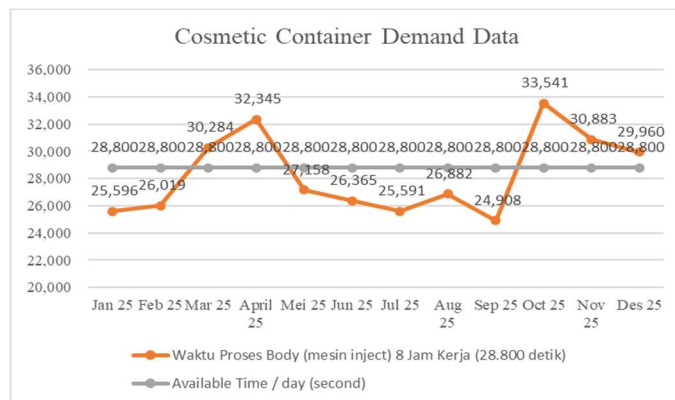


Figure 2 Cosmetic Container Demand Data

2. Research methods

This study applied the Lean Manufacturing approach to identify and reduce waste occurring in the production process. The analysis was not limited to a single aspect, but comprehensively evaluated the production flow through several Lean Manufacturing tools. Value Stream Mapping (VSM) was used to map the flow of materials and information throughout the production process, Process Activity Mapping (PAM) was utilized to classify value-added and non-value-added activities, while the analysis of the seven wastes was conducted to identify

dominant forms of waste within the production system. The integration of these approaches enabled the study to provide concrete improvement recommendations, such as reducing waiting time, minimizing work-in-process (WIP) inventory, improving production flow, and optimizing cycle time in order to enhance production efficiency and reduce delivery delays on the production floor.

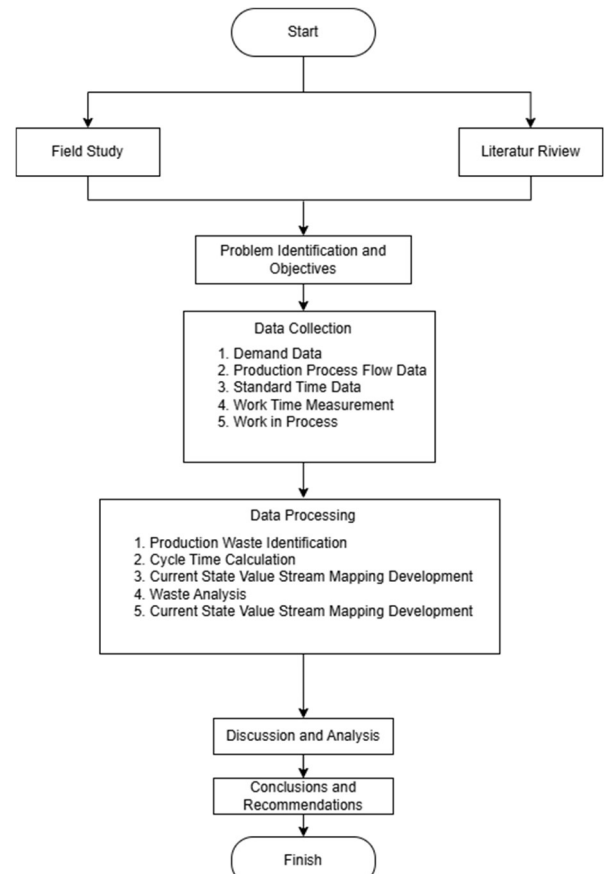


Figure 3 Research Stages

2.1 Fields Study

Field observations were carried out directly at the research location to obtain a comprehensive understanding of the actual conditions within the production process. Through this activity, researchers were able to identify operational activities, analyze factors contributing to existing problems, and collect factual data that could not be fully obtained through theoretical studies alone. The results of the field study were then used as the main foundation for conducting further analysis and developing appropriate improvement recommendations.

