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Lean Approach to Minimize Waste in Biscuit Production Process Using Value Stream Mapping Method at PT. XYZ

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ABSTRACT

PT XYZ is one of the companies in the snack food industry that focuses on processing biscuits. There is still waste in the production process, such as waiting and transportation, which adds time to the production process and makes it longer. To reduce waste and improve business efficiency, this research uses lean methodology and value stream mapping to ensure the biscuit processing production process runs smoothly. The results of the research that has been done, there is a decrease in non-value-added time by 13.27 minutes from 22.77 minutes, a total lead time of 68.32 minutes from 77.82 minutes, and process cycle efficiency increased by 75.29% from 66.10%. This shows that implementing lean methods using value stream mapping can improve the company's efficiency and productivity.
Keyword: Lean, Non-Value Added, Value Stream Mapping, Waste

ABSTRAK

PT. XYZ merupakan salah satu perusahaan di industri makanan ringan yang fokus pada pengolahan biskuit. Dalam proses produksinya, masih terdapat aktivitas yang menyebabkan pemborosan seperti transportasi dan *waiting time* sehingga mengakibatkan semakin lamanya waktu proses produksi. Oleh karena itu, penelitian ini melakukan pendekatan *lean* menggunakan *Value Stream Mapping* dalam meminimasi *waste* yang terjadi sehingga proses produksi pada pengolahan biskuit dapat berjalan dengan baik dan dapat meningkatkan efisiensi perusahaan. Hasil penelitian yang telah dilakukan, terjadi penurunan *non-value-added time* sebesar 13,27 menit dari 22,77 menit dengan *total lead time* sebesar 68,32 menit dari 77,82 menit dan *process cycle efficiency* meningkat sebesar 75,29% dari 66,10%. Hal ini menunjukkan bahwa penerapan metode *lean* menggunakan *value stream mapping* dapat meningkatkan efisiensi dan produktivitas perusahaan.
Kata Kunci: *Lean, Non-Value Added, Value Stream Mapping, Waste*

1. Introduction

There are many manufacturing companies in the era of Industrial Revolution 4.0, especially in the food industry. The increase in the quantity of food from year to year increases the optimism of food companies in creating various types of food products. Food companies strive to produce products that meet consumer demand, starting with creating new and interesting products. Companies demand increased productivity to compete with competitors and seize the market. One way to increase productivity is to minimize waste in the company [1]. Thus, production activities become more efficient.

Efficiency is key for the manufacturing industry. Lean manufacturing is one method to improve efficiency that can eliminate non-value-added work activities and increase productivity [2]. Be it people, machines, materials, methods, and costs, known as the 5Ms of production, it is an important activity in the manufacturing and service industries [3], [4], [5]. This can contribute to waste in the production process by causing errors and delays in achieving goals, which in turn shortens the time available to achieve targets.

Manufacturing companies have several activities that do not provide added value, so they can cause waste and result in inefficient use of resources [6], [7]. Added value can help a business achieve its goals and ultimately become more cost efficient [8]. This goal requires a reduction in the current production process [9].

By reducing the number of non-value-added activities, production costs and rework will be minimized [10]. Non-value-added activities are activities that are unnecessary and should be reduced or eliminated from the manufacturing process because they interfere with business performance [11].

Lean manufacturing systems are being implemented as part of waste reduction efforts. The processes that occur are best described by lean manufacturing [12]. Value Stream Mapping (VSM) is a useful technique in lean manufacturing methodology to identify time wastage. During the production process, VSM is able to map the information flow and production flow, so VSM can be an effective tool in identifying existing waste [13]. In addition, supporting analysis such as the 5 Whys can be used to identify the causes of waste.

Based on previous research, Kholil [14] have applied lean using VSM to a company known to generate waste in the production line for audio bracket assembly. Specifically, the company's movements, inventory, waiting, and processes involved a total cycle time of 704 seconds. After the improvement phase, this cycle time was reduced to 543 seconds, a reduction of 155 seconds. The cycle time was shortened, which increased the capacity efficiency from 75% to 91%. Other research has also been conducted by Purnomo & Lukman [15], there are waste problems in the production line, which include waiting, defects, overproduction, and inventory. A lean approach using VSM can make improvements by eliminating the existing non-value-added time, so that the process becomes more effective and efficient than before.

