

# Application of lean manufacturing method and BLOCPAN algorithm for productivity improvement of a laundry soap bar production

Ukurta Tarigan<sup>1\*</sup>, Uni Pratama P Tarigan<sup>1</sup>, and Akbar Rizky Rifangi<sup>1</sup>

<sup>1</sup>Departement of Industrial Engineering, Faculty of Engineering, Universitas Sumatera Utara, Jl. Almamater Campus USU Medan 20155, Indonesia

**Abstract.** The problem experienced by the manufacturing company that produces soap bars is the waste in its production process. The research objective is to reduce waste in the production process flow in terms of distance of displacement of the material nor heap of material of the production process of laundry soap bars so it can increase the productivity. To solve the problem, implementation integration of lean manufacturing and BLOCPAN algorithm is used. In the early stages, value-added activities and activities that are not value-added is identified through the depiction of value stream mapping, and value-added activities that are not reducible to the application of the principle of 5W and 1H. To get the total minimal distance to move materials, it is necessary to re-layout production facilities with BLOCPAN algorithm. Future state mapping is used to get an idea of the final result, in which all non-value added activities can be reduced, and the shorter lead time obtained in the production process. With the application of those two methods, process cycle efficiency is increased 33.62% resulting in increased productivity of the company amounted to 204 packs of soap bars each day.

## 1 Introduction

Relayout is to design an array of amenities physical objects such as equipment, land, buildings, and other facilities that aim to optimize the relationship between the executive officer, the flow of goods, information flow, and procedures necessary to achieve its business objectives in sangkil, economical, and safe [1]. A good facility design involves the systematic physical arrangement of various departments, workstations, machinery, equipment, storage areas and common areas in the manufacturing industry [2]. The layout of the factory is the main foundation in the layout and production and work areas that take advantage of extensive work to put machines or facilities supporting other production and facilitate the movement of material movements in order to obtain a flow of materials and working conditions of regular, safe and comfortable so

that they can support achieving the objectives of the principal companies [3].

Effective facility planning can significantly reduce operating costs and improve the performance of a production line [4]. Layout production facility is an overall shape and placement of facilities needed in the production process [5]. Lean manufacturing can also be defined as a systemic and systematic approach to identifying and eliminating waste [6]. Lean Manufacturing is a philosophy that maximizes efficiency, reduce costs, improve product quality, and also see the importance of how people work in factories [7,8].

PT XYZ Engaged in the production of soap manufacturing company bullion. This company uses the potential of natural resources, especially agricultural production. PT XYZ can serve the needs of society (consumers) and harvest their crops (oil palm).

---

\* Corresponding author: [ukurta.tarigan@yahoo.com](mailto:ukurta.tarigan@yahoo.com)

