JHSS (Journal of Humanities and Social Studies)
https://journal.unpak.ac.id/index.php/jhss
Volume 07, Number 01, March 2023, Page 097-101
e-ISSN: 2598-120X; p-ISSN: 2598-117X

REDUCING MANUFACTURING LEAD TIME WITH LEAN MANUFACTURING APPROACH CASE STUDY: CV SUHO GARMINDO

Yusup Mauluddin [a*)], Sopia Marwah [a)]

[a)]*Technology institute of Garut, Garut, Indonesia*

[*)]*Corresponding Author: 1yusuf.mauluddin@sttgarut.ac.id*

Article history: *received 27 January 2023; revised 16 February 2023; accepted 04 March 2023* *DOI:https://doi.org/10.33751/jhss.v7i1.7458*

Abstract. The purpose of this study is to reduce the Lead Time Manufacturing of mask products at CV Suho Garmindo. At this time it is known that Lead Time Manufacturing is influenced by Non-Value-Added activities and Necessary Non-Value Added activities in which there are several wastes that occur, these activities include the temporary storage process in the loading section, the process of reworking defective products and the transportation process. The method used is Lean Manufacturing, the tools used are Value Stream Mapping (VSM) and Process Cycle Activity (PAM). Value Stream Mapping is used to identify activities that have a cycle time greater than the takt time, followed by Process Cycle Activity mapping to analyze activities that are Non-Value Added activities. Furthermore, NVA activities are analyzed with 5W1H, and 5 why's tool to find out the root of the problem. Based on the research results from 126.1 minutes of lead time process 110 minutes is a non-value added activity. The rework process is identified as having the largest value of contributing lead time, so rework must be eliminated. After it is known that the root cause of the rework process is due to the ineffectiveness of the sewing process (bottleneck occurs), then for improvement the author proposes the needs of the available machines and man power. The changes are the number of machines from 9 to 10, sonday operators from 2 people to 1 person, finished stick operators from 2 people to 1 person, and funnel operators from 2 people to 4 people. Furthermore, the optimal layout improvement based on production flow is described. Due to research limitations, this research did not reach the implementation stage. So with the change in the number of machine requirements and available man power, it is expected that the rework process will be reduced so that the Manufacturing Lead Time can be reduced.

Keywords: lead time manufacture; lean manufacturing; value stream mapping; process activity mapping

I. INTRODUCTION

Production activities are the heart of a manufacturer, so productivity is a measure of the company's success in carrying out its production activities. **[1]**. Good productivity results from good production planning as well, by utilizing resources efficiently and controlling production planning that can be adjusted in production activities **[2]**. The corona virus pandemic has hit almost the entire world, including Indonesia, which has hampered all economic activities and decreased income. **[3][4]**. The Rabbani company is also affected by this pandemic problem, as a result the demand for Rabbani products has decreased. However, after this, masks are mandatory items that everyone must have and wear, seeing this condition Rabbani gets the opportunity to produce new products, namely masks. Due to the large number of consumer interest in this mask product, an explosion of demand occurred so that the production target was not achieved due to late delivery of goods. Based on the results of field studies by conducting observations and interviews with the company, it is known that there are obstacles in the production process, namely when sewing one of the mask components. This must first be proven in research. Therefore, a method is needed to improve Manufacturing Lead Time so that it can increase production capacity and achieve production targets.

Research on improving Manufacturing Lead Time has been done before by researchers. The movement study approach is one of the alternative problems solving **[5]**, There are also those who use line balancing to streamline the trajectory so that the lead time becomes faster **[6], [7]**. The most used approach is lean manufacturing, by reducing non-value-added activities, namely Value Stream Mapping (VSM) and Lean Manufacturing Metrix and value stream mapping analysis tools (Process Activity Mapping), activity process mapping with 5W1H, and the 5 why's tool. **[8],[9],[10] [11]**.

Based on several previous studies, the suitable method for this research is Lean Manufacturing. Lean manufacturing tools that will be used are Value Stream Mapping and Lean Manufacturing Metrix. VSM will be used as the first picture of the factory to identify waste on the production floor. PAM will be used to identify activities based on the type of Value Added and Non-Value-Added activities **[12][13]**. Metrix Lean Manufacturing will be used to calculate Manufacturing Lead Time (MLT) and determine the value of Process Cycle Efficiency **[14]**.