Research conducted by Koh and Singgih [16] implements lean manufacturing concepts in the production process to identify the main causes of waste and suggest appropriate changes. The research conducted by Hibatullah [17] where the objective of the study was to categorize different types of wastage and offer improvement suggestions to increase production efficiency. Based on the identification results, waiting and defects are the two main wastes. By implementing lean manufacturing, these wastes can be effectively corrected, thereby increasing the efficiency of the production cycle.

PT XYZ is a company that runs a snack food manufacturing process, one of which is the biscuit processing industry. The process of making biscuits starts with making dough with a mixing machine and ends with packaging. There are several types of waste in biscuit processing activities, such as transportation and waiting time. Waiting for biscuit products to be put into the feeder machine results in a longer production process time.

The activity of moving products to the next station also affects the length of production time, the longer the distance in the production area causes an increase in the time needed for the production process. This situation only causes the lead time to be longer and inefficient. For this reason, further identification of the presence of such waste is required, so that improvements can be proposed to optimize existing production processes. Therefore, this study utilizes lean methodology, using the Value Stream Mapping method to identify waste and 5W and 1H for suggested changes. The objective of this study is to reduce wastage in order to improve business efficiency and smooth production process of biscuit processing.

2. Methodology

In this study, primary and secondary data were used. Primary data was collected from November to December 2022 from each production shift activity, secondary data was obtained from No. XYZ production reports and other supporting data [18]. Drawing up a value stream map is done after the data search process. It is used in the production process to observe material flow and process information [19]. The data used in this preparation process are production process flow data, material flow, and cycle time data [20].

This makes it possible to identify waste in the production process by processing the findings of value stream mapping. Furthermore, waste that has been identified can be breakdown again through the description of activities that occur in process activity mapping. The procedure for determining the cause of the waste that has been discovered, which is the next step, involves applying the 5W and 1H approaches to determine the underlying reasons for the waste that occurred [21].

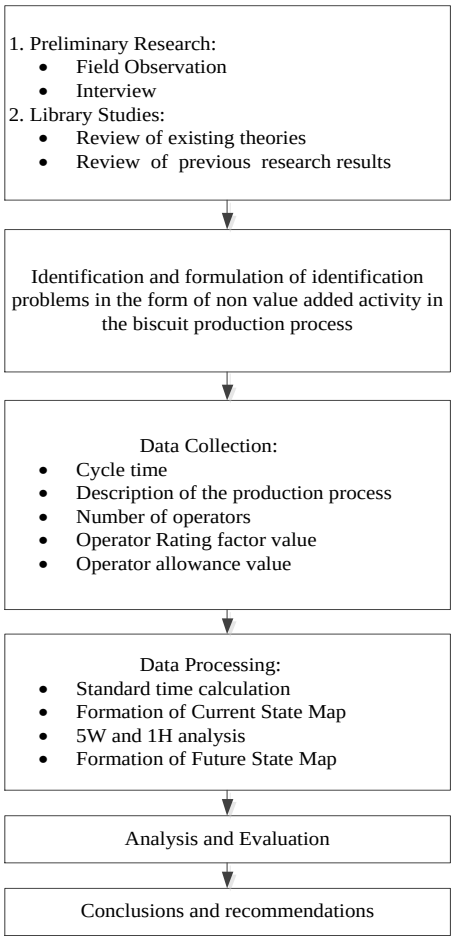

Figure 1. Flowchart of Research

3. Results and Discussion

3.1. Production Process Activities

The biscuit production process is described as follows.

Table 1. Biscuit Production Process Activities

No.	Activities
1	Picking up raw materials from the material warehouse to the production area
2	Transfer of raw materials to the weighing area
3	Weighing raw materials using scales
4	Transfer of raw materials from the scale area to the pallet
5	Feeding raw materials on mixing machine for material mixing
6	Milling of ingredients mixed on mixing machine into dough
7	The dough is waiting to be fed into the molding machine
8	Inserting dough on a molding machine for molding
9	Dough molding on molding machine
10	Transfer of prints to the oven machine
11	The mold in the oven becomes biscuits
12	Transfer of biscuits to stratwhell machine for cooling
13	Inspection of biscuits coming out of the oven machine
14	Biscuits cooled on the startwhell machine
15	Transfer of biscuits to gaido machine
16	Biscuit inspection in gaido machine
17	Biscuits waiting to be put into the feeder machine
18	Inserting biscuits on the feeder machine for arrangement
19	Transfer of biscuits that have been arranged to the packing machine
20	Biscuits packed on packing machine
21	Transfer of biscuit products to the finished product warehouse

