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Productivity Improvement Based Systematic Layout Planning and 5S (Case Study: CV. Mutya, Indonesia)

Calvin Aidil Febri [a*] and Anita Susilawati [a]

[a)] *Mechanical Engineering Department, Universitas Riau, Indonesia*

*Corresponding author: calvinaidil@gmail.com

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ABSTRACT

The amount of productivity had not met the target demand of customers in CV. Mutya. This happens could be due to un-optimal the facility lay out such as the distance of material working flow and un-effective the work processes. This paper aim is to improve productivity of wooden pallets product in CV. Mutya, Indonesia. The Systematic Layout Planning (SLP) method was used to improve the facility layout at CV. Mutya. To improve the work process was used 5S methods. The material transfer flow distance in the initial layout of CV. Mutya was 48.2 meters. Then, designing a new layout resulted the material displacement flow distance of 41.5 meters. Based the SLP method, to find out the root of the problem that occurs was employed the cause and effect analysis and work improvement using 5S. The 5S method was used to improve the conditions of the work environment and change attitudes by applying arrangement, cleanliness and discipline in the workplace.

KEYWORDS: *Systematic layout planning, productivity, 5S, wooden pallets, facility redesign*.

1.0 INTRODUCTION

CV. Mutya is an SME scale company (Small and Medium Enterprises) that engaged in wood processing to produce the wooden pallets products. Generally, the wooden pallet products are used as logistics goods storage. This pallet product can be used as a storage container for goods in the warehouse or as a container to accommodate products when distributed to various places both between cities and outside the city. The use of pallets is very important, because it can provide convenience in packing logistics goods. In Indonesia, most companies use wooden pallets for their inventory storage containers. It is due to the wooden pallets have strong durability and the stored goods are not damaged quickly. Therefore, the wood pallet products have a fairly high level of demand.

One of the ways to increase productivity on CV. Mutya is namely by improving the facility layout. A well-planned facility layout would determine efficiency and maintain the continuity or success of a company's work. Improvements in the production process are also able to increase company productivity. Production process improvement needs to be done continuously. Creating a comfortable and orderly work environment is also necessary to facilitate the work process. So, that can increase employee productivity. By making improvements in the workplace, it is expected to increase productivity and efficiency at work. Many methods can be used to increase productivity such as the SLP (Systematic layout planning) method, Kaizen and 5S.

The SLP (Systematic Layout Planning) is a procedure that describes the steps in the production layout planning process [1]-[3]. The purpose of facility layout is to increase work productivity and optimize the use of facilities such as work areas, machines and manpower [4][5]. One way to design a facility layout is to pay attention to the sequence of processes and the degree of proximity between the units contained in the facility to be designed. This method can also be used to redesign the layout of the facility to minimize the distance of material movement, degree of proximity, and production process time. Therefore, it can improve the productivity of products. The continuous improvement is necessary in product productivity.

A method of continuous improvement to increase productivity is Kaizen [6]-[8]. This method is able to provide relatively large improvements to the productivity control system. The principle of continuous improvement aims to improve production activities, processes and employee performance [8]. The employee performance is also influenced by working environment. The Improvement of working environment conditions in the company can be done by applying the 5S method. A 5S (sort, set in order, shine,

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standardizes and Sustain) is basically a process of changing attitudes by implementing organization, cleanliness and discipline in the workplace [9]-[12]. The concept of 5S is a culture of how a person treats the workplace properly. If the workplace is neat, clean and orderly, it is easy to create individual work facilities [9][12].

The purpose of the paper is to redesign the layout of the facility using SLP method and improving work processes based a 5S method, in making wooden pallets at CV. Mutya.

2.0 METODOLOGI

Data process and analyses were carried out using the Systematic Layout Planning (SLP) and 5S methods. The processing data is purpose to make a layout design of company facilities and improve work processes at CV. Mutya.

2.1 Data Collection

The data needed in this study were:

a. Primary data was data obtained directly through interviews and observations. Primary data includes data on the size of the floor area of the facility, the work process of making pallets, and others.

b. Secondary data came from documents and archives as supporting primary data in research or data that were not directly observed by researchers in the field. Secondary data includes data on pallet production and pallet demand in January-August 2020 and the number of workers.

