



Relayout of Production Layout to Reduce Material Handling Costs

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Abstract

Despite its long-standing operation, the company faces several issues related to the production floor layout, such as inefficient material flow, high waiting times, and suboptimal space utilization. These problems have led to decreased productivity, time inefficiencies, and an uncomfortable work environment. This study aims to redesign the production floor layout using the Systematic Layout Planning (SLP) method to improve material flow efficiency and productivity. The SLP method helps identify the relationships between activities and design an optimal layout by minimizing material transfer distances, reducing waiting times, and creating a more comfortable workspace. The research results are expected to provide optimal solutions for maximizing the efficiency of material handling distance and time while demonstrating the positive impact of layout changes on material handling costs. This study successfully redesigned the production facility layout to enhance operational efficiency. Changes were made to facilities C, D2, P, G, J, and I, along with the relocation of machine K and the removal of cutting machine H, which was no longer in use. The results showed a significant reduction in material transfer distances, from 23,457.5 meters to 13,194.65 meters per month (a 43.9% reduction). Additionally, material transfer times decreased from 438.41 minutes to 298.23 minutes per month (a 31.98% reduction). A comparison between the initial and proposed layouts revealed a reduction in material handling costs from IDR 269,738 to IDR 206,452 per month, resulting in savings of 23.46%. The layout optimization proved effective in reducing material flow inefficiencies, directly impacting operational cost reduction and productivity improvement.

Introduction

Industry has impacts that involve the economy, social, and the environment. The existence of industrial products and services triggers to improve the standard of living in the community, causing a lot of demand for new and innovative products and then encouraging the development of technological and process innovations to follow the demand. Until now, various innovations resulting from the development of the industry continue to emerge, there are products that have functional value to support other industries, there are also those that are intended directly for end users such as the community (Vermesan & Friess, 2015; Romero & Molina, 2011; Rahmawati et al., 2021; Javaid et al., 2021). Examples of large-volume products such as boiler machines to simple products such as packaging boxes.

In the manufacturing industry, for example, the raw material processing system or commonly called the production process involves planning a work facility, moving materials, calculating raw materials and warehousing. Among various manufacturing activities, facility design has a crucial role in increasing productivity in a sustainable manner (Hegab et al., 2023; Javaid et al., 2021; Fissi et al., 2021; Palange & Dhattrak, 201). This is realized through two main stages:

site planning and facility design. Location planning determines the strategic placement of the plant, considering access to raw materials, markets, and labor. Meanwhile, facility design focuses on structuring physical elements, such as machinery and equipment, regulating the flow of raw materials and products, and ensuring the safety and comfort of workers. With the right facility design, manufacturing companies can achieve efficiency, minimize waste, and improve product quality. This ultimately increases the company's productivity and profits in a sustainable manner (Hegab e al., 2023; Ciliberto et al., 2021; Challoumis, 2024; Fissi et al., 2021). CV Bayu Mandiri, is a company that focuses on printing services where serving various printing needs with a Make to Order system, where each order is printed specifically according to the needs and specifications provided by customers. CV Bayu Mandiri is committed to providing the best service with high-quality and timely prints. The products produced at CV Bayu Mandiri are quite diverse and each product has almost the same character and specifications of the production process, but there are special differences in each product.

CV Bayu Mandiri, although it has been operating for a long time, has never conducted a thorough evaluation of the layout of the production floor. This raises several problems that hinder the smooth and efficient production process. These problems include: 1) Unsupportive buildings: The layout of the building is not in accordance with the needs of the production process, thus hindering the flow of materials and workers; 2) Time inefficiency: There is a lot of wasted time due to suboptimal processes, such as wait times, idle time, and backsteps; 3) Difficulty in controlling inventory: An untidy and unorganized layout leads to difficulties in organizing and monitoring the inventory of raw materials and finished products; 4) Reduced productivity: There has been a decrease in production in some workplaces due to obstacles in the flow of materials and workers; 5) Uncomfortable workspace conditions: A crowded and untidy workspace makes workers uncomfortable and less productive; 6) Logistics inefficiencies: Too many people moving goods, bottlenecks in production, excessive temporary storage, and bottlenecks in the flow of goods; 7) Waste of space and time: An unoptimal layout leads to waste of processing space and time.