3.2. Normal Time and Standard Time Calculation

The average observation time multiplied by the performance rating results in a normal time. Standard time, often known as working time, is the amount of time required by an employee with an average skill level to complete a task, taking into account the time allocated to meet the necessary working conditions. Table 2 shows the standard time and normal time for producing biscuits.

Table 2. Normal Time and Standard Time Calculation

Activity Number	Cycle Time (Minutes)	Rating Factor	Normal Time (Minutes)	Allowance	Standard Time (Minutes)
1	7,37	1,17	8,62	13,00	9,91
2	1,60	1,17	1,87	13,00	2,15
3	3,39	1,17	3,96	13,00	4,55
4	1,67	1,17	1,96	13,00	2,25
5	4,36	1,17	5,10	11,00	5,73
6	10,44	1,17	12,22	11,00	13,73
7	3,33	1,17	3,90	11,00	4,38
8	1,70	1,17	1,99	11,00	2,23
9	15,52	1,19	18,46	11,00	20,75
10	1,43	1,19	1,71	11,00	1,92
11	6,49	1,19	7,72	11,00	8,68
12	1,74	1,19	2,07	11,00	2,32
13	1,75	1,17	2,04	13,00	2,35
14	4,55	1,17	5,32	13,00	6,12
15	2,63	1,17	3,07	13,00	3,53
16	1,74	1,19	2,07	18,00	2,52
17	5,51	1,17	6,45	12,00	7,33
18	1,69	1,17	1,98	12,00	2,25
19	1,71	1,17	2,01	12,00	2,28
20	1,75	1,19	2,08	18,00	2,54
21	8,39	1,19	9,99	18,00	12,18

Based on Table 2, it can be seen that there are 21 activities in the biscuit production process. Where the highest normal time and standard time are found in activity 9, which is 18,46 minutes and 20,75 minutes.

3.3. Current State Map

The process of creating a current state map for each process category involves the use of additional data in addition to the standard time data for each process, which is obtained after the standard time of each process is determined. Figure 2 displays the current state map, complete with material and information flows.

According to Figure 2, the results of the current condition map show that the production process is sequential, from raw material preparation and weighing to packaging, with a total waiting time of 77.82 minutes, an added value of 51.44 minutes, and a cycle efficiency of 66.10%.

3.4. 5W and 1H Analysis

The 5W and 1H methods, in this case, process activities that do not add value will be discarded. In addition, activities that can shorten the production process time will also be considered. Transporting raw materials to the weighing area is an example of an activity that has no added value and can be evaluated. Dough waiting to be put into the molding machine and biscuits waiting to be put into the feeder machine. Due to waiting and transportation activities, this is based on direct observation and discussion results. Table 3 shows the 5W and 1H analysis.

Based on Table 3, the results of the identification and analysis that have been carried out show that there are several things that are proposed to be improved in order to get maximum results.