2.2 Data Processing

The stages of data processing were carried out to make a design of the layout of company facilities and improvement of work processes at CV. Mutya. According to Wignjosoebroto (2009), the steps in systematic layout planning are [13]-[16]:

- Collection of input and activity data. This activity was carried out by collecting information data related to company activities, such as the sequence of the wood pallet manufacturing process.
- Analysis of material flow and operational activities. This analysis relates to material movement and operational activities. This analysis includes analysis of material flow, work equipment and operators, because the layout was basically designed to regulate the smooth flow of product manufacturing work. Then the material flow pattern was made to determine the layout.
- Activity relationship chart (ARC) was a map of activity relationships that serves to show the importance or not of the relationship between activities that exist in each work station.
- The need for the available area. This step serves to analyze the required plant area and consider the available area to build the facilities of the factory. To get the available area, firstly look for material requirements planning, planning machine requirements and planning floor area requirements.

The stages of applying the 5S method are [17]-[21]:

1. *Seiri*, the concept is to get rid of unused items from the work area. The smaller the number of items in an area, it will make the work area more spacious and help smooth work and productivity.
2. *Seiton* is to arrange the location and storage of goods. So, it can support smooth work and productivity.
3. *Seiso* is cleaning and ensuring the cleanliness of all items and work areas in peak condition. A clean work area makes the work environment healthy and comfortable.
4. *Seiketsu*, at this stage must ensure that the first three steps actually work consistently by setting standards. For example, by making procedures that regulate how often the activity must be carried out, who will do its. All work practices must be carried out consistently and standardized in order to avoid quality deterioration.
5. *Shitsuke* is maintaining and reviewing things that have been standardized on a regular basis. If 5S activities are carried out regularly, a habit will be created to maintain cleanliness and order. So, that has an impact on the success of work in the company.

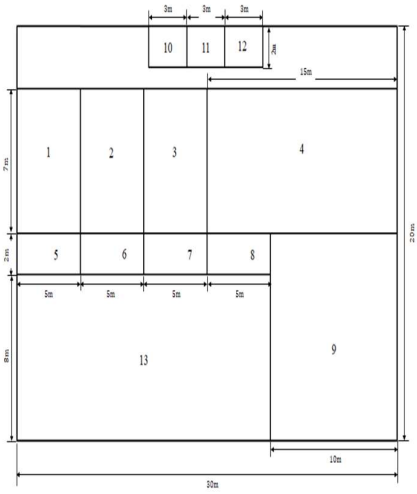
3.0 RESULT AND DISCUSSION

3.1 Systematic Layout Planning

The factory layout is the procedure for setting up factory facilities to support the smooth production process. Planning a factory needs to consider several aspects such as proximity to facilities, communication systems, working atmosphere, waste disposal and so on. Aspects that need to be carefully considered in planning include the equipment used, machines, and all the furniture. In the factory layout there were two things that were regulated, namely the machine layout and the departmental layout in the factory.

3.1.1 Initial Layout Sketch

Room facilities and tools/machines in CV. Mutya, namely: sawmill machine, planer machine, cross cut machine, pallet assembly room, wood raw material storage area, wood storage area to be planed, wood storage area to be cut, wood storage area to be assembled, pallet storage room, generator room, toilet, equipment and tool room, parking area. The initial layout sketch in CV. Mutya can be seen in the Figure 1. Total material transfer distance at each work station in preliminary layout can be seen in Table 1.



No	Station
1	Sawmill Machine
2	Planner Machine
3	Cross cut Machine
4	Assembly Pallet Room
5	Wood Raw Material Storage
6	Wood Storage to be Planned
7	Wood Storage to be Cutted
8	Wood Storage to be Assembled
9	Pallet Storage
10	Genset Room
11	Toilet
12	Tools and Equipment Room
13	Parking Area

Figure 1: Initial layout sketch in CV. Mutya

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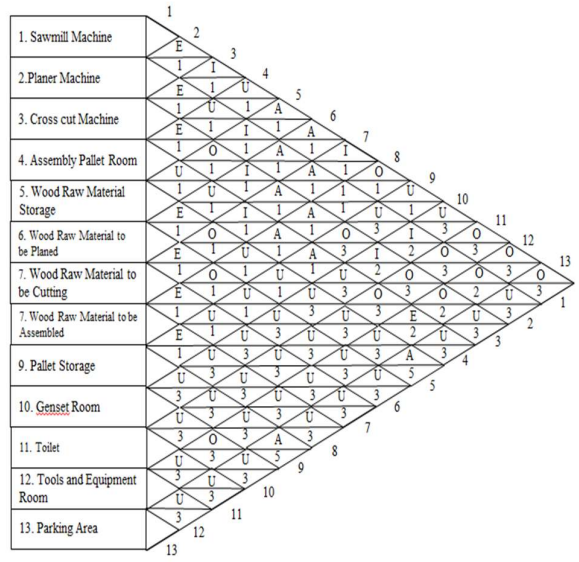
Table 1: Total material transfer distance at each work station in initial layout