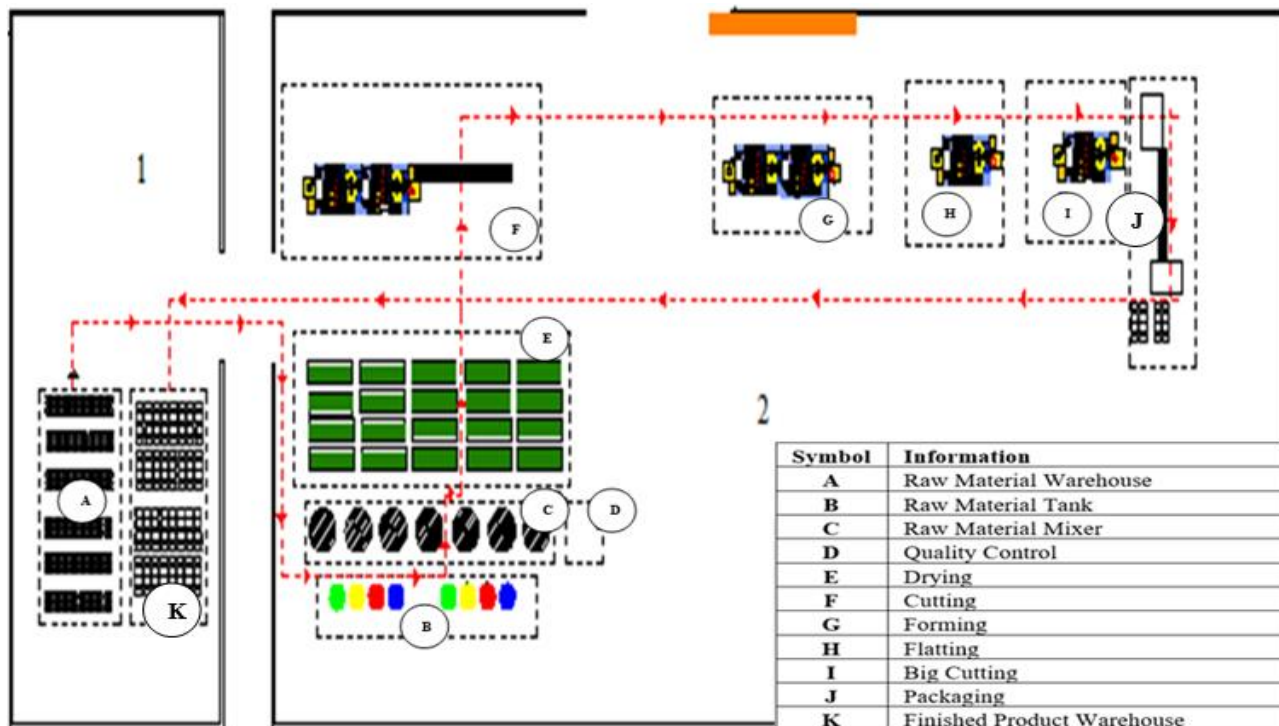


Fig. 1. Layout initial production floor.

From Fig. 1 above can be seen that the distance to station the packing to the warehouse department long enough product. So it takes time for 567 seconds to remove the finished product leading to the finished product warehouse department and lead to waste. Long-distance transfer of the material is a waste of time. [9] The process of making soap bars in one cycle takes 85188.89 seconds. Long lead time the product is affected by the activities non-value added such as long transport activity and the buildup process. problem waste solved by integrating approach lean manufacturing to reducing non-value-added activities with improvements layout BLOCPAN algorithm to produce a layout that has a moment of minimum displacement.

Lean manufacturing to reduce non-value-added activities with continuous production sector with a focus on the manufacturing industry [10] and aims to get the best quality, lowest cost, waiting time and productivity slightly increased [11]. The fundamental focus on production lean is a systematic elimination of activities that do not have added value. production application Lean shows the implementation of philosophy the lean through modifications to the layout [12]. Companies that have successfully implemented lean production prove that value stream mapping can eliminate 50% waste, shorten cycle times by 30%, reduce variations from 30% to 5% and improve product quality [13]. In making the value stream mapping classification of activities by asking a series of questions about the activities to be classified [14]. The objective of lean is to continually improve customer value through continuous improvement of the value-to-waste ratio [15]. Waste is the minimum amount of equipment, business, materials, spare parts, space and time available and important to add value to the product [16].

\* Corresponding author: [ukurta.tarigan@yahoo.com](mailto:ukurta.tarigan@yahoo.com)

## 2 Methods

Based on its nature, this research is classified as descriptive research, that is research which try to explain problem solving to a problem now systematically and factually based on data. This research includes the process of collecting, presenting and processing data and analysis and interpretation. The study begins by reviewing and collecting data in PT. XYZ. Gathered data from the company document is a soap product demand, describing the production process, production volume, area station, transfer distance and a description of the activity making direct observation and interviews directly in the field. The data in this research using the following steps:

### 2.1 Current state map

- Determining the value stream manager
- Diagram SIPOC (Supplier – Input – Process – Output - Customer)
- Calculation of standard time
- Mapping for each category of processes along the value stream
- Establishment flow maps the entire plant
- Calculation Process Cycle Efficiency
- Identification of waste PAM (Process Activity Mapping)

### 2.2 Analysis of current state map

- Details activity
- The analysis of activity mapping process

### 2.3 Improvement with lean manufacturing

- Coordinate point calculation block layout initial
- Calculation distances between work stations early
- Determination of the frequency of material movements of each work station early
- Calculation of total material movements at the moment of the initial layout
- Troubleshooting with software BLOCPLAN
- Process activity mapping proposal
- Depiction the future state map

## 3 Results and discussion

### 3.1 Formatting of current state map

Current state map is an overview of the production process that takes place within the company include

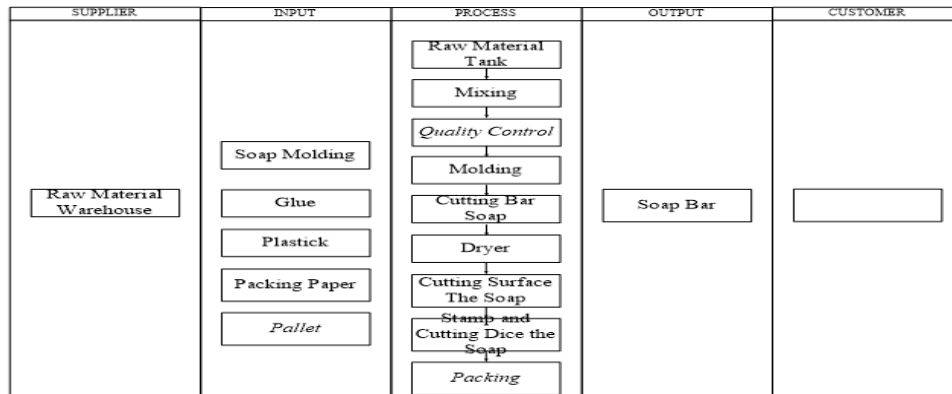


Fig. 2. SIPOC bars soap making diagram.

