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FACILITY LAYOUT DESIGN FOR CV. JULANG MARCHING WITH SYSTEMATIC LAYOUT PLANNING METHOD

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ABSTRACT

CV Julang Marching is one of the local companies engaged in the manufacture and service of drum band / marching band musical instruments. CV Julang Marching has not been able to fulfill Marching Bell and Carrier product orders in a timely manner because the layout of the production area is less effective according to interviews with company owners. This is caused by the material handling time is too long because of the distance between far areas. In addition, material handling costs have not been considered in the total operating costs at CV Julang Marching. Therefore, it is necessary to improve the layout of the facilities in the Marching Bell and Carrier production process at CV Julang Marching to improve production performance and reduce material handling costs. The smooth production process can be supported by improving the layout of the facilities using the Systematic Layout Planning (SLP) method and the Flow Planner software as a tool for making alternative designs of the facility's layout. The results of this study indicate that alternative layout changes have minimized material handling distance by 28.8%, shortened material handling time to 47.6%, and minimized material handling costs by 47.6% so that the layout became more efficient.

KEYWORDS: Facility Layout Design, Systematic Layout Planning, Flow Planner.

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1. INTRODUCTION

Facility layout is a design that involves technology, processes, and facilities and regulates the relationship between the three aspects [1]. The layout of facilities is something that must be considered in an effort to maintain the quality of the company. Company performance is related to the effectiveness and efficiency of the resources used by the company. Assessment of company performance can be seen from machine productivity, cost efficiency, and accuracy of delivery of goods [2]. One of the clearest characteristics of a productive company is layout because layout determines the shape and appearance of its environment [3].

CV Julang Marching is one of the local companies engaged in the manufacture and service of drum band / marching band musical instruments. CV Julang Marching has an area of 1381 m2 with 10 areas, namely the area of Costumes, Machining, Marching Bell, Carrier, Polishing, Assembly, Warehouse, Painting, Welding, Finish Good, Packing, Wood Storage, and Woodworking. This research focuses on Marching Bell and Carrier products which are the company's flagship products. Its production capacity can reach 480pcs per year.

CV Julang Marching has not been able to fulfill orders on time and workers often work overtime to fulfill these orders. Product delays can reach one month from the due date. This is due to inefficient production activities where material handling time is too long between areas. Material handling time that is too long is caused by the arrangement of the room not seeing the aspect of closeness between processes so that the distance between remote areas [4]. Area settings that do not see the aspect of closeness cause criss-crossing in moving components between areas in the Marching Bell and Carrier products.

CV Julang Marching also does not have a special operator in charge of material handling. In addition, material handling costs have not been considered in the total operating costs at CV Julang Marching. A less systematic material handling system becomes a problem that affects the smoothness of the production process so that it can affect a whole system [5]. Therefore, it is necessary to improve the layout of the facilities in the Marching Bell and Carrier production processes at CV Julang Marching to improve production performance.

The smooth production process can be supported by improving the layout of the facilities using the Systematic Layout Planning (SLP) method. The purpose of this method is to evaluate the existing layout so as to minimize the distance of material handling between areas and produce an alternative layout for optimal production facilities.

This research uses Flow Planner software as a tool for making alternative designs for facility layout. Flow Planner is one of the software used to create material flow diagrams and automatically calculate the distance, time, and cost of material handling.

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

2. RESEARCH METHOD

This study uses a method developed by Muther [6] which is a procedural method by considering quantitative factors and qualitative factors that affect production performance. This method can be used for areas with different areas and non-rectangular areas.

Data collection is done by conducting direct observations in the field and direct interviews. The data that has been collected is processed using the Systematic Layout Planning (SLP) method, which is described in three phases, namely the analysis phase, the alternative design phase, and the selection phase. The analysis phase is carried out to analyze the conditions of the initial layout related to the flow of operations and material, the interrelationship between activities, the area of space, and the costs required. After analyzing the existing layout, an alternative layout design is done based on the results of the analysis in the previous phase. The selection phase is carried out by evaluating the alternative layout of the facility. This stage is carried out a comparison of initial layout material handling and alternative layout alternatives produced by Flow Planner. The stages of alternative layout design procedures using the Systematic Layout Planning (SLP) method are:

1. Identify the operating process using the PQRST to analyze the processes that exist in making products.
2. Material flow identification uses the Multi Product Process Chart (MPPC) to determine the area used in the sequence of processes for each part based on a map of the operation process that has been made.
3. Identify the linkages of activities described in the Activity Relationship Chart (ARC) to combine the degree of relationship between activity and material flow.
4. Description of the initial layout to identify the shortcomings of the initial layout conditions by using the Flow Planner software to calculate the distance, time, and cost required in material handling automatically.
5. Making a Space Relationship Diagram (SRD) based on the relationship between departments, and the area requirements for the area of each department.
6. Design alternative layout of facilities and identify changes in alternative conditions from initial layout conditions by using the Flow Planner software to automatically calculate the distance, time, and cost needed in material handling.
7. Calculation of DLHL Ratio to find out unproductive operator time by looking at material handling time and total production process time by formula:

$$DLHL\ Ratio = \frac{material\ handling\ time}{Total\ time\ direct\ labor\ works}$$

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

3. RESULT AND DISCUSSION

Data processing requires the number of areas on the production floor, the area of each area, the production process, the material flow in the production process, the production floor area, standard time, production capacity, material handling equipment, UMR, and the type and number of machines used. Table 1 and Table 2 show the list of operations on Marching Bell and Carrier products.

From interviews with company owners, an Activity Relationship Chart (ARC) was obtained which contained relationships between areas in the Carrier production process in Figure 1 and Marching Bell in Figure 2.

Based on the degree of relationship between departments, alternative layout 1 and alternative layout 2 can be made as illustrated in Figure 3 and Figure 4.

Table 1 List of Marching Bell Operations

Process	Duration (second)	Machine	Area
Wood			
Sanding the wood	1793	Wood Shaving Machine	Woodworking
Chopping wood	917	Wood saw machine	Woodworking
Connecting the woods	958	Hammer, Wood Glue, and Nails	Woodworking
Sanding the wood	11635	Sandpaper	Woodworking
Paint wood with base paint	3730	Paint & Brush	Painting
Final painting	7155	Paint & Brush	Painting
Alumunium Bars			
Cutting the bars	3733	Mechanic Saw	Cutting
Initial boring the bars	385	Drilling Machine	Marching Bell
Drilling bars	827	Drilling Machine	Marching Bell
Tuning bars	7361	Milling	Marching Bell
Pad			
Cutting the pad	52	Pond Machine	Machining
Frame			
Cutting the frame	2804	Plate Cutter	Cutting
Drilling the frame	669	Driling Machine	Machining
Welding	603	Welding machine	Welding
Painting frame	4115	Spray Painting	Painting

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

Assembly		
Assembly	677	Marching Bell
Total	47.414	

Table 2 List of Carrier Operations

Process	Duration (second)	Machine	Area
Alumunium Pipe			
Cutting alumunium pipe	362	Saw machine	Cutting
Bending alumunium pipe	725	Bender	Assembly
Treatment painting carrier	297		Painting
Spray painting carrier	128	Spray Painting	Painting
Oven carrier	3774		Painting
Pad			
Cutting pad and fabric	311	Scissor	Carrier
Sew the pad and fabric	3629	Sewing Machine	Costume
Clam			
Cutting alumunium clam	194	Saw Machine	Cutting
Drilling clam	183	Drilling	Carrier
Threading clam	190	Taping	Carrier
Buffing clam	317	Buffing	Polishing
Treatment painting carrier	311		Painting
Spray painting carrier	136		Painting
Oven carrier	3648		Painting
Plastic			
Casting plastic seeds	3921	Casting machine	Carrier
Assembly			
Welding	1237	Welding Machine	Welding
Assembly carrier	483		Carrier
Total	19.846		