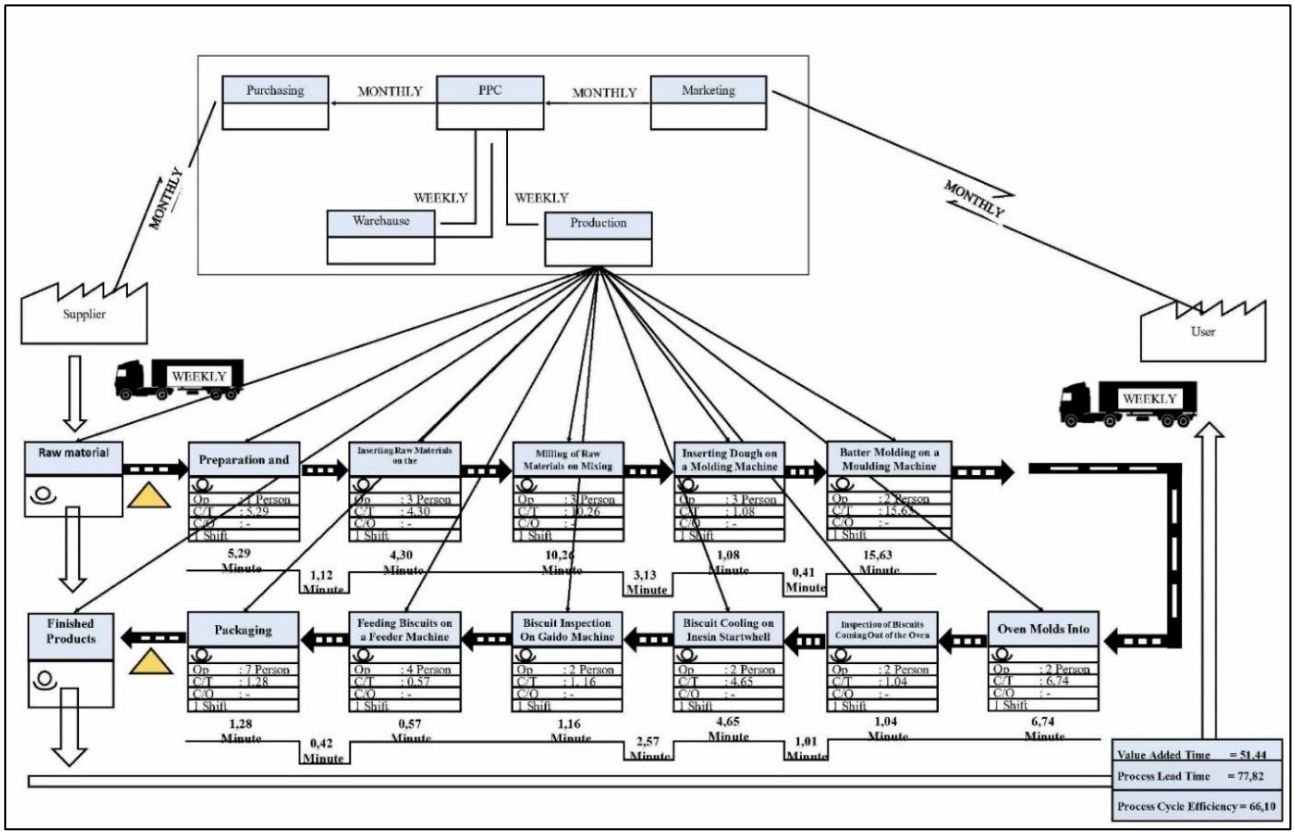

Figure 2. Current State Map

Table 3. Analysis 5W and 1H

Activity	Analysis	Information
Transfer of raw materials to the weighing area	What	Transfer of raw materials to the weighing area
	Who	Raw material carriers
	Where	At the upper processing station
	When	This element of work is carried out after the process of taking raw materials from the warehouse
	Why	This transportation activity is ineffective and can prolong production lead time which should be eliminated
	How	This transportation activity is eliminated by carrying out the weighing process directly in the raw material warehouse
The dough is waiting to be fed into the molding machine	What	The dough is waiting to be fed into the molding machine
	Who	Mixing operator
	Where	At the upper processing station
	When	This working element is carried out after grinding the mixed materials on the mixing machine
	Why	This waiting activity is not effective and can prolong production lead time that should be eliminated
	How	This waiting activity is eliminated by directly inserting the dough on the molding machine
Biscuits waiting to be put into the feeder machine	What	Biscuits waiting to be put into the feeder machine
	Who	Feeder operator
	Where	At the packing station
	When	This element of work is carried out after the inspection process in the gaido machine
	Why	This waiting activity is not effective and can prolong production lead time that should be eliminated
	How	This waiting activity is eliminated by directly inserting biscuits into the feeder machine

3.5. Lean Matrix After Improvement

At this stage, value-added and non-value-added activities will be separated after a number of operations in the biscuit processing production process are eliminated. The production process activities will become 18

activities from the previous 21 activities. So, the value-added time is 51.44 minutes, the lead time value is 68.32 minutes, and the non-value-added time value is 13.27 minutes. Then, the process cycle efficiency increased by 75.29%, illustrating that the process is more efficient in the production process. This increase occurred due to the reduction of non-value-added activities, so that the total lead time decreased while the value added remained. The following is a mapping of the improvement efforts made to the new production time in the production process using the future state map in the condition after the improvement illustrated in Figure 3.