### 3.2 Standard time calculation

Example standard time calculation for the work center (WC) I is as follows.

$$\begin{aligned}
 \text{Standard Time} &= \\
 & \text{Normal Time} \times \{100\% / (100\% - \text{Allowance}\%)\} \quad (1) \\
 &= 32232.90 \times \{100\% / (100\% - 14\%)\} \\
 &= 2899.88 \text{ seconds/unit}
 \end{aligned}$$

Summary of the standard time can be seen in Table 1.

Table 1. Summary of standard time.

WC	Normal Time (sec)	Allowance (%)	Standard Time (sec)
I	2232.90	14	2596.40
II	14412.35	19	17793.03
III	329.20	17	396.63
IV	21248.08	17	25600.09
V	98.27	16	116.98
VI	620.80	18	757.08
VII	55.85	18	68.10
VIII	242.67	14	282.17
IX	37, 42	18	45.64

material flow and information flow. Measures formation of the current state map.

#### 3.1.1 Determination of value stream manager

Value stream manager plays an important role in the production process and someone who understands the whole process soap products. In this study, value stream manager selected is the production manager.

#### 3.1.2 SIPOC (supplier – input – process – output - customer) diagram

SIPOC Diagram process of making soap has elements that are used in the SIPOC diagram a stream of information, materials, processes, suppliers, and products can be seen in Fig. 2.

Based on the above table, we get the standard time result for each activity which increases with the increase of allowance. The data will be used to identify waste activities.

### 3.3 Waste identification process activity mapping

Through process activity mapping of making soap above an obtained amount of the transportation process, inspection and delay along with his time can be seen in Table 2

Table 2. Process activity mapping.

Symbol	Number	Time (sec)	Percentage %
Operating	19	48199.840	56.580
Transport	9	1343.500	1.577
Inspection	2	1021.633	1.199
Storage	-		0.000
Delay	9	34623.920	40.644
TOTAL	39	85188.893	100

Based on the above table, obtained activities that are not worth adding the delay activity of 34623.920 seconds which will be eliminated and transportation

activities will be strived as small as possible by arranging the layout.

### 3.4 Formation flow map overall factory

Each process along the value stream coupled with the flow of material and information flow so that it becomes an integral flow in the plant. Map the value stream is usually made as a one-page flow chart depicting the production line or line current design of a product from the customer request to delivery [17].

Map the value stream is usually made as a one-page flow chart depicting the production line or line current design of a product from the customer request to delivery [18]. After all the information was obtained, thus the current state map may be formed by placing all of the flow of material and information into folders Current state map bar soap products can be seen in Fig. 3.