No	From	To	Distance (m)
1	Wood Raw Material Storage	Sawmill Machine	4.5
2	Sawmill Machine	Storage of Wood to be Planed	6.1
3	Storage of Wood to be Planed	Planer Machine	4.5
4	Planer Machine	Storage of Wood to be Cut	6.1
5	Storage of Wood to be Cut	Cross Cut Machine	4.5
6	Cross Cut Machine	Storage of Wood to be Assembled	6.1
7	Storage of Wood to be Assembled	Assembly Pallet Room	7.6
8	Assembly Pallet Room	Pallet Storage	8.8
	Total		48.2

3.1.2 Activity Relationship Chart

The activity relationship chart (ARC) can be used to analyze a layout and see the relationship between stations of a factory/company by analyzing the material flow. Making an activity relationship chart was obtained from the sequence of activities in the wood pallet production process, which would be connected in pairs to determine the level of relationship between these activities. Based on the relationship at each activity and the reasons, the map of the relationship at each activity can be seen in the Figure 2.



Code	Reason
A	Absolute
E	Very Important
I	Important
O	Usual
U	Not Impotant
X	Not Required

No	Reason
1	According to the Order of Work Flow
2	Using the Same Equipment
3	Not Very Influential
4	Smell, Noise, Dust, Etc
5	Easy Access

Figure 2: The Activity Relationship Chart (ARC) in CV. Mutya

3.1.3 Machine Requirements Planning

In determining the number of machines needed in operation, it can be known by comparing the existing efficiency with the number of products produced per-hour. The machine requirements planning on CV. Mutya can be seen in the Table 2.

Table 2: Machine requirements planning

No	Machine Name	Machine Needs	Actual Number of Machine	Down Time (minute)	Set Up (minute)	Work Hour (minute)	Eficiency (%)
1	Sawmill Machine	2	1	0	5	480	99
2	Planer Machine	2	1	15	5	480	96
3	Cross Cut Machine	2	1	0	0	480	100

3.1.4 Planning of Floor Area Requirements

In planning the production floor area of CV. Mutya, the main problem was the total area of the machine and the total floor area. For this reason, it was necessary to calculate these problems. As for the production floor area of CV. Mutya by calculating the allowance factor, it can be seen in the Table 3.

Table 3: Planning of floor area requirements

No	Station	Total Floor Area ($_{m2}$)
1	Sawmill Machine	40
2	Planer Machine	24
3	Cross Cut Machine	24
4	Assembly Pallet Room	70
5	Wood Raw Material Storage	28
6	Wood Storage to be Planed	10
7	Wood Storage to be Cut	10
8	Wood Storage to be Assembled	5
9	Pallet Storage	100
10	Genset Room	6
11	Toilet	6
12	Tools and Equipments Room	6
13	Parking Area	117
Total Area of the Production Floor of CV. Mutya		446

3.1.5 Layout Alternative Design

The redesigning of layout on CV. Mutya was carried out data collection, data processing, and used the SLP method to design the station layout. It was developed into a three-dimensional form in the inventor application software.