The above problems show that CV Bayu Mandiri urgently needs to change the layout of the production floor. Optimal layout rearrangement can increase efficiency, increase productivity, create a comfortable workspace, and reduce waste. At the time of observation at CV Bayu Mandiri, several disturbance factors have been found, namely the backtrack of inefficient material flow, where the material must be returned to the previous place so that there is an alternating current that hinders the production process. Then the accumulation of semi-finished goods on the production floor, thus hindering the flow of materials and workers (Oktalia et al., 2021; Fibriani et al., 2024). Plus operators who work double have to do several jobs at once, which can reduce productivity. The process of moving raw materials is a valuable activity because it will determine the bond or relationship between production facilities (Wignjosobroto, 2009; Sellitto et al., 2021; Wu et al., 2023). One of the efforts to make the transfer of raw materials go well is to implement layout arrangements as agreed by Heizer et al. (2018). Suboptimal material flow in the plant indicates the need for a redesign of the layout. The Systematic Layout Planning (SLP) method offers an effective solution by considering the space needs and available space.

Systematic Layout Planning (SLP) identifies and understands the relationships between activities and departments to design optimal layouts by helping to group work zones, reduce travel distances, and avoid overlapping activities (Cahyani, 2022). With existing considerations, the use of the SLP Method is an alternative to overcome layout problems and increase production efficiency. With in-depth analysis, relationship mapping, and a focus on space and material flow efficiency, SLP helps companies achieve higher productivity and create a better work environment. Systematic Layout Planning (SLP) or better known as

systematic layout planning, is a very important method in arranging workspaces in a manufacturing factory environment (Gao et al., 2023; Rodriguez & Oliveira, 2022). The main focus of SLP is to strategically place frequently used work areas and arrange them to have a close logical relationship with each other. Through this approach, SLP enables the most efficient flow of material during the production process, resulting in cost reductions and avoiding unnecessary or inefficient handling activities.

By carefully applying the principles of SLP, factories can increase their productivity and overall improve their operational efficiency (Anam, 2021). The application of SLP is often used to overcome various problems in the industry such as production, transportation, warehousing, assembly support services, and other office activities. In general, according to Wignjosoebroto (2009), in principle, the steps mentioned above can be broken down into three main stages according to Nugeroho (2021), namely the first stage, namely the analysis phase starting with conducting an analysis of material flows and activity relationships, this stage involves making a diagram of activity relationships and considering the needs of the area. The second stage is the research stage, which begins with planning the area relationship diagram and continues by developing various layout alternatives. Finally, the third stage in the selection process is to evaluate and select alternative layouts that have been planned.

Methods

Systematic Layout Planning (SLP) is an important method of organizing workspaces in a manufacturing plant environment. This method aims to strategically place frequently used work areas, so that they have a close logical relationship with each other. With this approach, SLP supports a more efficient flow of material during the production process, reduces costs, and avoids unnecessary or ineffective handling activities.

SLP consists of three main stages. The first stage is analysis, which includes the analysis of material flows and relationships between activities, including the creation of diagrams of activity relationships as well as the determination of area needs. The second stage is research, which involves planning area relationship diagrams and developing various layout alternatives. The final stage is selection, where alternatives to the layout that have been designed are evaluated and selected.

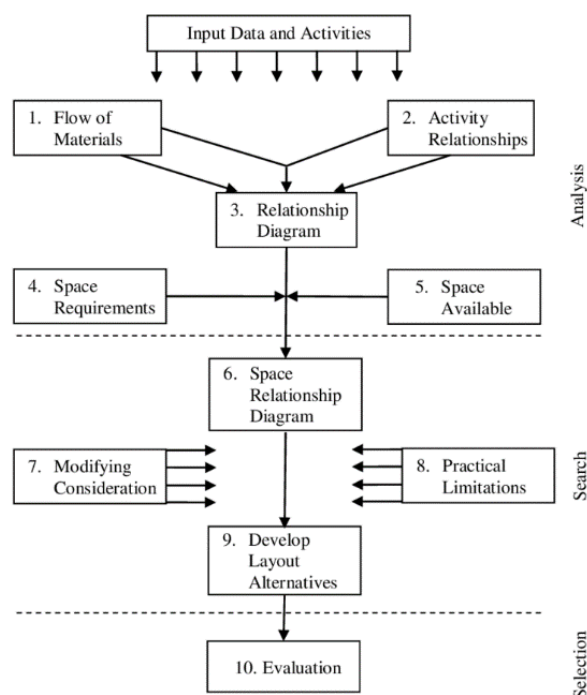


Figure 1. SLP Procedure

Operation Map

An operation process map is a map used to describe the operation flow that a product goes through with information on time, scrap and tools or machines used. Meanwhile, a process flow map is a map that describes all activities, both productive (operation and inspection) and unproductive (transportation, waiting, and storing), where the activities involved in the work implementation process are described in detail from start to finish.