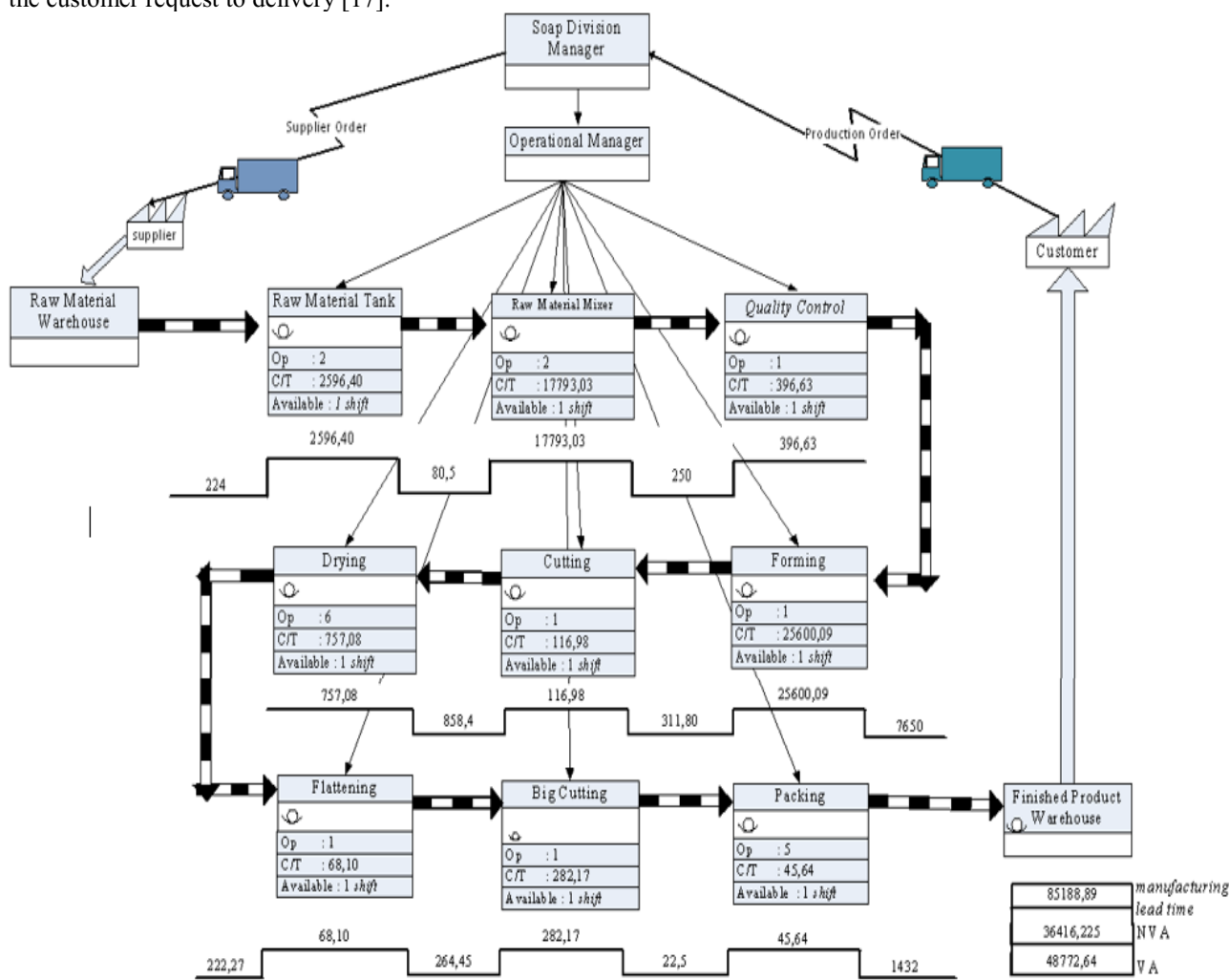


Fig. 3. Current state map products soap bars.

### 3.5 Calculation process cycle efficiency current state map

Calculations Process Cycle Efficiency performed to determine the circumstances of the original factory. Calculation Process Cycle Efficiency comprising manufacturing lead time calculations, process cycle efficiency, manufacturing lead time of 85188.89 seconds.

$$\begin{aligned}
 \text{Process Cycle Efficiency} &= \text{Value added time} / \text{Manufacturing lead time} \quad (2) \\
 &= 48772.64 / 85188.89 \\
 &= 0.5719 \approx 57.19\%
 \end{aligned}$$

$$\begin{aligned}
 \text{Average rate completion} &= \text{Total Production (year)} / \text{Number of Working days} \quad (3) \\
 &= 154106 / 312 \\
 &= 494 \text{ packs/day}
 \end{aligned}$$

### 3.6 Activity relationship chart

Activity Relationship Chart calculating the degree of relationship closeness of the machine based activity that is often expressed in qualitative assessments and considerations tend to be based on a degree of subjectivity. The assessment is taken from the real conditions that exist in the current field observations

[19]. Activity Relationship Chart based on qualitative data that is integrated with methods lean manufacturing that distance and value-added activities that do not affect the length of the production process. Aiming to minimize the transport of waste.

ARC data is then converted into numeric form with basic rank TCR value. Can be seen in Fig. 4.