2.2 Literature Study

A literature study was carried out to develop a theoretical basis that supports the research topic being investigated. In this stage, researchers collected information from various academic sources such as books, scientific journals, previous research, and other relevant references related to Lean Manufacturing and production process improvement. The collected references were then analyzed and reviewed to gain an understanding of concepts, methods, and

findings from earlier studies associated with the research problem. Through this literature review process, the research obtained a stronger conceptual framework and a clearer direction for supporting the analysis and discussion in the subsequent stages of the study.

2.3 Data Collection

Data collection is an essential stage in the research process because the information obtained serves as the primary basis for conducting analysis. In this stage, researchers collected data related to the research object through several methods, including direct observation, interviews, documentation, and literature studies. The collected data were adjusted to the research objectives in order to support the identification and analysis of problems effectively. Furthermore, all obtained information was systematically organized and classified according to the research requirements to facilitate the subsequent analysis process.

2.4 Value Stream Mapping Data Processing

Value Stream Mapping data were processed and analyzed to identify activities that provide added value (value added) and activities that do not provide added value (non-value added) within the production process flow. The stages of data processing included identifying the flow of materials and information, measuring cycle time, lead time, waiting time, work in process (WIP), and mapping production activities using Current State Value Stream Mapping. Data collection was carried out through direct observation on the production floor, interviews with operators, and documentation of the production process [2]. Furthermore, the collected data were analyzed to identify the types of waste occurring in the production process based on the Lean Manufacturing concept, such as waiting, transportation, unnecessary motion, overproduction, inventory, defects, and unnecessary processing. After identifying the dominant waste, an evaluation of process activities was conducted using Process Activity Mapping (PAM) to classify activities into value added (VA), necessary but non-value added (NNVA), and non-value added (NVA) categories [3]. The results of the analysis were then used as the basis for developing Future State Value Stream Mapping aimed at providing proposed improvements to the production process. The proposed improvements focused on reducing waste, increasing process flow efficiency, minimizing waiting time, and optimizing cycle time so that the production process becomes more effective and capable of meeting customer demand on time [4].

A. Waste

Waste is defined as any activity that does not provide added value to a product. According to Japanese terminology in the Toyota Production System: Beyond Large-Scale Production, waste is categorized into three main concepts, namely muda, mura, and muri. Muda refers to activities that do not add value, mura refers to unevenness or inconsistency in work results, and muri refers to excessive or repetitive work beyond normal capacity. In general, waste is considered a symptom rather than the root cause of a problem within the production system. Waste includes all types of activities that do not contribute value to the production process. Therefore,

companies need to minimize waste and other constraints that disrupt production activities so that the production process can run more efficiently, effectively, and smoothly [5].

B. Current State Mapping

The current state map is a visual representation of the existing process or workflow currently taking place within the production system. This mapping illustrates every step in the process, including cycle time, inventory, delays, bottlenecks, and the flow of information and materials[6]. Through the current state map, organizations are able to identify inefficiencies, waste, and various problems occurring in the existing production process.

The development of the current state map begins with several important activities aimed at understanding the actual conditions on the production floor and identifying the sources of improvement opportunities. The steps involved include:

1. Conducting direct observations (gemba) from the beginning to the end of the production process.
2. Carrying out direct discussions or brief interviews with operators in the production area to ensure a proper understanding of the process.
3. Making simple notes for each process and identifying critical points in every production activity.
4. Using a stopwatch to measure cycle time in each process, as well as conducting random checks to verify the collected data and observe specific activities of interest.
5. Creating an initial simple sketch of the production flow as a draft of the current state map.

The development of a current state map is an important initial step in analyzing and improving production processes. By following these steps, organizations can identify existing problems and use the results as the basis for developing a future state map, which represents the ideal condition after improvements have been implemented.[7].