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

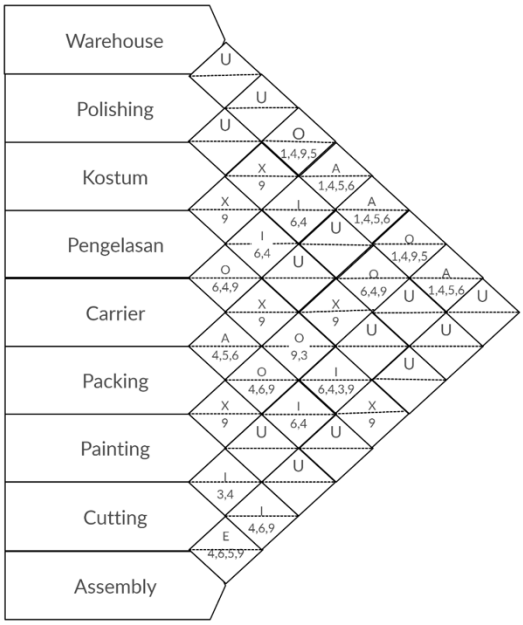

Figure 1 ARC Carrier

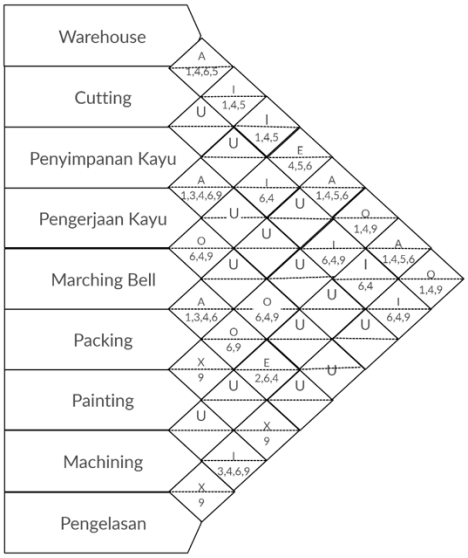

Figure 2 ARC Marching Bell

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

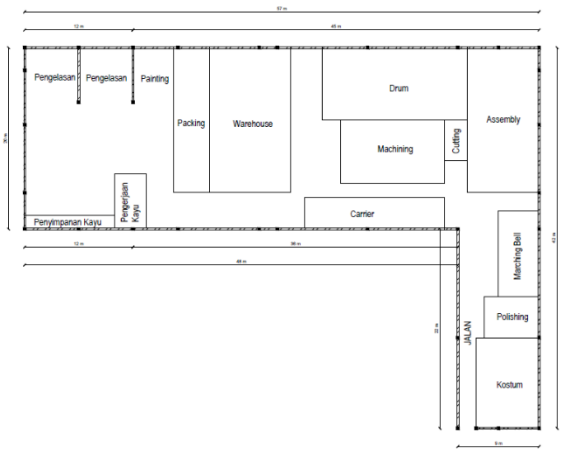

Figure 3 Alternative Layout 1

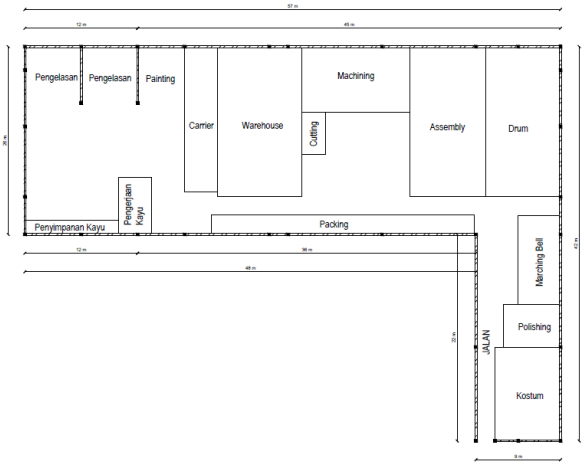

Figure 4 Alternative Layout 2

Table 3 and Table 4 show a recap of the results of calculations of distance, time, material handling costs, and DLHL Ratio of initial conditions and alternative conditions in 1 year of production for Marching Bell and Carrier products:

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

Table 3 Recap of Marching Bell Layout Conditions

Parameter	Initial Condition	Alternative 1	Changes	Alternative 2	Changes
Total Distance (m)	213.600	165.600	22,5%	137.760	35,5%
Time (s)	177.901,93	138.874,67	21,9%	114.982,99	35,4%
Cost (Rp)	526.481,2	410.984,44	21,9%	340.279,31	35,4%
DLHL Ratio	0,026	0,020	23,08%	0,016	38,5%

Table 4 Recap of Carrier Layout Conditions

Parameter	Initial Condition	Alternative 1	Changes	Alternative 2	Changes
Total Distance (m)	312.000	222.240	28,8%	162.240	48%
Time (s)	259.430,15	185.616,68	28,5%	135.873,78	47,6%
Cost (Rp)	767.754,63	549.315,27	28,5%	402.103,18	47,6%
DLHL Ratio	0,037	0,027	27%	0,020	45,9%

7.1 SELECTED ALTERNATIVE LAYOUTS

Improvements to alternative layouts 1 and 2 have brought the location of the related areas closer so that the material handling distance in the two alternatives is smaller than the initial layout conditions. Reducing the distance between areas in alternative layouts can reach 20-89%. This can be found in research conducted by Kommula [7] about improving layout using the SLP method and the Flow Planner software can reduce the distance between areas by 20% -68% from the initial layout using the SLP method and the Flow Planner software. Alternative layout 2 has the lowest material handling mileage for Marching Bell and Carrier products compared to alternative 1.