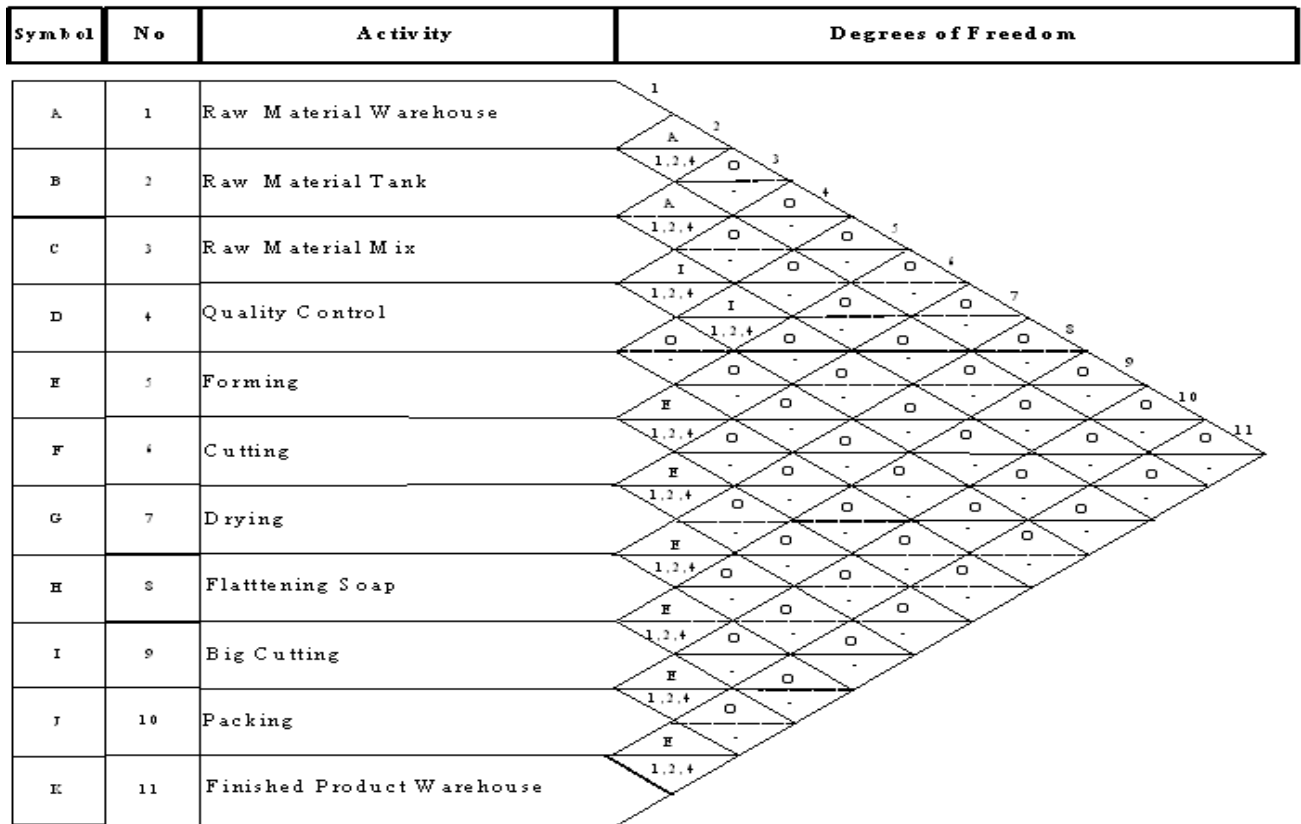


Fig 4. Activity relationship chart.

### 3.7 BLOCPAN software

Troubleshooting with the BLOCPAN Software based on input from the ARC activity link map with lean manufacturing. The data used in the BLOCPAN algorithm can be quantitative data formed using the Activity Relationship Chart (ARC) as well as the data on

the flow of products and the size of the existing building area will be occupied by the facility. After the formation of the initial layout then BLOCPAN algorithm will do iteration automatically as much as 20 times to get the most maximum layout score. Fig. 5 shows the results of 20 iterations in the BLOCPAN Algorithm.

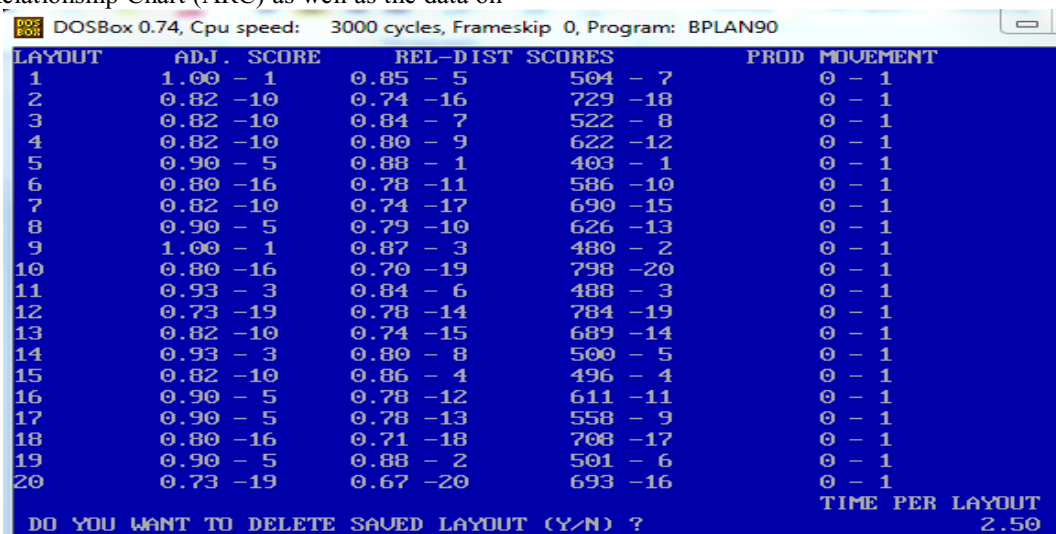


Fig. 5. Display results from 20 iterations on BLOCPAN algorithm.