Distance

Factory layout is a procedure for arranging facilities in factories to support the smooth production process. Measuring the distance between departments can be done by pulling the center point from one department to the axis of the path, and then pulling from this point to the center point of another department (Sanjaya, 2022). In this planning, distance measurement is essential to ensure efficiency and productivity. According to Santoso & Haryanto (2020) there are 6 ways to measure distance, namely:

Euclidean

$$d_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \quad (1)$$

Information:

d_{ij} = Distance between facilities I and J

x_i = X coordinates for facility i

x_j = X coordinates for facility j

y_i = Y coordinates for facility I

y_j = Y coordinates for facility j

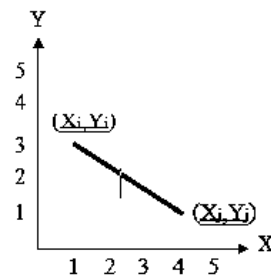


Figure 2. Euclidean Distance

Source: Purnomo (2004)

Square Euclidean

$$d_{ij} = [(x_i - x_j)^2 + (y_i - y_j)^2] \quad (2)$$

a. Rectilinear

$$d_{ij} = |x_i - x_j| + |y_i - y_j| \quad (3)$$

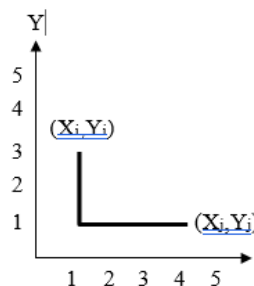


Figure 3. Rectilinear Distance

Source: Purnomo (2024)

Tchebychev

$$d_{ij} = \max (|x_i - x_j|, |y_i - y_j|, |z_i - z_j|) \quad (4)$$

Aisle

In the measurement of the distance of the factory layout, there is a difference between the aisle distance and the previous method of measuring the distance. The aisle distance is measured by calculating the actual distance along the track traveled by *the material handling equipment*. This method is particularly relevant in the context of manufacturing layouts. An example of the use of *aisle distance* is when you want to measure the distance from facility i to j. To reach this goal, you must go through routes a, b, c, and d. The distance measured is the total length of the track traveled by the material handling equipment during the journey from i to j through the specified route.

Adjacency

Adjacency is a method of measuring tools that help evaluate the layout of a facility. This measuring tool focuses on the proximity between facilities in the factory so that it has a weakness, namely it is difficult to distinguish between facilities that are not close together. This measuring tool is used in *the Systematic Layout Planning (SLP)* method to evaluate the layout of facilities.

Displacement

OHM

The formula of the OMH calculation can be seen as follows:

Material handling cost = distance x cost x frequency (5)

$$OHM/METER = \frac{\text{Operating costs per day}}{\text{distance per day}} \quad (6)$$

OMH Total = OMH x Distance (7)

$$Frekuensi = \frac{\text{Transferred units}}{\text{Capacity of transport equipment}} \quad (8)$$

Activity Relationship Chart

The Activity Relationship Chart establishes the relationship between machines or production facilities that are interconnected through a process of discussion and interviews with the operator concerned. The following is the procedure for a map of activity relationships to be constructed. 1) Identify all the facilities and work departments to be regulated; 2) Conduct interviews with relevant departments; 3) Describe the relationship and reason for each department to be laid out; 4) Evaluate the results with all relevant departments.

Table 3. Codes & Descriptions

Code	Description
1	Sharing notes
2	Using the same workforce
3	Using the same space area
4	Frequent personnel contact degrees
5	Degree of contact of frequently carried out paperwork
6	Workflow sequence
7	Carry out the same work activities
8	Using the same work equipment
9	Possible unpleasant odors, crowds, etc.