II. RESEARCH METHODS

The research begins with a field study to find out the problems that occur in the field in the mask production process. Next is a literature study, namely reviewing research

Volume 07, Number 01, March 2023, Page 097-101
e-ISSN: 2598-120X; p-ISSN: 2598-117X

journals that discuss almost the same problem as a reference. Data collection in the form of time data for making masks per bundle by direct measurement using the stopwatch method with several observations to calculate production cycle time. Data processing begins with mapping the initial conditions with VSM, followed by mapping the production process activities with PAM and determining the classification of value added, non-value added and necessary non-value-added activities **[15]** which are then analyzed with 5W1H and 5 Why's.

III. RESULTS AND DISCUSSION

Value Stream Mapping

Value Stream Mapping (VSM) is a tool that can visually map the flow of production from upstream to *downstream*, whether value-added or not. The identification of the production process cycle time with VSM will be compared with the production *takt time*.

1. ***Takt* Time Calculation**

Takt Time is the trajectory speed that must be achieved to meet customer demand. The Takt time formula is:

$$T = \frac{Ta}{D}$$

(source: Vorne Industries, 2009)

With: T = *takt time*
Ta = *time available* (net available working time)
D = demand

Then the desired *takt time* value:

$$T = \frac{7\ jam\ x\ 60\ menit\ x\ 60\ detik}{375\ kodi} = 67.2\ detik/kodi$$

Value Stream Mapping

The first identification result using VSM as shown in Figure 1 shows that there are several activities that have cycle times exceeding the *takt* time.

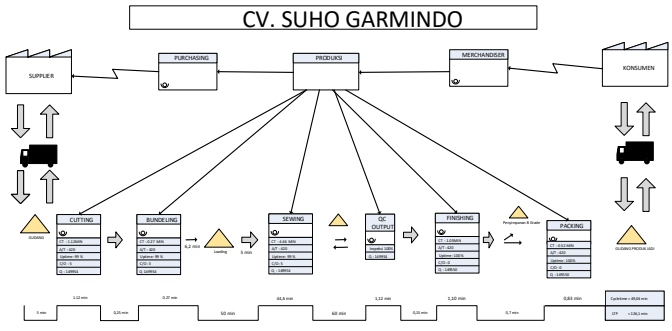

Figure 1. *Curent Value Stream Mapping*

A comparison between cycle time and takt time can be seen in table 1.

Table 1. Cycle time and *takt time* comparison

Activities	*Cycle Time*	*Takt Time*
Delivery of Materials from temporary warehouse to *cutting*	60	67.2
Cutting	67.2	67.2
Transportation from cutting to bundling	15	67.2
Bundeling	16.2	67.2
Transportation from bundeling to loading	372	67.2
Loading	3000	67.2
Sewing	2676	67.2
Rework	3600	67.2
Qc Output	67.2	67.2
transportation from QC to Finishing	9	67.2
Finishing	66	67.2
Transportation from finishing to packing	42	67.2
Packing	49.8	67.2

Table 1 shows that there are 4 processes that have a longer *cycle time* than the *takt time*, including: transportation from bundeling to *loading*, *loading*, *sewing* and *rework* processes. The existence of processes that exceed far from the *takt time value* causes the length of the production process time, so it can be said that the current production process is not good and needs improvement to eliminate time waste by reducing and or eliminating activities that have a *cycle time* value *greater than takt time* because if left unchecked it will become *waste*.

Lean Manufacture Metrics

Lean metrics measurement is used to see the initial condition of the company in the production process of certain products. Since the basis of *lean manufacturing* has been applied in CV Suho Garmindo, the metrics measurement will provide an overview for the *improvement* process in the company. The production process that has a *cycle time* value greater than the *takt time* is the cause of the long *lead time*, therefore the process must be improved. In measuring *Lean* metrics, to see whether the activity is value-added or not for the production process, the *Process Activity Mapping (PAM)* tool is used which will then calculate the production *Process Cylce Efficiency.*

1. **Identify *value added time, non-value added* with *Process Activity Mapping* (PAM) *tool*.**

PAM (*Process Activity Mapping*) is a *lean tool* used for further identification based on the results of the VSM that has been made. The purpose of PAM is to identify the *lead time of* the production flow. In addition, PAM also categorizes activities that include *value-added activities* (VA), *non-value-added activities (*NVA) and activities that are not value-added but still *needed (*NNVA). The recapitulation of data processing results with PAM is;