The result obtained is that the highest R-score is at the 5th iteration with R-score 0.88- 1. The proposed layout with BLOCPLAN software can be seen in Fig. 6.

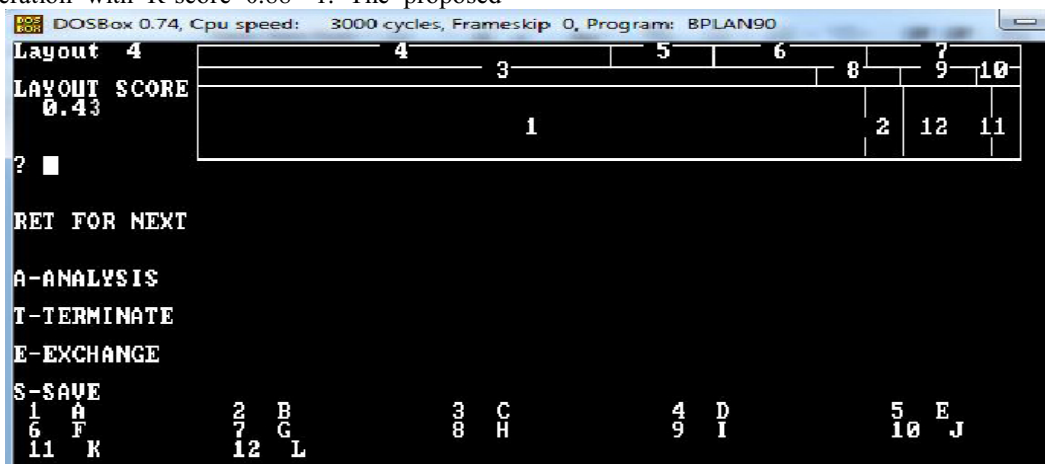


Fig. 6. BLOCPLAN proposed layout.

Relayout with approach, Lean Manufacturing can be seen in Fig. 7.

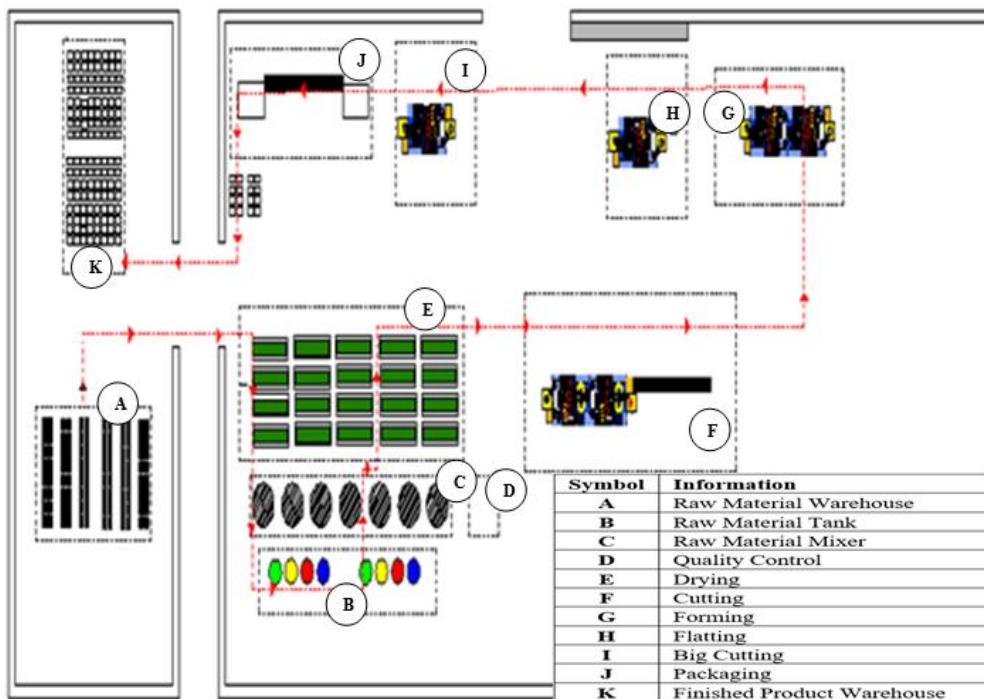


Fig. 7. Layout proposed.