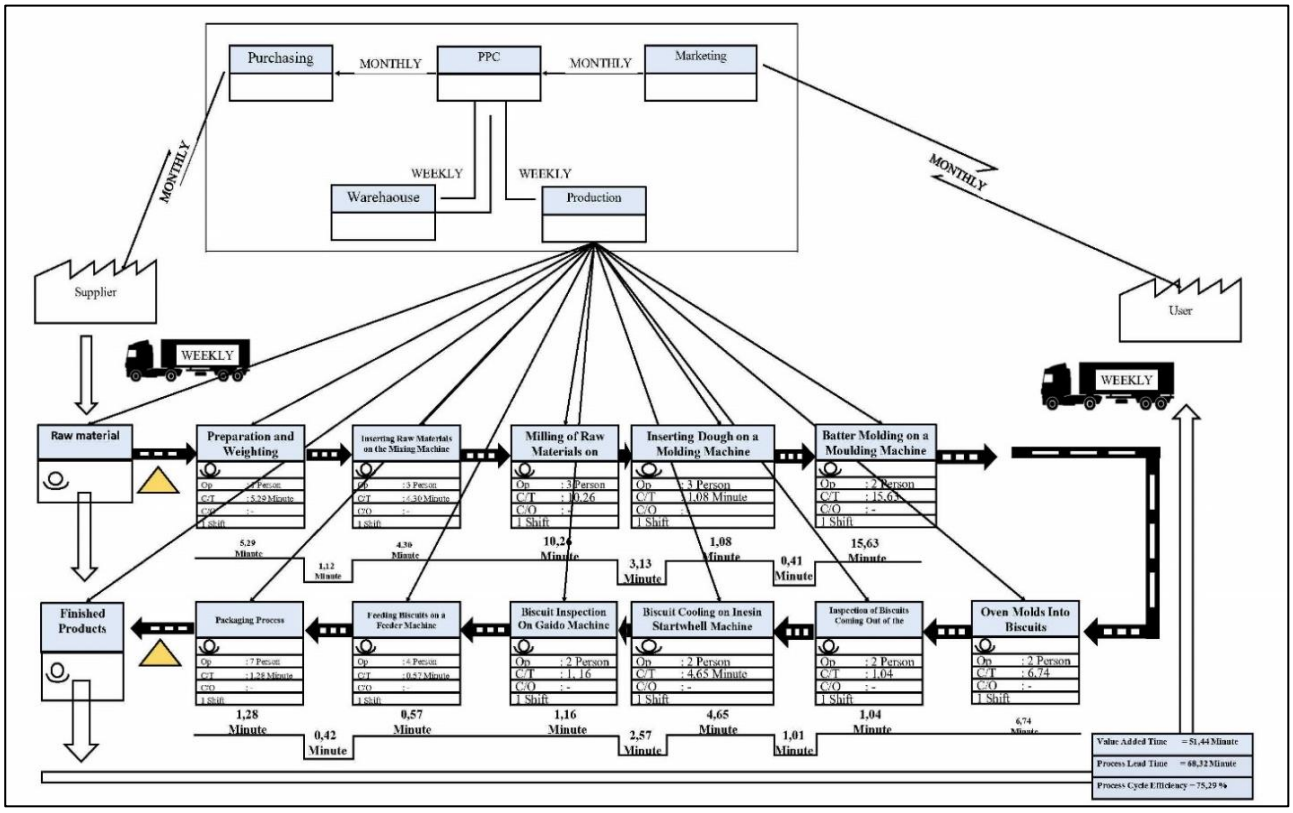

Figure 3. Future State Map

Based on Figure 3, the findings from the future state map created show that cycle efficiency has grown by 75.29%, lead time by 68.32 minutes, and value added by 51.44 minutes.

3.6. Process Speed Improvement Analysis

The purpose of this calculation is to assess the plant condition from a lean perspective, where non-value-added activities are eliminated. The percentage improvement, both with and without value addition, is shown in Figure 4.