Source: (Wingjosoebroto, 2009)

Table 4. Codes & Relationships

Code	Relationship
A	Absolute
E	Very Important
I	Important
O	Enough
U	Not Important
X	Unwanted

Source: (Wingjosoebroto, 2009)

Activity Relationship Diagram

The first step is to enter the data obtained from the Activity Relationship Chart into a worksheet as seen in the data table below.

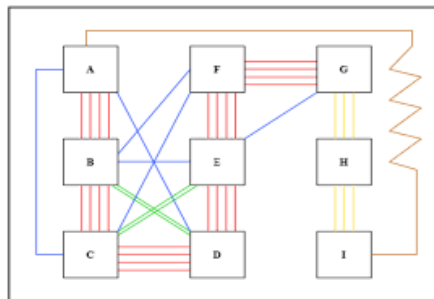


Figure 5. Activity Relationship Diagram

Source: (Wingjosoebroto, 2009)

Table 7. Code & Proximity Relationship

Code	Facilities	Area (m2)	Degree of Proximity				
			A	I	O	U	X
B	Design Room	23,7	C	D1, D2		A, D1, I, N, J, E, L, M, P	
C	CTP	5	D1, D2		A	E	G, I, N, J, L, M, P
D1	Heidelberg Engine	12,1	C, E	B, A, J, P	G, I, N, L, M	B, D2	
A	Material Warehouse	10,1		D1, G, D2, J	C, I, N	B, E, L, M, P	
G	Wehlerberg	2,4		A, J	D1, I, N, D2, E	L, M, P	C
I	Plong Machine	0,6		N, D2, J	D1, A, G	B, E, L, M, P	C
N	Assembly Table	16,8	P	J, L, M	D1, A, G, D2	B, E	C
D2	SM-52	10,4	C, E	B, A, I	G, N	D1, J, L, M, P	
J	Horizon Founding	2,1	P	D1, A, G, I, N		B, E, L, M	C
E	Remote	1	D1		G	B, C, A, I, N, J, L, M, P	
L	Junhans	1,3		N, M	D1	B, A, G, I, D2, J, E, P	C
M	Banding	1,2		N, L	D1	B, A, G, I, D2, J, E, P	C

P	Hot Print	0,36	N, J	D1		B, A, G, D2, E, L, M	C
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Source: (Wingjosoebroto, 2009)

Space Calculation

In the form of comparison results before and after changes to the layout on the production line.

Results and Discussion

Material Handling Equipment Data

The following is data on material handling equipment used in moving materials and mold production results on CV Bayu Mandiri

Table 8. Material Handling Equipment Data

Name	Sum	Depreciation Costs/Second	Maintenance Costs/Second	Operator Fees/Second	Total Material Handling Cost/Second
Manual	1	-	-	Rp. 6,34	Rp. 6,34
Trolley	2	Rp. 0,04	Rp. 0,03	Rp. 12,68	Rp. 12,75
Hand Pallet	2	Rp. 0,07	Rp. 0,13	Rp. 12,68	Rp. 12,88

Source: CV Bayu Mandiri (2024)

Distance Data Between Initial Facilities

The following are the results of measuring the distance between facilities in sequence according to the production flow at CV Bayu Mandiri.

Table 8. Facility Distance

No	From	To	Distance (M)
1	B	C	30.637
2	C	D	29.287
3	A	C	17.257
4	A	D	14.6
5	D	G	12.4
6	A	G	2.4
7	G	I	8.1
8	G	N	6.9
9	N	I	11.39
10	D	E	1
11	D	J	13.8
12	J	P	21.15
13	P	N	10.1
14	J	N	11.85
15	J	L	13.2
16	L	M	3.5
17	M	N	2

Source: Data processed (2024)

Displacement

Here is the data on the displacement in the production process for a month.

Table 9. Displacement

No	Department Code		Tool	Total Displacement (times/month)
	From	To		
1	B	C	No Tools	140
2	C	D	No Tools	53
3	A	C	Hand Pallet	10
4	A	D	Hand Pallet	82
5	D	G	Hand Pallet	82
6	A	G	Trolley	26
7	G	I	Hand Pallet	50
8	G	N	Hand Pallet	50
9	N	I	Hand Pallet	8
10	D	E	No Tools	196
11	D	J	Hand Pallet	13
12	J	P	Trolley	26
13	P	N	Trolley	26
14	J	N	Hand Pallet	13
15	J	L	Hand Pallet	5
16	L	M	Trolley	325
17	M	N	Trolley	78

Source: Data processed (2024)

Material Handling Costs

After going through observations and measurements in the field, it is known that the initial layout at CV Bayu Mandiri has problems with material movement that is too far and alternating currents in several facilities which causes considerable waste of material handling costs. Here are the details of the calculation on the initial layout:

Calculation of Labor Costs

The average salary of CV Bayu Mandiri employees on the production line is Rp. 4,750,000 per month. With 26 working days, the working duration is 8 hours on Monday-Friday and 5 hours on Saturday. The salary will be reduced to a daily salary, hourly salary, salary per minute, and salary per second.