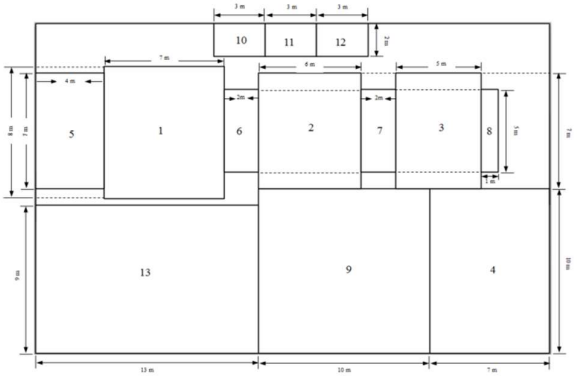


Figure 3: 2D sketch of new layout planning in CV. Mutya

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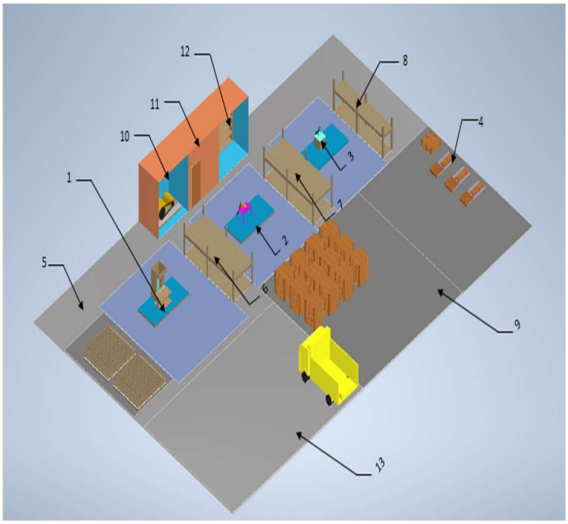

1. Sawmill machine
2. Crab machine
3. Cross cut machine
4. Pallet assembly room
5. Storage of wood raw materials
6. Storage of wood to be planed
7. Storage of wood to be cut
8. Wood storage area to be assembled
9. Pallet storage space
10. Genset room
11. Toilet
12. Tools and equipment room
13. Parking area

Figure 4: New layout design in CV. Mutya

The modification was to reduce the distance of movement of material flow in the production process in CV. Mutya. The layout of sawmill machine station, planer machine and cross cut machine were redesigned to make easy for workers on this station perform back and forth movements and move materials. In addition, it made easier for workers to have more space to do their work. More, it increased the total production floor area in the pallet storage space from the total area of the previous layout.

The addition of the total production floor area also occurred in the log storage area, the wood storage area to be planed, the wood storage area to be cut and the wood storage area to be assembled. This addition was made because in the initial layout the total production floor area was too narrow. Then, it can reduce the total production floor area at the pallet assembly station. The total floor area of the pallet assembly station production floor in the initial layout was considered too large for the number of workers, which were only 7 workers.

Distance of material transfer at each work station on the new layout CV. Mutya can be seen in the Table 4. The total distance of the initial layout material displacement on the CV. Mutya was 48.2 meters. So, the new layout was designed on the CV. Mutya to reduce the distance of material transfer. Therefore, the work process became more effective. Based on the new layout created, the material transfer distance was 41.5 meters.

3.2 5S (*Seiri*, *Seiton*, *Seiso*, *Seiketsu*, *Shitsuke*)

According to [19][22] the 5S is a method of structuring and maintaining an intensive work area originating from Japan. That is used by management in industry or companies to maintain order, increase productivity, efficiency and discipline at work sites while improving overall company performance.

Table 4: Distance of material transfer at each work station on the new layout CV. Mutya

No	From	To	Distance (m)
1	Wood Raw Material Storage	Sawmill Machine	5.5
2	Sawmill Machine	Storage of Wood to be Planed	4.5
3	Storage of Wood to be Planed	Planer Machine	4.0
4	Planer Machine	Storage of Wood to be Cut	4.0
5	Storage of Wood to be Cut	Cross Cut Machine	3.5
6	Cross Cut Machine	Storage of Wood to be Assembled	3.0
7	Storage of Wood to be Assembled	Assembly Pallet Room	8.5
8	Assembly Pallet Room	Pallet Storage	8.5
	Total		41.5

1. *Seiri* (Concise)

The principle of this concept is to identify and keep away items that are not needed in the workplace. In the processing of raw logs into wooden boards and beams at the sawmill machine station. There were some pieces of wood that can be resold. The remnants of these pieces of wood was usually be bought by someone who was used for cooking fuel. The design of applying this principle was like setting aside the remaining pieces of wood waste that can be sold with useless pieces of wood waste. Then the pieces of wood waste that were not useful were set aside to be disposed of in a landfill.

Figure 9: The remains of pieces of wood that have not been set aside

Figure 10: The remains of pieces of wood that have been set aside

2. *Seiton* (Neat)

The principle in this concept is to organize the items needed so that they can be easily found or easy to use by anyone. In the CV. Mutya, the wood that was planed or cut left scattered because there was no place to put this wood.