C. Value Stream Mapping Symbols

No	Simbol	Nama	Keterangan
1.		Customer/Supplier	This symbol represents the supplier when placed at the upper left side of the Value Stream Mapping (VSM) as the starting point of material flow. When placed at the upper right side of the VSM, this symbol represents the customer.
2.		Dedicated Process	This symbol represents a process, operation, machine, or department through which the material flows.
3.		Shared Process	This symbol represents an operational process, department, or work center shared with other value stream families.
4.		Inventory WIP	This icon indicates inventory between two processes. In the current state, the amount of inventory is recorded below the triangle symbol. If there is more than one inventory accumulation, another inventory symbol may be used.
5.		Electronic Information	Describes the exchange of information through electronic media.
6.		Manual Information	Describes general information from memos, reports, or conversations that convey important information or other relevant matters.

7.		Other	Represents other important information or relevant matters.
8.		Truck Shipment	Describes shipment from supplier to customer using external transportation.
9.		Computer Assisted	Represents scheduling using MRP/ERP systems or other centralized systems.
10.		Timeline	Indicates value-added time (cycle time) and non-value-added time (waiting time). This symbol is used to calculate lead time and total cycle time.
11.		Operator	Indicates the number of operators required to process a product family at a particular VSM workstation.
12.		Kaizen Burst	Used to highlight the need and improvement plans for kaizen activities in a specific process that are important for achieving the future state map.
13.		Push Arrow	Describes the flow of materials from one process to the next. Push means that a process produces something without considering the immediate needs of the downstream process.

Figure 4 Process Symbols in Value Stream Mapping

D. Time Study

Time measurement aims to obtain standard time data required to complete a particular task, which refers to the time needed by a worker to perform a job under normal working conditions and using the established work method effectively and consistently [8]. The criteria that must be fulfilled in conducting a time study are that the activities must be repetitive and uniform, the work must be homogeneous, and the output must be measurable quantitatively, either as a whole or for each work element performed. In addition, the job should be carried out frequently and systematically, making it feasible to measure and calculate its standard time accurately [9]. There are two techniques commonly used in conducting time study measurements, namely:

1. Direct Time Measurement

This measurement method is carried out by directly observing the work activities performed and recording the time required by workers to complete their tasks. Direct time measurement can be conducted using two methods, namely the stopwatch time study method and the work sampling method.

2. Indirect Time Measurement

In this measurement method, the observer does not need to be directly present at the workplace because the calculation is based on predetermined standard times and predetermined motion time systems [10].

E. Value Stream Analysis Tools (VALSAT) - PAM

The VALSAT (Value Stream Analysis Tools) method is used as a framework for selecting appropriate tools in Value Stream Mapping to identify and reduce waste within the production process [5]. Production activities are classified into value added (VA), necessary but non-value added (NNVA), and non-value added (NVA) activities, where NVA activities should be eliminated, while NNVA activities require system

improvements. One of the primary tools used in this method is Process Activity Mapping (PAM), which functions to map production processes in detail by classifying activities such as operations, transportation, inspection, and storage, while also considering factors including time, distance, location, and labor involvement. The implementation of PAM includes analyzing process flow, identifying waste, improving work sequences, evaluating facility layout, and assessing the effectiveness of each activity in order to improve production efficiency.

F. Future State Mapping

The future state map is a visual representation of the desired condition of a process after improvements have been implemented. This map illustrates how the production process will operate after waste reduction, workflow improvement, and system optimization have been carried out. In the future state map, there must be an analysis of the proposed improvements applied to the production flow. The improvement analysis focuses on enhancing the value stream of each process in order to reduce waste and eliminate non-value-added activities, thereby increasing the overall efficiency and effectiveness of the production system [7].

3. Results and Discussion

3.1 Production Process Flow

The production process flow for cosmetic container and skincare products at CV XYZ begins with raw material preparation, mixing, injection molding, quality inspection, assembly, and packaging processes. Based on the observation results, a bottleneck was identified in the injection molding process because the process time exceeded the available production time of 28,800 seconds per day, resulting in work-in-process (WIP) accumulation and delays in the production process.