Salary per day = (Rp. 4.750.000)/26= Rp. 182,692.3

Hourly salary = (Rp. 182.692,2)/8 = Rp. 22,836.5

Salary per minute = (Rp. 22.836,5)/60 = Rp. 380.6

Salary per day = (Rp. 380,6)/60 = Rp. 6.34

Depreciation Cost Calculation

In the process of moving materials, trolleys, and hand pallets are used. The use of assistive devices certainly has a depreciation value, so it is necessary to make calculations so that costs can be more controlled. The following is the depreciation calculation using the straight line method:

DT= (Harga Awal-Harga Sisa)/(Tahun Ekonomis)

The calculation for the entire material handling tool can be seen in the following table:

Table 10. Depreciation

It	Name	Sum	Starting Price	Age	Residual Price	Depreciation/Year
1	Trolley	2	Rp. 950.000	3	Rp. 350.000 x 2 units = Rp. 700.000	Rp. 200.000 x 2 units = Rp. 400.000
2	Hand Pallet	2	Rp. 2.650.000	3	Rp. 1.000.000 x 2 units = Rp. 2.000.000	Rp. 200.000 x 2 units = Rp. 660.000

Source: Data processed (2024)

Table 11. Depreciation data per second

Depreciation Value	Trolley	Hand Pallet
Per Year	IDR 400,000	IDR 660,000
Per Month	IDR 33,333.33	IDR 55,000
Per Day	IDR 1,282.05	IDR 2,115.38
Per Hour	IDR 160.25	IDR 264.42
Per Minute	IDR 2.67	IDR 4.4
Per Second	Rp. 0.04	Rp. 0.07

Source: Data processed (2024)

Calculation of Maintenance Costs

Based on the results of interviews with the company and related operators, a table has been prepared to calculate the monthly maintenance cost for each material handling tool. This maintenance cost includes routine expenses such as the purchase of oil, fuel, and other operational costs needed to support the performance of the tool.

Table 12. Maintenance Costs

Maintenance Costs	Trolley	Hand Pallet
Per Year	IDR 300,000	IDR 1,200,000
Per Month	IDR 25,000	IDR 100,000
Per Day	IDR 961.53	IDR 3,846.15
Per Hour	IDR 120.19	IDR 480.76
Per Minute	IDR 2	Rp. 8.01
Per Second	Rp. 0.03	Rp. 0.13

Source: Data processed (2024)

Total Equipment Cost Calculation

Table 13. Calculation of Equipment Costs

It	Name	Sum	Depreciation Costs/Second	Maintenance Costs/Second	Operator Fees/Second	Total Material Handling Cost/Second
1	Manual	1	-	-	Rp. 6,34	Rp. 6,34
2	Trolley	2	Rp. 0,04	Rp. 0,03	Rp. 12,68	Rp. 12,75
3	Hand Pallet	2	Rp. 0,07	Rp. 0,13	Rp. 12,68	Rp. 12,88

Source: Data processed (2024)

Initial Layout Material Handling Costs

After calculating the material handling components, it is then followed by the calculation of the initial layout material handling cost with the following formula:

Total Movement

$$= ((\text{Frekuensi Total Displacement} \times 2) - 1)$$

Total Cost

$$= \text{Time} \times \text{Cost} \times \text{Total Displacement}$$

Total Time

$$= \text{Time} \times \text{Total Displacement}$$

Total Distance

$$= \text{Distance} \times \text{Total Pergerakan}$$

Details of the initial OHM Layout calculation can be seen in the table below

Table 14. Overall Calculation of Initial Layout OHM

No	Facilities		Tool	Distance (cm)	Time (s)	Total Dis a Month	Cost	Total Movement	Total Cost of OHM/Month (Rp)	Total Time /month	Total Distance mh/month (cm)
	From	To									
1	B	C	No Tools	3064	26,47	140	Rp 6,34	279	Rp 46.821,72	7385	854856
2	C	D	No Tools	2929	24,86	53	Rp 6,34	105	Rp 16.549,30	2610	307545
3	A	C	Hand Pallet	1726	31,09	10	Rp 12,88	19	Rp 7.608,34	591	32794
4	A	D	Hand Pallet	1460	24,76	82	Rp 12,88	163	Rp 51.982,13	4036	237980
5	D	G	Hand Pallet	1240	19,52	82	Rp 12,88	163	Rp 40.981,07	3182	202120
6	A	G	Trolley	240	4,28	26	Rp 12,75	51	Rp 2.783,07	218	12240
7	G	I	Hand Pallet	810	9,28	50	Rp 12,88	99	Rp 11.833,11	919	80190
8	G	N	Hand Pallet	690	6,42	50	Rp 12,88	99	Rp 8.186,27	636	68310
9	N	I	Hand Pallet	1139	17,11	8	Rp 12,88	15	Rp 3.305,65	257	17085
10	D	E	No Tools	100	1,19	196	Rp 6,34	391	Rp 2.949,94	465	39100
11	D	J	Hand Pallet	1380	22,85	13	Rp 12,88	25	Rp 7.357,70	571	34500
12	J	P	Trolley	2115	27,76	26	Rp 12,75	51	Rp 18.050,94	1416	107865
13	P	N	Trolley	1010	8,03	26	Rp 12,75	51	Rp 5.221,51	410	51510
14	J	N	Hand Pallet	1185	18,21	13	Rp 12,88	25	Rp 5.863,62	455	29625
15	J	L	Hand Pallet	1320	21,42	5	Rp 12,88	9	Rp 2.483,01	193	11880
16	L	M	Trolley	350	3,95	325	Rp 12,75	649	Rp 32.682,39	2563	227150
17	M	N	Trolley	200	2,57	78	Rp 12,75	155	Rp 5.078,96	398	31000
Total/ Month				20958	269,77				Rp 269.738,74	26305	2345750

Source: Data processed (2024)

The initial layout analysis in the table above shows that the cost incurred by the company to move materials from one facility to another reaches Rp. 269,739 every month. The total distance traveled by the material in this moving process is 2,345,750 centimeters. The time required to complete all material removal activities is recorded at 26,305 seconds per month.

Proposed Layout Design

Create an Activity Relationship Chart (ARC)

After analyzing the factors that affect the proximity of activities. Therefore, a diagram of the relationship between facilities is made to provide a visual picture of the level of linkage between these activities

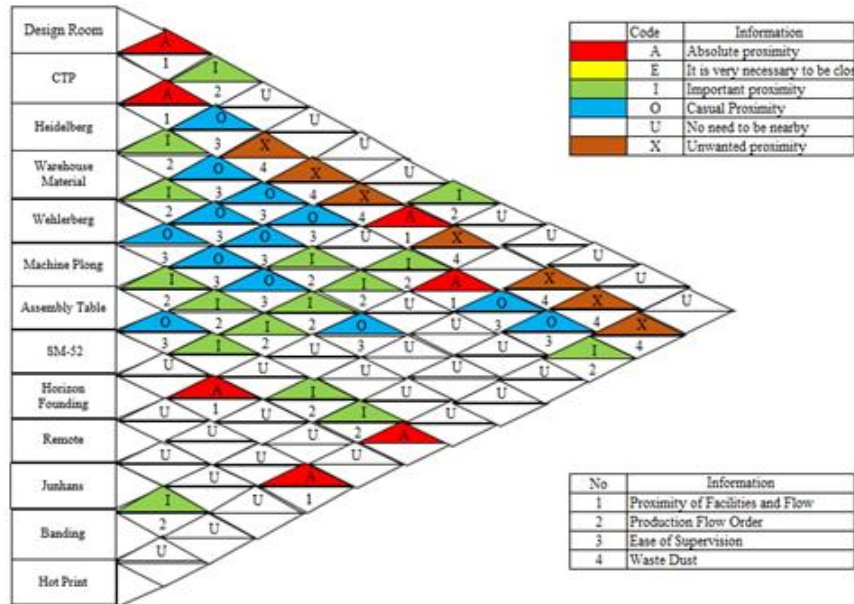


Figure 6. Activity Relationship Chart

Source: Data processed (2024)

From the results of ARC, it is necessary to redesign the layout to optimize material flow and increase production efficiency.