From the results of the proposed layout, can be seen there is a reduction in displacement distance which means there is a reduction of time of movement so that waste activity can be reduced.

### 3.8 Analysis process activity mapping proposed

After repairs done next is to describe the results of improvement through process mapping activity proposal. In Process Activity Mapping real-time for the first activity, namely soap bars were taken to the tank using a forklift with a distance of 32 meters, take the time 224 seconds, so it can be expected to speed Forklift =  $224 \text{ sec} / 32 \text{ meters} = 7 \text{ m/sec}$ . Eliminasi activity is considered to have no value, In addition to eliminating non-value

\* Corresponding author: [ukurta.tarigan@yahoo.com](mailto:ukurta.tarigan@yahoo.com)

added activity will be considered also repair activity that is capable of minimizing the processing time with better working methods. Activity analysis to plan repairs carried out by the method of 5W and 1 H.

### 3.9 Formation of future state map

Improvement in the production floor layout can be minimized when the transport arrangements more efficient layout by reducing the distance between process associated with using software BLOCPLAN. Obtain 5W and 1H analysis on the waste that occurs on the production floor than in implementing corrective action will be carried out such that waste reduction improvements layout to reduce waste.

### 3.10 Depictions future state map

Future State Map based on the results of the proposed improvements that have been made previously. Changes

included a time that is a time shift can be observed or predicted from the current conditions, while the reduction in the time can be obtained as a reduction in transport time and production.

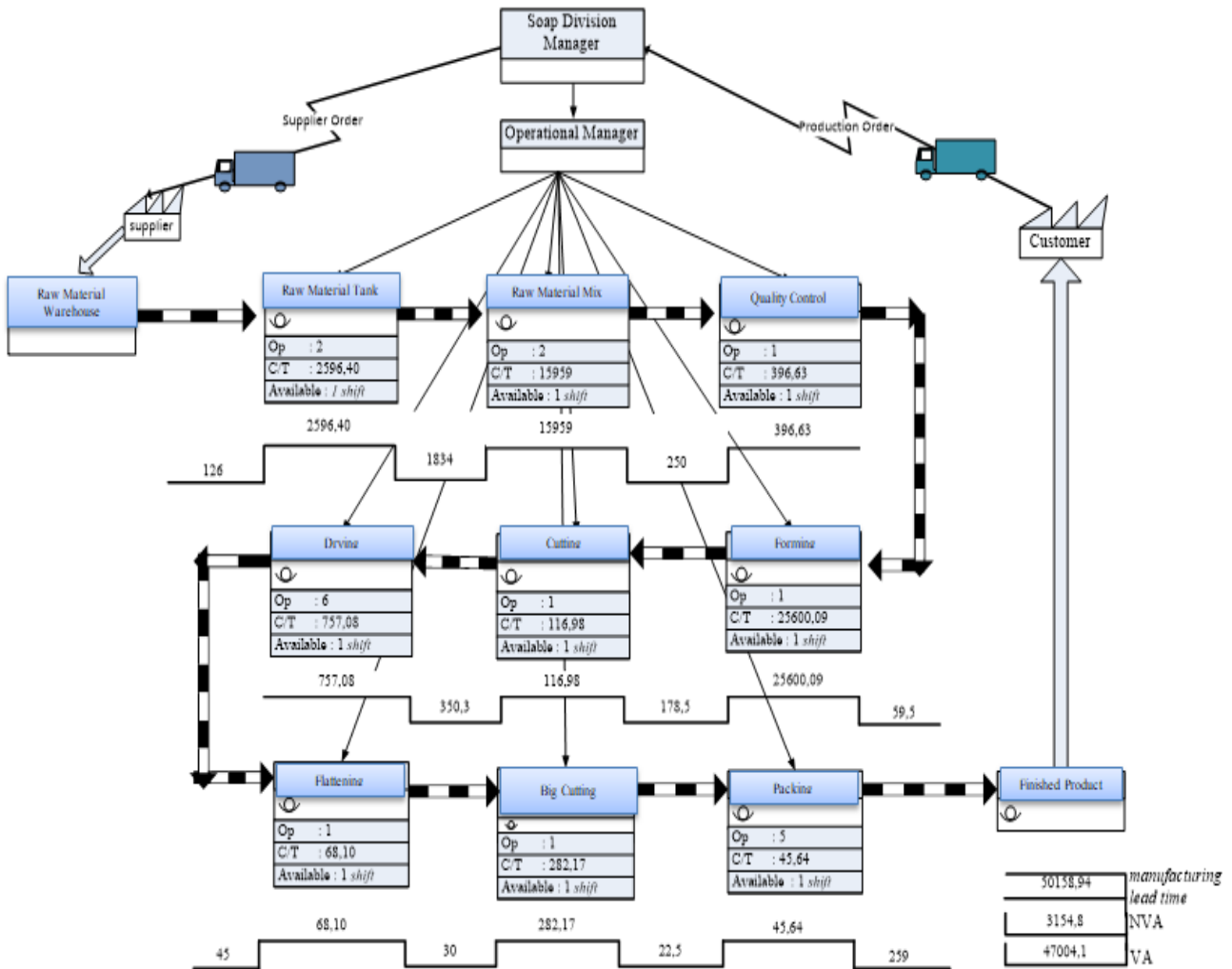


Fig. 7. Future state map proposed.