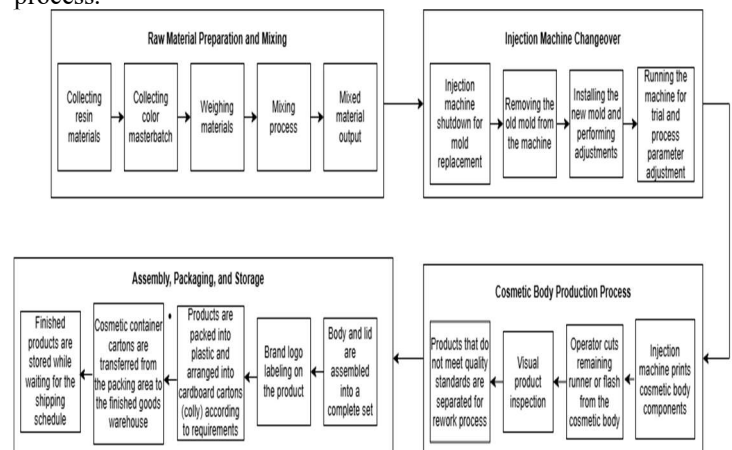


Figure 5 Cosmetic Container Production Process

3.2 Cycle Time of Each Workstation

In the process of collecting cycle time data on the cosmetic container and skincare container production line at CV XYZ, observations were carried out at each workstation, starting from material preparation and mixing, injection machine changeover, injection molding production process, to assembly, packaging, and finished goods storage. Cycle time is an important indicator used to determine the time required to

complete one production cycle at each workstation and to identify imbalances in the production process flow. Differences in cycle time values between workstations may indicate the presence of bottlenecks or excessive workloads in certain processes, which have the potential to cause waste in the form of waiting time and accumulation of Work In Process (WIP).

Table 4 Cycle Time Work Station Cosmetic Container

No	Workstation	Main Activities	Cycle Time (minutes)
1	Material Preparation and Mixing	Collecting resin, collecting color masterbatch, weighing materials, mixing process	9,42
2	Injection Machine Changeover	Machine shutdown, removing old mould, installing new mould, trial and parameter setting	29
3	Cosmetic Body Production Process	Body injection, runner/flash cutting, visual inspection, separation of rework products	2,36
4	Assembly, Packaging, and Storage	Assembling body and mirror, logo application, plastic packaging, carton arrangement, finished goods storage	11,18

3.3 Standard Production Process Time

Standard production process time refers to the time established by the company as a reference for completing tasks at each workstation within the production line. This standard time is used to ensure that the production process operates according to the planned production capacity and targets set by the company. In addition, standard time serves as the basis for production scheduling, machine and labor capacity calculations, and the evaluation of overall production process performance. By implementing standard time, the company is able to determine whether the production process is operating normally or experiencing obstacles that may affect the smooth flow of production.

Table 5 Standard Production Time

No	Workstation	Main Activities	Company Standard Time (minutes)	Number of Operators
1	Material Preparation and Mixing	Resin collection, masterbatch collection,	8	2

		weighing, and mixing		
2	Injection Machine Changeover	Machine shutdown, mould replacement, setting, and trial	15	2
3	Injection Molding Process	Body/lid molding, runner cutting, and visual inspection	1.5	1
4	Assembly, Packaging, and Storage	Assembly, branding, packing, carton arrangement, and storage	8	3

3.4 Stages of Cosmetic Container Production Process

This section describes the stages of the cosmetic container production process, starting from material preparation, mixing process, injection machine changeover, cosmetic body injection process, to the assembly, packaging, and finished goods storage stages. The arrangement of these production stages aims to identify the production flow, cycle time, material movement distance, as well as the utilization of machines and operators in each activity, so that potential waste and bottlenecks within the production line can be identified.