Volume 07, Number 01, March 2023, Page 097-101
e-ISSN: 2598-120X; p-ISSN: 2598-117X

Table 2. Recapitulation of PAM Results

Category	Total	Time (Minutes)	Percentage
Operation	6	107.67	52.21%
Transportation	6	26.8	12.99%
Inspection	3	1.42	0.69%
Delay	2	70.35	34.11%
Storage	4	0.35	0.17%
Total	**21**	**206.24**	**100%**

After grouping all activities on the production floor as in Table 2, further grouping of activities based on the type of value-added activities (VA), non-value-added (NVA) and non-value-added but still needed (NNVA).

Table 3. Percentage of Each Activity

Activities	Total	Time	Percentage
VA	5	47.67	23.11%
NVA	3	120.35	58.35%
NNVA	13	38.22	18.53%
Total	**21**	**206.24**	**100%**

Activities that have no added value or *non-value added* have the largest percentage of 58% *Non-value added activities* are activities that do not provide added value to the product, therefore if there are many NVA activities, it will become excess *waste motion*.

2. VA and NVA analysis

Activities that have a *cycle time* value greater than the *takt time* based on table 1 will be separated according to the *Value Added* (VA) and *Non-Value* Added (NVA) categories. The following is the explanation:

a. *Value Added* Activity

Value Added is obtained from the production operation process in VSM. However, not all operations can be categorized as *value added*, for example the *rework process*. Then the rework activities based on PAM data processing are:

Table 4. *Value Added* Activities

No.	Value Added Activity	Time (minutes)
1	Cutting	1,12
2	*Sewing* Process	44,6
3	Barcode Process	0,4
4	Labeling process	0,45
5	Packing process	0,83

b. Non-Value Added

The average NVA activity is a production process *lead time* activity. But there is no denying the existence of operating activities that are also NVA activities.

Table 5. *Non-Value Added* Activities

No.	Non-Value Added Activities	Time (minutes)
1	Cutting materials are stored in *loading*	50
2	Defective products are repaired (*rework*)	60
3	Defective products are separated (B grade)	0,35

Based on VSM, from 126.1 minutes *lead time process* 110 minutes are *non-value added* activities. So to improve *Process Cycle Efficiency* and reduce *Manufacturing Lead Time, it* must be reduced to eliminate NVA activities. Based on table 5.4, the NVA activity that can be reduced to eliminate is the *rework* process. This is because *rework is* an NVA activity categorized as non-value-added operations and has the largest cycle time.

3. NVA Activity Analysis with 5W1H

Analysis of NVA activities with 5W1H aims to find out more about *the* root causes of NVA activities. Based on table 5.3, NVA activities that have a cycle time greater than *takt time* consist of: loading process and *rework* process. Then the two activities will be analyzed as follows:

Table 6. Analysis of NVA activities with 5W1H

Factor	***Loading* Process**	***Rework* Process**
What	*Loading* process	The existence of the *rework* process
Why	For the production planning of the factory head	So that defective goods can be repaired
Where	Loading section or temporary storage	*Sewing* section, especially mask mouthpiece making
When	As soon as possible	Every day
Who	Factory head	Operator
How	Increase storage capacity, increase workers.	Maximize *sewing* performance by optimizing the use of machines and time (adding machines or increasing processing time)

Based on table 6. the *rework* process must be improved first, because *leads* occur every day, besides the *rework* process has the longest *cycle time* value which can affect the production process activities every day. If the *rework* process is still provided, the activity will become *waste* with activities that have excessive *motion*. The loading process is also important to improve, but because it is related to the planning of the factory head and the PPIC production department, further research must be done.

4. *Rework* Analysis with 5Why's

Improve that will be done is to make improvements by analyzing the *rework* process with 5Why's. The 5Why's *tool is* used to find *out* more about the root causes of the *rework* process. So that the *rework* process can be eliminated.

Volume 07, Number 01, March 2023, Page 097-101
e-ISSN: 2598-120X; p-ISSN: 2598-117X

Table 7. *Rework* Analysis with *5Why's*

Factor	Question	Answer
Why	Why there should be a *rework* process	So that stitching defects can be repaired
Why	Why are there defective goods	Because the operator (*sewing*; funnel section) is working in a hurry
Why	Why operators work in a hurry	So that the next operator (the finished stick section) does not wait
Why	Why does the operator (finished stick section) wait	Due to the long funnel manufacturing process
Why	Why the long funnel manufacturing process	Due to the long *cycle time*, the *man power of the* funnel and the machine is lacking.