### 3.11 Process cycle efficiency analysis proposed

Lean metric calculations performed to determine the circumstances of the factory from the stand point of lean.

$$\text{Process Cycle Efficiency} = \frac{\text{Value added time}}{\text{Manufacturing lead time}} \quad (4)$$

$$= \frac{47004.1}{50158.94}$$

$$= 0.9371 \approx 93.71\%$$

$$\text{Improvement Production} = \frac{\text{Manufacturing Lead Time Current} - \text{Manufacturing Lead Time Sugestion}}{\text{Manuacuring Lead Time Actual}} \quad (5)$$

$$= \frac{(85188.89 - 50158.94)}{85188.94}$$

$$= 0.41 \times 494 \text{ packs/day (actual)}$$

$$= 202 \text{ packs}$$

The results of lean manufacturing approach, manufacturing lead time change proposed of 50158.94 second. Improvements to the improved lean

manufacturing method for process cycle efficiency increased by 33.64% and to increase daily production by an average of 204 packs, from 464 packs to 696 packs per day.

## 4 Conclusions

Classification of non-value added activity that is the delay for the next process such as a buildup of soap waiting to be appointed, besides the distance is too far to go to the next station which can lead to waste of time for removal of the finished products to the warehouse. The composition of the proposed layout of this improvement over existing weaknesses in the initial layout seen from the increase in productivity. After repairs to the approach lean manufacturing changes manufacturing lead time propose of 50158.94 seconds. The improvements with method Lean Manufacturing the results of the increase for Process Cycle Efficiency increased by 33.64% and to increase average daily production of 204 packs into 696 packs per day.

In this research, the authors would like to thank profusely to Universitas Sumatera Utara that gives chances to publish and develop author in the process.

## References

1. Kazi, et al, Integrated Job Shop Scheduling And Layout Planning: A Hybrid Evolutionary Method For Optimizing Multiple Objectives (2014)
2. BS Kallurkar, et al., Literature Review on Efficient Plant Layout Design, *International Journal of Industrial Engineering Research and Development* (2016)
3. J. Apple, Plant Layout and Material Handling, **3** (1997)
4. V. Afrianti, Evaluation Facility Factory Layout On Rice Milling Company Diki In Sigi (2017)
5. Sebastian, Facility Layout Redesign For Improvement Efficiency And Cost Reduction, *JCM* (2017)
6. A. R. M. Kholil, Analysis of Lean Production Application Process for reducing Lead Time Process Engine Treatment, *PT GMF AEROASIA* (2009)
7. N. Syed Ali, et al., Productivity Improvement of a Manufacturing Facility Using Systematic Layout Planning (2015)
8. Haghani. et al, A Genetic Algorithm For solving A Multi-Floor Layout Design Model Of A Cellular Manufacturing System With Alternative Process routings And Flexible Configuration, *Springer* (2013)
9. Agrahari. et al, Implementation Methodology In The Small Scale Industry: A Case Study, *IJSTR* (2015)
10. Sharma. et al, Lean Manufacturing: A Review *IJRMET* (2015)
11. D. Purnomo, Planning and Design Facility, *Graha Science* **1** (2004)
12. C. L Meng et al, The Application of Value Stream Mapping Based Lean Production System, *International Journal of Business and Management* (2010)
13. L. Michael L.G. R et al, The Lean Six Sigma Pocket Toolbook, *McGraw-Hill* (2005)
14. V.Gaspersz, Lean Six Sigma for Manufacturing and Service Industry, *PT. Gramedia Pustaka Utama* (2007)
15. M. Rother J. Shook, Learning to See, Value Stream Mapping to Create Value and Eliminate Muda, *The Lean Enterprise Institute, Inc* (2003)
16. M. Dzanya et al., Value Stream Mapping in Glide Manufacturing: A Case Study of Insti-Tools in Zimbabwe (2015)
17. D. Stadnicka, et al., Application of Value Stream Mapping and Possibilities of Manufacturing Processes Simulations in Automotive Industry (2015)