Table 6 Stages of Cosmetic Container Production Process

No	Activity	Machine/ Equipment	Actual Cycle Time (minutes)	Distance (meters)
1	Resin and masterbatch preparation	Manual	2	3
2	Material weighing	Digital Scale	1.5	2
3	Material transfer to mixing area	Hand Pallet	1.2	4
4	Material mixing process	Mixing Machine	3.5	-
5	Material transfer to injection machine	Hand Pallet	1.5	5
6	Machine shutdown and old mould removal	Manual	7	-
7	Installation of new mould	Manual & Crane	10	3

8	Machine trial and parameter setting	Injection Machine	12	-
9	Cosmetic body injection process	Injection Machine	1.2	-
10	Runner/flash cutting	Manual	0.8	1
11	Visual product inspection	Manual	0.6	1
12	Transfer to assembly area	Hand Pallet	1.5	6
13	Body and mirror assembly	Manual	2	-
14	Logo/branding application	Manual	1.5	-
15	Plastic packaging	Manual	2	-
16	Carton arrangement	Manual	1.8	3
17	Transfer to finished goods warehouse	Hand Forklift	2.5	10

3.5 Current State Mapping

The Current State Mapping was developed by collecting production process data such as cycle time, waiting time, number of operators, and the sequence of activities at each workstation. The main processes mapped included material preparation and mixing, injection machine changeover, injection molding process, visual inspection, assembly, packaging, and finished goods storage. The results of this mapping were used as the basis for analyzing waste within the production process and developing improvement proposals aimed at increasing production efficiency and reducing production lead time.

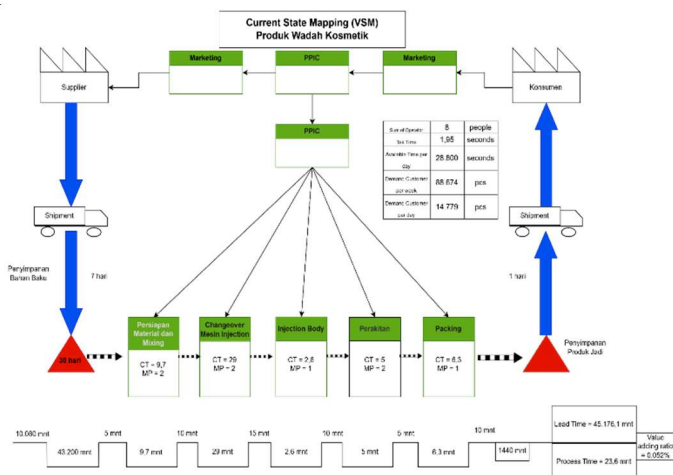


Figure 6 Current State Mapping Cosmetic Container

3.6 Process Activity Mapping (PAM)

Process Activity Mapping (PAM) is a Lean Manufacturing tool used to map all activities within the production process based on the categories of operation (O), transportation (T), inspection (I), storage (S), and delay (D) in order to identify activities classified as Value Added (VA), Non-Value Added (NVA), and Necessary but Non-Value Added (NNVA). In this study, the PAM was developed based on direct observations of the cosmetic container and skincare container production processes at CV XYZ using the Stopwatch Time Study (STS) method and the company's historical data. Through this mapping process, activities that potentially generate waste and affect production process efficiency could be identified.