Based on the results of the *waste* analysis, it is known that the *rework* process occurs due to lack of *man power* in the *sewing* production line, therefore defective goods often occur because *workers* are in a hurry to meet the target. Improvements that can be made so that defective goods do not exist and the rework process is eliminated are adding man power or machines. *Rework* is a *non-value added* activity. Therefore, *rework* should be eliminated in production activities. The elimination of *rework* can be done with several *improvements*. One of them is by maximizing performance by optimizing the use of machines and available time which can be seen from *idle* work time and the number of employees available.

5. *Improve* Proposal Analysis

As known from the results of processing, discussion and analysis, the cause of the largest *lead time* is *non-value added* activities. From the analysis using 5W1H, it is known that the rework process is the largest NVA contributor activity, therefore the *rework* process should be eliminated. The results of the *5Why's tool* analysis show that the cause of many products going through *rework is* due to the lack of smoothness in the *sewing* process, so if the *rework* process is to be removed, the sewing performance must be optimized. Eliminating the *rework process* can save 60 minutes of working time. Saving working hours will directly increase the production capacity of the mask without having to increase the input used in the production process so that productivity increases. The proposal to remove *rework* is to calculate the number of machines and man power available as in table 8. The consequences of eliminating the *rework* process are:

a. Production *Lead Time* (LTP) is reduced. The initial LTP based on VSM is 126.1 minutes then after the *rework* process is eliminated, the LTP is reduced to 66.1 minutes.
b. The percentage of *Process Cycle Efficiency* (PCE) has increased from 28.37% to 44.13%.

Table 8. Number of machines that must be in place

No.	Production Activities	Production Target (Pcs)	Available Time (Seconds)	*Cycle Time*	*Takt Time*	Production Capacity Per Day	Number of Machines to Have	Actual Machine Quantity
1	Sonday	750	25200	16.52	33.6	1525.7315	0.491567	1
2	Rope Splicing	750	25200	13.41	33.6	1879.661	0.399008	1
3	Basic Join	750	25200	36.03	33.6	699.41715	1.072321	2
4	Finished Sticks	750	25200	22.04	33.6	1143.2027	0.656052	1
5	Funnel Making	750	25200	123.93	33.6	203.34333	3.688343	4
6	Bejo Rope Cap	750	25200	56.03	33.6	449.75905	1.667560	2

6. Proposed Improve

The proposal for improvement to remove *rework* is with *Layout improvement in the sewing* section. Changes in the *layout of the sewing* process are based on the number of machines and *man* power that must exist from table 5.7, so there will be changes in *operator jobs* and additional machines that will occur from the previous *layout* (A). Based on the observation of field conditions, the proposed improvement *layout* is with O-shaped flow (B).

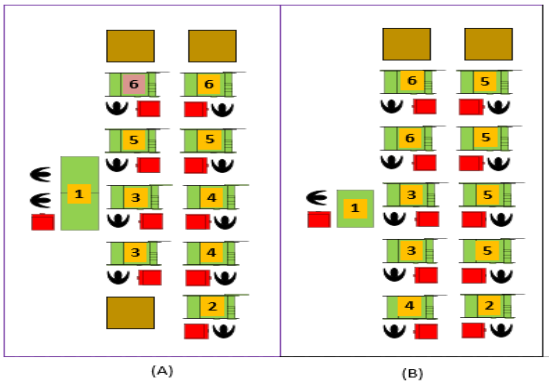

Figure 2. *Before and after improvement*

Figure 2 (B) above illustrates the proposed optimal *layout improvement*. The proposal is described by adjusting the efficiency of operator work (sewing operators and *helpers*), the flow of goods and the *efficiency of layout space.*

IV. CONCLUSION

Based on the results of the research that has been done, the conclusion is that reducing the Manufacturing Lead Time of mask production can be done by removing Non-Value Added activities. By removing Non-Value Added activities (Rework process) obtained Production Lead Time (LTP) is reduced. The initial LTP based on VSM is 126.1 minutes then after the rework process is eliminated, the LTP is reduced to 66.1 minutes. The percentage of Process Cycle Efficiency (PCE) has increased from 28.37% to 44.13%.