Creating an Activity Relationship Diagram (ARD)

Table 15. Activity Relationship Diagram Worksheet

Code	Facilities	Area (m2)	Degree of Proximity				
			A	I	O	U	X
B	Design Room	23,7	C	D1, D2		A, D1, I, N, J, E, L, M, P	
C	CTP	5	D1, D2		A	E	G, I, N, J, L, M, P
D1	Heidelberg Engine	12,1	C, E	B, A, J, P	G, I, N, L, M	B, D2	
A	Material Warehouse	10,1		D1, G, D2, J	C, I, N	B, E, L, M, P	
G	Wehlerberg	2,4		A, J	D1, I, N, D2, E	L, M, P	C
I	Plong Machine	0,6		N, D2, J	D1, A, G	B, E, L, M, P	C
N	Assembly Table	16,8	P	J, L, M	D1, A, G, D2	B, E	C
D2	SM-52	10,4	C, E	B, A, I	G, N	D1, J, L, M, P	

J	Horizon Founding	2,1	P	D1, A, G, I, N		B, E, L, M	C
E	Remote	1	D1		G	B, C, A, I, N, J, L, M, P	
L	Junhans	1,3		N, M	D1	B, A, G, I, D2, J, E, P	C
M	Banding	1,2		N, L	D1	B, A, G, I, D2, J, E, P	C
P	Hot Print	0,36	N, J	D1		B, A, G, D2, E, L, M	C

Source: Data processed (2024)

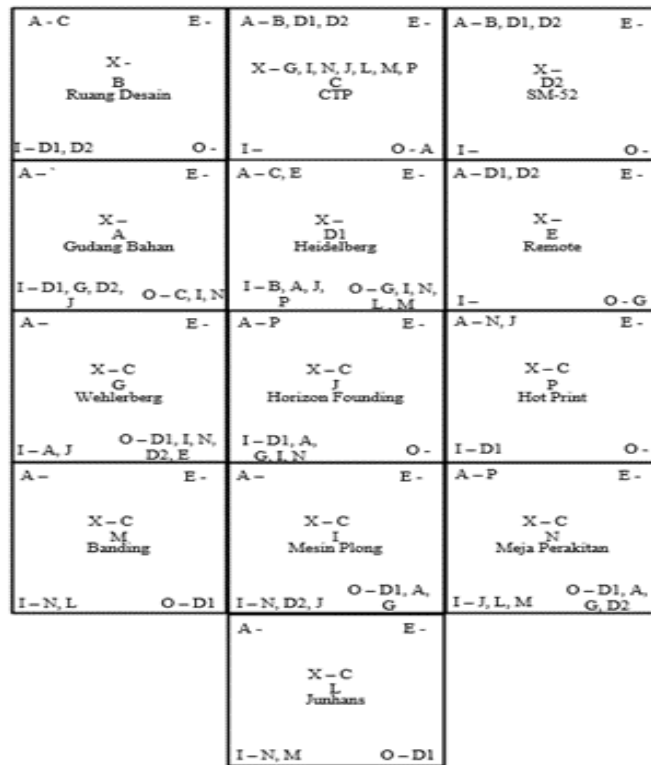


Figure 7. Activity Relationship Diagram

Calculation After Proposed Layout

Distance Data after Proposal

Table 16. Spacing After Proposal

No	Department Code		Distance (M)
	From	To	
1	B	C	8
2	C	D	6
3	A	C	9,5
4	A	D	14,6
5	D	G	16,35
6	A	G	1,4
7	G	I	5,5
8	G	N	5

9	N	I	5
10	D	E	1
11	D	J	16,7
12	J	P	1
13	P	N	3
14	J	N	7,3
15	J	L	16,1
16	L	M	3,5
17	M	N	2

Source: Data processed (2024)

Post-Proposal Displacement Data

Table 17. Displacement After Proposal

No	Department Code		Tool	Total Displacement (times/month)
	From	To		
1	B	C	No Tools	140
2	C	D	No Tools	53
3	A	C	Hand Pallet	10
4	A	D	Hand Pallet	82
5	D	G	Hand Pallet	82
6	A	G	Trolley	26
7	G	I	Hand Pallet	50
8	G	N	Hand Pallet	50
9	N	I	Hand Pallet	8
10	D	E	No Tools	196
11	D	J	Hand Pallet	13
12	J	P	Trolley	26
13	P	N	Trolley	26
14	J	N	Hand Pallet	13
15	J	L	Hand Pallet	5
16	L	M	Trolley	325
17	M	N	Trolley	78

Source: Data processed (2024)

Material Handling Costs After Proposal

By using the calculation formula as before, but for distance data, use data after the layout is changed. The calculation can be seen in Table 3.12 below.