Table 7 Process Activity Mapping Cosmetic Container

No	Section	Activity	Activity Description	Time Calculation	Machine /Tool	Distance	Time (Minutes)	Workers	Activity Type	Category
1	Raw Material Warehouse	Raw material storage	Materials are stored in the warehouse before the production process	Historical Data	Warehouse	0 m	43,200	-	Storage (S)	NVA
2	Material Preparation and Mixing	Material retrieval	Operator retrieves raw materials to the mixing area	STS	Manual	7 m	2	2	Transportation (T)	NNVA
3	Material Preparation and Mixing	Material weighing	Materials are weighed according to production requirements	STS	Scale	3 m	3.5	2	Operation (O)	VA
4	Material Preparation and Mixing	Material mixing	Materials are mixed before the injection process	STS	Mixer	0 m	6.2	2	Operation (O)	VA
5	Injection Machine Changeover	Machine setup	Mould replacement and injection machine setting	STS	Injection Machine	0 m	29	2	Delay (D)	NNVA
6	Injection Body	Body injection	Cosmetic container body forming process	STS	Injection Machine	0 m	2.6	1	Operation (O)	VA
7	Inspection	Visual inspection	Inspection of injection body results	STS	Checksheet	0 m	1.5	1	Inspection (I)	NNVA
8	Assembly and Packaging	Product assembly	Combining product components	STS	Manual	0 m	4.3	3	Operation (O)	VA
9	Assembly and Packaging	Product packaging	Products are packaged before storage	STS	Packing Tools	0 m	7	3	Operation (O)	VA
10	Finished Goods Warehouse	Product storage	Finished products wait for shipment	Historical Data	Finished Goods Warehouse	0 m	1,440	-	Storage (S)	NVA
11	Delivery	Product shipment	Products are delivered to customers	Historical Data	Vehicle	10 m	480	-	Transportation (T)	NNVA

Table 8 Recapitulation of PAM Results for Cosmetic Container Products

Activity Type	Number of Activities	Percentage	VA (Minutes)	NVA (Minutes)	NNVA (Minutes)
Operation	5	45%	23.6	-	-
Transportation	2	18%	-	-	482
Inspection	1	9%	-	-	1.5
Storage	2	18%	-	44,640	-
Delay	1	10%	-	-	29
TOTAL	11	100%	23.6	44,640	512.5

Based on the recapitulation results, operation activities accounted for 15 activities or 45% of the total production activities, transportation activities accounted for 11 activities or 33%, inspection activities accounted for 4 activities or 12%, storage activities accounted for 2 activities or 6%, and delay activities accounted for 1 activity or 3%. Furthermore, the calculation results showed that the total Value Added (VA) time was 18.54 minutes, Non-Value Added (NVA) time was 51,250.29 minutes, and Necessary but Non-Value Added (NNVA) time was 3,162.725 minutes. The largest amount of time was found in storage activities at 50,953.23 minutes due to raw material storage in the warehouse, while delay activities of 288 minutes indicated waiting time between production processes. These findings indicate that the production process is still dominated by non-value-added activities, causing the production lead time to be significantly higher compared to activities that provide added value to the product.

3.7 Future State Mapping

In the Future State Mapping (FSM) of Cosmetic Container products, the raw material storage time in the warehouse was reduced from 30 days to 7 days so that inventory could be controlled more effectively. In addition, the injection machine changeover time was reduced from 29 minutes to 15 minutes through the implementation of machine setup SOPs and mould preparation before the production process begins. Material transfer activities were also made more efficient, allowing transportation time between processes to be minimized. With these proposed improvements, the total production lead time became lower compared to the current state condition, and the overall production flow became more effective and efficient.

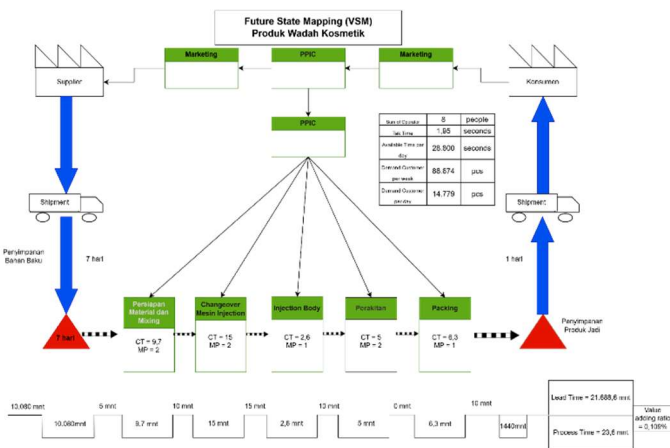


Figure 7 Future State Mapping Cosmetic Container

The production lead time for cosmetic containers decreased from 44,747.6 minutes to 21,688.6 minutes, or approximately 15 days. Meanwhile, the process time or value-added time remained at 23.6 minutes, with the Value Adding Ratio (VAR) increasing from 0.052% to 0.109%. These results indicate that the proposed improvements were able to reduce non-value-added activities, particularly in inventory and waiting activities, thereby making the production process flow more effective and efficient compared to the current state condition.