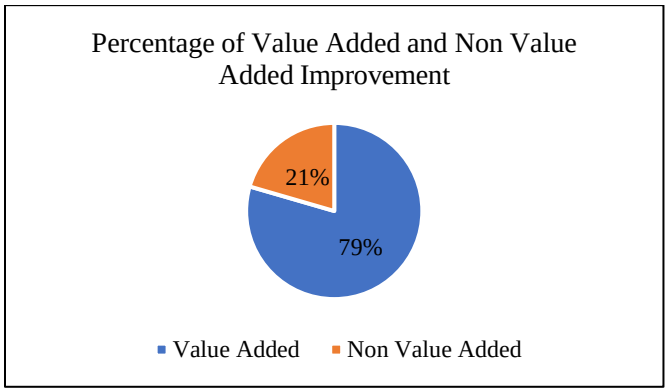

Figure 4. Percentage of Value Added and Non-Value Added

Figure 4 shows that the value-added time is 79% of the biscuit making activity, while the time that does not add value is 21%. The actual and proposed Lean Metrics comparison results are presented in Table 4.

Table 4. Comparison of Actual State Lean Metrics and Improvement

Metrics Lean	Actual	Proposed
Number of Production Activities (Processes)	21	18
Value Added Time (Minute)	51.44	51.44
Non-Value-Added Time (Minute)	22.77	13.27
Manufacturing Lead Time (Minute)	77.82	68.32
Process Cycle Efficiency (%)	66.10%	75.29%

Drawing a conclusion from the above-mentioned data, it can be said that a 9.5 minute decrease in production lead time has resulted in a 9.19% increase in process cycle efficiency. The decrease in non-value-added operations resulted in an overall decrease in lead time, but the added value was maintained, which is why the improvement occurred.

4. Conclusion

Based on the research results, the number of production process activities increased to 18 with a total standard time of 68.32 minutes after eliminating non-value-adding time. Where the manufacturing lead time value decreased by 9.5 minutes so that the process cycle efficiency value increased by 75.29% from 66.10%. This shows that the application of lean methods using value stream mapping can improve the efficiency and productivity of the company.

References

[1] P. K. M. M. K. E. A. Mantiri, "Lean Manufacturing Approach To Improve Efficiency in Production Process using Value Stream Mapping at CV. INDOSPICE," *Jurnal EMBA*, vol. 5, no. 2, pp. 1292–1303, 2017.

[2] N. Kartika and F. P. Setiawan, "Lean Production Implementation on Coffee Beans Business," *Jurnal Manajemen Teori dan Terapan| Journal of Theory and Applied Management*, vol. 13, no. 3, p. 294, Dec. 2020, doi: 10.20473/jmtt.v13i3.19577.

[3] N. A. M. B. M. Musfita, "Implementasi Lean Manufacturing Guna Meminimalisasi Pemborosan Pada proses Produksi AMDK Jenis Gelas Pada PT. XYZ," *Jurnal Engineering*, vol. 6, no. 2, pp. 1683–1693, 2021.

[4] D. M. R. I. A. T. P. R. F. Wigati, "Penerapan Lean Manufacturing dalam Mereduksi Pemborosan Pada Raw Material Bumbu dengan Metode PDCA," *Jurnal Ilmiah Fakultas Pertanian*, vol. 12, no. 2, pp. 137–145, 2021.

[5] F. Romadhani, N. Mahbubah, and M. D. Kurniawan, "IMPLEMENTASI METODE LEAN SIX SIGMA GUNA MENGELIMINASI DEFECT PADA PROSES PRODUKSI PURIFIED GYPSUM DI PT. AAA," *RADIAL: Jurnal Peradaban Sains, Rekayasa dan Teknologi*, vol. 9, no. 2, pp. 89–103, Dec. 2021, doi: 10.37971/radial.v9i2.224.

[6] E., K. & F. S. M. Febianti, "Analisis Proses Produksi Gas Coalescer Filter Menggunakan Metode Lean Manufacturing dan Simulasi," *Journal Industrial Servicess*, vol. 3, no. 2, pp. 78–84, 2018.

[7] T., M. A., & N. P. P. Ristyowati, "Minimasi Waste Pada Aktivitas Proses Produksi dengan Konsep Lean Manufacturing Studi Kasus di PT. Sport Glove Indonesia," *Jurnal Optimasi Sistem Industri*, vol. 10, no. 1, pp. 85–96, 2017.