Reducing material handling mileage is directly proportional to reducing material handling time. Reducing material handling distance in alternative layout 1 and alternative 2 has shortened the time needed in material handling as in research by Naqvi et all [8] where material handling time is calculated as lead time and lead time in alternative layout has decreased. Material handling time on alternative layout 2 is shorter than alternative layout 1. Decreasing material handling time can increase the amount of material handling that can be produced annually and can increase worker productivity by looking at the DLHL Ration. Shorter material handling time on alternative layout 2 makes DLHL Ratio on alternative layout 2 less than

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

DLHL Ratio on alternative layout 1. So, alternative layout 2 has the highest level of worker productivity compared to alternative layout 1 and layout initial location where the production process time is more efficient because material handling time decreases.

The results of the calculation of material handling costs per year indicate that the cost of material handling in alternative layout 2 is lower than the alternative layout 1. This is because changes in material handling costs are directly proportional to changes in material handling time. The reduction in material handling costs in research by Muslims and Ilmaniati [9] has reduced material handling costs by 35% but in alternative layout 2 in this study the reduction in material handling costs can reach 47.6%.

The advantage of alternative layout 1 is the position of the Warehouse area that is closer to the Carrier area so that the distance, time and material handling costs can be decreased more than alternative layout 2, but alternative layout 1 has the disadvantage that the Carrier area with Polishing is important for brought closer but Carrier's position is kept away from the Polishing position so that the distance, time and material handling costs have increased compared to the layout of the initial conditions. While the advantage of alternative layout 2 is that almost all areas experience a decrease in distance, time, and material handling costs. Only the removal of the Cutting area makes the distance between the Cutting area and the Welding area even farther away and this becomes a drawback from the alternative layout 2.

8. CONCLUSION

The conclusions obtained from the research are as follows.

1. Changes in alternative layouts for Marching Bell and Carrier products at CV Julang Marching have minimized material handling distances by 28.8%. The reduced material handling distance has shortened material handling time and reduced material handling costs.
2. Based on the results of the calculation of distance, time, and material handling costs along with the advantages and disadvantages of the two alternative layouts, alternative layout 2 which is the selected alternative layout. This is because alternative layout 2 has a smaller material handling compared to alternative layout 1. In addition, alternative layout 2 has more advantages that do not only focus on a particular area and the disadvantages of alternative layout 2 do not have much effect due to the removal of the area Cutting makes other areas related to the Cutting area closer.

REFERENCES

[1] Hales, H. (1984). Computer Aided Facilities Planning. NY: M. Dekker.

[2] Riyana, D. (2017). Pengukuran Kinerja Perusahaan PT Indofood dengan Menggunakan Balanced Scorecard. Jurnal Sekuritas (Saham, Ekonomi, Keuangan dan Investasi), 1(2), 42-53.

ISSN: 2582-6271

Vol. 4, Issue.6, Nov-Dec 2023, page no. 35-44

[3] Slack, N., Chambers, S., & Johnston, R. (2002). Administração da Produção, 2nd ed. Sao Paulo: Editora Atlas.

[4] Onkar, S. S., & Philip, D. (2016). Material Optimization and Process Improvement using Simulation for Makeshift Auto Chassis Manufacturing of an Indian SME. International Conference on Industrial Engineering and Operations (pp. 1294-1304). Kuala Lumpur: IEOM Society International.

[5] Ramos, M., Simanjuntak, R. A., & Susetyo, J. (2010). Perancangan Ulang Tata Letak Fasiltas Produksi Dengan Pendekatan Group Tecnology dan Algoritma Blocplan untuk Meminimasi Ongkos Material Handling. Jurnal Teknologi, 3(1), 75-84.

[6] Muther, R. (1973). Systematic Layout Planning. Boston, MA: Cahners Books.

[7] Kommula, V., Mapfaira, H., Gandure, J., K., M., R., M., & Samuel, O. (2015). Improving Productivity of a Machine Workshop through Facilities Planning. International Journal of Mining, Metallurgy & Mechanical Engineering (IJMMME), 3 (3), 187-192.

[8] Naqvi, S. A., Fahad, M., Atir, M., Zubair, M., & Shehzad, M. M. (2016). Productivity improvement of a manufacturing facility using systematic layout planning. Cogent Engineering, 3, 1207296.

[9] Muslim, D., & Ilmaniati, A. (2018). Usulan Perbaikan Tata Letak Fasilitas Terhadap Optimalisasi Jarak dan Ongkos Material Handling dengan Pendekatan Systematic Layout Planning (SLP) di PT Transplant Indonesia. Jurnal Media Teknik dan Sistem Industri, 45-52.