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Figure 11: Scattered wood

The design of the application of this concept was to make a shelf for wood storage, both to be planed and to be cut. So, the stored wood became neater and not scattered. This wooden storage rack can be made with wood base materials. This shelf has 1 level with a height of 1 meter. Hence, the workers were easier to put the wood. The wood storage rack design is illustrated in Figure 12.

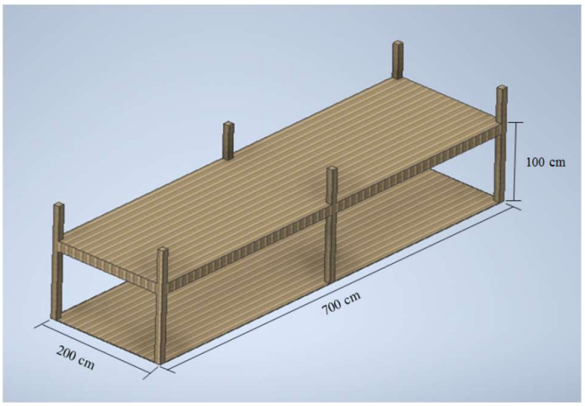

Figure 12: Wood storage rack design

3. *Seiso* (Clean)

The principle of this concept is to clean the workplace every day. The purpose of this design is to create a clean work environment because the cleanliness of the work environment can also indirectly affect the performance of every employee who works. The design application of this concept was to clean sawdust on all floors of facilities at CV. Mutya by using cleaning tools such as brooms and shovels and then these cleaned powders into sacks. This sawdust also has a resale value. The sawdust before cleaning and the sawdust that has been put in a sack are depicted in Figure 12 and 14, respectively.

Figure 13: Sawdust before cleaning

Figure 14: Sawdust that has been put in a sack

4. *Seiketsu* (Treat)

The principle in this concept is to care for and maintain *seiri, seiton* and *seiso*, then, it can take place continuously. The following were the steps in designing the principle of *seiketsu*:

- List cleaning tools. Cleaning tools were needed to keep the environment clean. Evaluation of cleaning tools was needed in the workplace, such as broom sticks, trash shovels, and waste baskets.
- Hygiene criteria. Workers must know what to clean and useless objects to clean or to throw away. Examples of objects that must be thrown away were the small pieces of wood that cannot be resold. The examples of objects that should not be thrown away were the pieces of wood that can be resold and sawdust.
- Responsibility for the overall cleanliness of the workplace. Every worker must be responsible for the cleanliness of the entire workplace, not just their own work station.

5. *Shitsuke* (Diligent)

The principle in this concept is the step of self-awareness of work ethics, including discipline towards work standards. The design of work procedures on CV. Mutya were intended to change one's habits to became more disciplined. The steps for designing the *shitsuke* principle:

a) Getting used to the implementation of work standardization. The purpose of customizing the implementation of work standardization was the duties and responsibilities in the implementation of 5S. The duties and responsibilities of each worker related to the implementation of 5S must be adhered to and implemented. The purpose of this procedure was to make everyone involved in the workplace and discipline to carry out a more structured 5S program and implementation.

b) Carry out 15 minutes 5S. The design of 15 minutes 5S aimed to help instill 5S culture in daily work activities. This implementation was carried out for 15 minutes after working hours end. The activities carried out in this 15 minutes 5S activity were: (1) Returning work equipment to its place, (2) Set aside useful sawdust and wood chips and discard useless ones and (3) Clean the entire work area.

4.0 CONCLUSION

The result of observations and analyzes the facilities layout at CV. Mutya was found the distance of material flow transfer that was not optimal. So, a redesign of the facility layout was needed to reduce the distance of material flow transfer. The redesign of layout facility at CV. Mutya's production based

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data collection, data processing and using the SLP method. The initial layout, the material displacement distance was 48.2 meters. So, redesigned the layout on the CV. Mutya was to reduce the distance of material transfer, so that the work process becomes more effective. Based on the new layout revealed the material transfer distance was 41.5 meters. Based on the results of the design and do some examples of 5S implementation that can be done in CV. Mutya, got some pretty good changes in CV. Mutya. This change can be seen from several conditions that have been carried out, examples of implementation, namely the removal of useful and useless pieces of wood and cleaning of sawdust. Therefore, the 5S implementation can make the cleaner and neater working condition.

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