[8] S. Suparno and A. S. Susanto, "Peningkatan Produktivitas Leaf Spring Jenis Minicup Tipe MMS 2230 dengan Mengurangi Pemborosan Proses Produksi Melalui Penerapan Metode Lean Manufacturing," *Jurnal Rekayasa Sistem Industri*, vol. 10, no. 1, pp. 89–100, Apr. 2021, doi: 10.26593/jrsi.v10i1.3813.89-100.

[9] I., S. & F. L. Rahmatillah, "Peningkatan Kualitas Produk Crackers berdasarkan Metode Lean Six Sigma di PT M.," *Jurnal Rekayasa Hijau*, vol. 3, no. 2, pp. 95–106, 2019.

[10] A. A., Santoso and A. F. Fudhla, "Perbaikan Sistem Produksi Kardus dengan Pendekatan Lean Dmai di PT Kedawung CCB. JISO," *Journal of Industrial and Systems Optimization*, vol. 1, no. 1, pp. 39–46, 2018.

[11] Kalaena and Riskabella, "Analysing The Value And Non-Value Activities Using Activity-Based Management Concept At Pt. Celebes Mina Pratama Bitung," *Jurnal EMBA*, 2019.

[12] W., Kosasih, I. Sriwana, and E., & D. Sari, "Applying value stream mapping tools and kanban system for waste identification and reduction (Case study: a basic chemical company).," *IOP Conference Series, Science, Materials*, pp. 1–8, 2019.

[13] I. K., Sriwana and Kurniawan, "Usulan Peningkatan Efisiensi Keseimbangan Lini Dengan Value Stream Mapping Dan Yamazumi Chart Pada PT.PAI," *Jurnal Metris*, pp. 33–44, 2019.
[14] Muhammad Kholil, Adizty Suparno, Adizty Suparno, and Rizki Aprilia, "Lean Approach for Waste Reduction in Production Line by Integrating DMAIC, VSM, and VALSAT Method (Study Case: Assembling Bracket Manufacturing Automotive Industry)," *ournal of Intelligent Decision Support System (IDSS)*, vol. 5, no. 1, pp. 37–43, 2022.
[15] D. H. Purnomo and M. Lukman, "Reduce Waste using Integration of Lean Six Sigma and TRIZ Method: A Case Study in Wood Industry," *Jurnal Teknik Industri*, vol. 21, no. 2, pp. 139–152, Aug. 2020, doi: 10.22219/JTIUMM.Vol21.No2.139-152.
[16] J. Koh and M. L. Singgih, "Implementation Lean Manufacturing Method of Plywood Manufacture Company.," *IPTEK Journal of Proceedings Series No. 2.*, 2020.
[17] N. D. et al. Hibatullah, "The Analysis of Lean Manufacturing in Waste Reduction During Rosin Ester Production at PT XYZ," *Agroindustrial Journal*, vol. 8, no. 1, 2021.
[18] A. M. Almansur, S. Sukardi, and M. Machfud, "IMPROVING PERFORMANCE OF BISCUIT PRODUCTION PROCESS THROUGH LEAN SIX-SIGMA AT PT XYZ," *Indonesian Journal of Business and Entrepreneurship*, vol. 3, no. 2, May 2017, doi: 10.17358/ijbe.3.2.77.
[19] R. S. Sirajudeen and K. A. Krishnan, "Application of Lean manufactruing Using Value Stream Mapping (VSM) in Precast Component Manufacturing: A Case Study.," *Journal Materialtoday: Proceedings*, vol. 65, no. 2, pp. 1105–1111, 2022.
[20] C. Grewal, "An Initative to Implement Lean manufacturing Using Value Stream Mapping in a Small Company," *Int. Journal Manufacturing Technology and Management*, vol. 15, no. 3, 2008.
[21] O. K. A. R. Damanik, V. M. Afma, and B. A. H. Siboro, "Analysis Of Lean Manufacturing Approach With Vsm (Value Stream Mapping) Method To Reduce Time Development (Case Study Ud. Almaida). ," *Jurnal PROFISIENSI*, vol. 5, no. 1, pp. 1–6, 2017.