3.8 Process Activity Mapping After Future State Mapping

Table 9 PAM After FSM Cosmetic Container

No	Section	Activity Description	Time Before (minutes)	Time After (minutes)	Activity Type	Category
1	Warehouse	Plastic resin and masterbatch are stored in the warehouse before the production process	43,200	10.08	Storage	NVA
2	Material Preparation and Mixing	Operator transfers raw materials to the mixing area	2	0	Transportation	NNVA
3	Material Preparation and Mixing	Materials are weighed according to production requirements	3.5	3.5	Operation	VA
4	Material Preparation and Mixing	Materials are mixed before the injection process	6.2	6.2	Operation	VA
5	Injection Machine Changeover	Mould replacement and injection machine setting	29	15	Delay	NNVA
6	Injection Body	Cosmetic container body forming process	2.6	2.6	Operation	VA
7	Inspection	Visual inspection of injection body results	1.5	1.5	Inspection	NNVA
8	Assembly	Product component assembly	5	5	Operation	VA
9	Packing	Products are packed before storage	6.3	6.3	Operation	VA
10	Finished Goods Warehouse	Finished products wait for shipment	1,440	1,440	Storage	NNVA
11	Finished Goods Warehouse	Products are delivered to customers	1.44	0	Transportation	NNVA

Description:

■ = Activities that need to be considered for reducing waiting time and synchronizing production flow.

■ = Activities that require reduction and consolidation of material transfer activities into a single process.

Table 10 Recapitulation PAM After FSM

Activity Type	Number of Activities	Percentage	VA Before	VA After	NVA Before	NVA After	NNVA Before	NNVA After
Operation	5	45%	23.6	23.6	-	-	-	-
Transportation	2	18%	-	-	-	-	3.44	0
Inspection	1	9%	-	-	-	-	1.5	1.5
Storage	2	18%	-	-	44.64	11.52	-	-
Delay	1	10%	-	-	-	-	29	15
TOTAL	11	100%	23.6	23.6	44.64	11.52	33.94	16.5

Based on the recapitulation of Process Activity Mapping (PAM) after the development of Future State Mapping (FSM), significant efficiency improvements were achieved in the cosmetic container production flow. The main improvement occurred in Non-Value Added (NVA) activities, where storage time was reduced from 44,640 minutes to 11.52 minutes through improved inventory control. In addition, Necessary but Non-Value Added (NNVA) activities were optimized by eliminating transportation time from 3.44 minutes to 0 minutes and reducing delay time from 29 minutes to 15 minutes through layout improvements and machine setup optimization. Meanwhile, Value Added (VA) activities remained constant at 23.6 minutes to maintain product quality standards. Overall, the Future State Mapping successfully reduced production lead time and created a more effective and efficient production flow through waste reduction improvements.

4. Conclusion

Based on the results of the Lean Manufacturing analysis using the Value Stream Mapping (VSM) approach on the cosmetic container production process at CV XYZ, several types of waste were identified, including waiting, transportation, inventory, and delay activities that contributed to the high production lead time. The Current State Mapping analysis showed that the production process was still dominated by Non-Value Added (NVA) activities, particularly raw material storage and waiting time between processes, which caused bottlenecks and delivery delays. Through the implementation of Future State Mapping (FSM), several improvement proposals were developed, such as reducing raw material storage time, optimizing machine setup activities, improving production flow, and minimizing unnecessary transportation activities. The implementation of these improvements successfully reduced the production lead time from 44,747.6 minutes to 21,688.6 minutes, while the Value Adding Ratio (VAR) increased from 0.052% to 0.109%. These results indicate that the Lean Manufacturing approach with Value Stream Mapping was effective in reducing waste, improving production flow efficiency, and supporting more timely product delivery at CV XYZ.

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