REFERENCES

[1] A. & Y. akhimuloh & Mauluddin, "Analisis Kapasitas Produksi di PT.XYZ," *Kalibrasi*, vol. 17, pp. 8–17, 2019.

[2] Y. Mauluddin and I. Masitoh, "Rancangan Perbaikan Produktivitas Terhadap Perubahan Design di Departemen Produksi Sewing," *J. Kalibr.*, vol. 18, no. 2, pp. 49–57, 2021, doi: 10.33364/kalibrasi/v.18-2.736.

[3] E. S. Apriliana, "Upaya Peningkatan Pendapatan Nasional di Tengah Wabah Virus Corona Perspektif Ekonomi Islam," *Al Iqtishadiyah J. Ekon. Syariah Dan Huk. Ekon. Syariah*, vol. 6, no. 1, p. 19, 2022, doi: 10.31602/iqt.v6i1.3097.

[4] S. Alfaritsi, D. Anggraeni, and A. Fadhil, "Analisis wacana kritis berita 'tentang social distance'', cara pemerintah cegah penyebaran virus corona di Detik.com,'" *J. Communicology*, vol. 8, no. 1, pp. 131–152, 2020.

[5] I. Nurhidayat and Y. Mauluddin, "Penentuan Waktu Dan Jumlah Pengiriman Bolu Lapis Legit Dengan Model Probabilistic P (Penelitian Di Pd. Sawargi Kp.Radug - Garut)," *J. Kalibr.*, vol. 12, no. 1, pp. 1–9, 2016, doi: 10.33364/kalibrasi/v.12-1.279.

[6] Y. Mauluddin, K. Yusuf, and E. Lesmana, "Perbaikan Lintasan Produksi untuk Meningkatkan Efisiensi dengan Menghilangkan Bottleneck dan Penyeimbangan Lintasan pada Divisi Sewing," *Semin. Nas. Tek. dan Manaj. Ind.*, vol. 1, no. 1, pp. 47–54, 2021, doi: 10.28932/sentekmi2021.v1i1.42.

[7] Handayani, D. Yuli, B. Prihandono, and M. Kiftiah, "Analisis Metode Moodie Young Dalam Menentukan Keseimbangan Lintasan Produksi," *Bul. Ilm. Mat. Stat. dan Ter.*, vol. 5, no. 03, pp. 229–238, 2016.

[8] Y. Mauluddin and I. F. Rahman, "Analisis Lean Manufacturing Pada Aktivitas Proses Produksi di PT. Mandala Logam Utama," *J. Kalibr.*, vol. 17, no. 2, pp. 59–68, 2020, doi: 10.33364/kalibrasi/v.17-2.694.

[9] S. Batubara and R. A. Halimuddin, "Penerapan Lean Manufacturing Untuk Meningkatkan Kapasitas Produksi Dengan Cara Mengurangi Manufacturing Lead Time Studi Kasus: Pt Oriental Manufacturing Indonesia," *J. Penelit. Dan Karya Ilm. Lemb. Penelit. Univ. Trisakti*, vol. 1, no. 1, pp. 49–56, 2016, doi: 10.25105/pdk.v1i1.431.

[10] I. Siregar, A. A. Nasution, U. Andayani, R. M. Sari, K. Syahputri, and Anizar, "Lean manufacturing analysis to reduce waste on production process of fan products," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 308, no. 1, 2018, doi: 10.1088/1757-899X/308/1/012004.

[11] Oleghe, O., & Salonitis, K. "Variation modeling of lean manufacturing performance using fuzzy logic based quantitative lean index". *Procedia CIRP*, 41, 608- 613. 2016

[12] Rohani, J. M., & Zahraee, S. M. "Production line analysis via value stream mapping: A lean manufacturing process of color industry". *Procedia Manufacturing*, 2, 6-10. 2015.

[13] Wyrwicka, M. K., & Mrugalska, B. "Mirages of Lean Manufacturing in Practice. *Procedia Engineering*, 182, 780-785. 2017.

[14] Kurilova-Palisaitiene, J. Lean "Remanufacturing: Reducing Process Lead Time", *PhD Thesis* Linköping University, Sweden. 2018.

[15] Turseno, Andi. "Proses Eliminasi Waste dengan Metode Waste Assessment Model & Process Activity Mapping pada Dispensing". *Journal Industrial Manufacturing*. 3,(1), pp. 45-50. 2018.