Table 18. Calculation of OHM after proposal

No	Facilities		Tool	Distance (cm)	Time (s)	Total Dis a Month	Cost	Total Movmt	Total Cost /Month	Total Time month	Distance /month (cm)
	From	To									
1	B	C	No Tools	800	8,92	140	Rp 6,34	279	Rp 15.778,23	2489	223200
2	C	D	No Tools	600	6,21	53	Rp 6,34	105	Rp 4.134,00	652	63000
3	A	C	Hand Pallet	950	17,27	10	Rp 12,88	19	Rp 4.226,31	328	18050

4	A	D	Hand Pallet	1460	24,76	82	Rp 12,88	163	Rp 51.982,13	4036	237980
5	D	G	Hand Pallet	1635	24,52	82	Rp 12,88	163	Rp 51.478,27	3997	266505
6	A	G	Trolley	140	3,50	26	Rp 12,75	51	Rp 2.275,88	179	7140
7	G	I	Hand Pallet	550	7,31	50	Rp 12,88	99	Rp 9.321,13	724	54450
8	G	N	Hand Pallet	500	5,65	50	Rp 12,88	99	Rp 7.204,43	559	49500
9	N	I	Hand Pallet	500	13,39	8	Rp 12,88	15	Rp 2.586,95	201	7500
10	D	E	No Tools	100	1,19	196	Rp 6,34	391	Rp 2.949,94	465	39100
11	D	J	Hand Pallet	1670	16,85	13	Rp 12,88	25	Rp 5.425,70	421	41750
12	J	P	Trolley	100	1,31	26	Rp 12,75	51	Rp 851,83	67	5100
13	P	N	Trolley	300	2,38	26	Rp 12,75	51	Rp 1.547,60	121	15300
14	J	N	Hand Pallet	730	18,21	13	Rp 12,88	25	Rp 5.863,62	455	18250
15	J	L	Hand Pallet	1610	26,44	5	Rp 12,88	9	Rp 3.064,92	238	14490
16	L	M	Trolley	350	3,95	325	Rp 12,75	649	Rp 32.682,39	2563	227150
17	M	N	Trolley	200	2,57	78	Rp 12,75	155	Rp 5.078,96	398	31000
Total/ Month				12195	184,43				Rp 206.452,28	17894	1319465

Source: Data processed (2024)

The initial layout analysis in the table above shows that the cost incurred by the company after using the new layout is Rp. 206,452.28 every month. The total distance traveled by the material in the moving process is now 1,319,465 centimeters. The time required to complete all material removal activities after the proposal was recorded at 17,894 seconds per month.

Comparison of Initial and Proposed OHM Layout Results

Table 19. Comparison of OHM Measurement Results

Initial Layout				
OHM (Rp/Month)	Total Displacement Distance (cm/month)	Total Displacement Distance (m/month)	Total Migration Time (second/month)	Total Migration Time (minutes/month)
Rp. 269.738	2.345.750,00	23.457,50	26.305	438,41
Proposed Layout				
OHM (Rp/Month)	Total Displacement Distance (cm/month)	Total Displacement Distance (m/month)	Total Migration Time (second/month)	Total Migration Time (minutes/month)
Rp. 206.452	1.319.465	13.194,65	17.894	298,23

Source: Data processed (2024)

Conclusion

Based on the results of the analysis and redesign of the layout, it can be concluded that the optimization of the facility layout has a significant positive impact. This change succeeded in reducing the material transfer distance by 43.9% and the moving time by 31.98% per month. In addition, material handling costs decreased by 23.46%, from IDR 269,738 to IDR 206,452 per month. These results show that good layout planning not only improves operational

efficiency but also provides substantial cost savings, supporting the company's overall sustainability and productivity.

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