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FACILITY LAYOUT DESIGN USING FROM TO CHART (FTC) METHOD AND AUTOMATED LAYOUT DESIGN PROGRAM (ALDEP)

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ABSTRACT

This research is conducted in SMEs engaged in the convection of children's and adult clothing. The problems in this study related to the optimization of the layout of the facility. The study aims to determine and compare the distance of moving materials before and after designing the layout of the facility and determining the layout of the facilities obtained by the From to Chart (FTC) method and the Layout Design Program Algorithm method. (ALDEP). The researchers took this problem to study because the production process flow from Adelian convection is still not optimal due to the large number of alternating material flows that cause swelling in material handling costs, resulting in less effective and efficient work. The results of the study using the FTC method obtained that the distance for the movement of goods for the initial layout from the process starting to storage is 624 m. The distance of the movement of goods for the proposal layout from the start of the process to storage is 437 m. Therefore, there is a reduction in the distance between facilities from the start of the process to the storage of goods by 187 m. The results of the study using the ALDEP method could cost material handling costs of 30.01% from the comparison between OMH/month in the initial layout, which was Rp.26. 947,778 with OMH/month from the proposal layout, which was Rp. 18,861,310.8, so there was a decrease in OMH/month by Rp. 8,086,467.2.

Keywords: aldep, facility layout, from to chart, material handling cost

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1. INTRODUCTION

There are many SMEs with different types standing in Indonesia, and among them there are convection SMEs. Convection SMEs usually stand in residential areas where the availability of land is getting narrower from time to time, so it requires expensive investment costs to be able to build or rent a convection industry. The availability of narrow land results in convection not being good at arranging the layout of its production facilities so that the production process becomes ineffective and efficient, while facility layout is the field of selecting the most effective physical facility arrangements to enable greater efficiency in reducing the total cost of production activities (Suhardini and Rahmawati, 2019).

The research was conducted at the Adelian Convection SMES which produces children's and adult clothing such as robes, negligees, t-shirts and koko. In the production process, there are 3 main processes, namely pattern cutting (cutting), pattern joining/sewing (sewing), and finally the process of attaching buttons to packing (finishing). In Adelian convection, the production process is carried out from the initial process to the final process with an unfavorable layout of production facilities, which causes the production flow to become irregular, such as cabinets for cutting patterns with sewing sharing machines that are far apart. According to the production flow, the cabinets for cutting patterns with sewing sharing machines should be close together due to the successive flow of the production process. The current layout of the facilities that Adelian convection applies, causes the convection to be unable to maximize its production. The following is the production data for children's robes:

Table 1. Production of Children's Gamis

No	Month	Production (pcs)
1	July	2413
2	August	2402
3	September	2434
4	October	2419
5	November	2406
6	December	2389

A good layout is a facility layout that can minimize material handling costs (Tambunan et al., 2018). Material handling constraints are caused by inappropriate facility layout arrangements, in which facility layout design can contribute to making the production process more economical (Burggräf et al., 2021). The incompatibility of the facility layout on Adelian convection causes backtracking or backtracking. The backtracking problem is caused by several process flows that are considered unfavorable, such as the flow of materials moving from the cutting room to the sewing room, back to the cutting room, and then arriving at the finishing room.

The research conducted on the arrangement of the layout of the facilities on Adelian convection which is not suitable aims to provide suggestions for optimizing the layout of the facilities and the flow of materials for clothing production so that the production process runs effectively and efficiently. The method used in this study is the Automated Layout Design Program (ALDEP) method for setting the layout of the facilities and the From to Chart method for determining the flow of material transfer. ALDEP is an algorithm that is used when activity relationships are the main consideration (Karandikar et al., 2017). From to Chart is a diagram used to show the flow of material from one department to another (Barbara and Cahyana, 2021).

2. METHODS

The research object observed was the layout of the facilities in the production area at the Adelian convection. The variables in this study are related to the flow of materials, the order of the production process, the transfer of materials, the distance of material movement, and the total moment of material movement. This research has activities in the form of stages described in the following research procedures.

The data processing carried out in this research is making OPC and FTC, making block layouts, calculating the distance between departments, determining the frequency of transfers, calculating the total moment of movement, doing calculations using the From to Chart (FTC) method, making Activity Relationship Charts (ARC), and optimizing facility layouts with the Automated Layout Design Program (ALDEP) software.

The following are the calculation formulas used in the facility layout design:

a. Calculation of Distances Between Departments

Calculation of the distance between these departments starts from calculating the coordinates of the facilities by using the rectilinear formula as follows:

$x = \frac{x1+x2}{2}$ dan $y = \frac{y1+y2}{2}$ (1)

Information:

X1 = Top side of the department, *X2* = Underside of department, *Y1* = Left side of the department, *Y2* = Right side of the department

$dij = |Xi - Xj| + |Yi - Yj|$ (2)

Information:

dij = Distance between departments, *Xi* = X coordinate at facility I, *Xj* = X coordinate at facility j, *Yi* = Y coordinate at facility I, *Yj* = Y coordinate at facility j

b. Calculation of Total Moment Displacement

This calculation is carried out based on the results of calculating the distance between departments multiplied by the frequency of movements obtained from field observations

$Z = fxd$ (3)

Information:

Z = Total displacement moment, *F* = Displacement frequency, *d* = Distance between departments

c. Calculation of Material Handling Cost (OMH)

The following is the formula used to calculate material handling costs:

Tool Depreciation

$$Depreciation\ Tool = \frac{facility\ purchase\ price - facility\ of\ the\ remaining\ price}{economic\ times} \quad (4)$$

Facility purchase price = Expenditures for purchasing equipment, *The remaining price of the facility* = obtaining costs from sales after the end of its economic life, *Economic times* = Time of use (year x month x day x hour)

Cost of Material Handling Per Meter

3. FINDINGS AND DISCUSSION

3.1. Findings

Clothing production process activities are carried out in a production area that has an area of 114.3 m with a section length of 12.7 m and a width of 9 m. The following is the initial layout and facility dimension data for the production area of the Adelian convection:

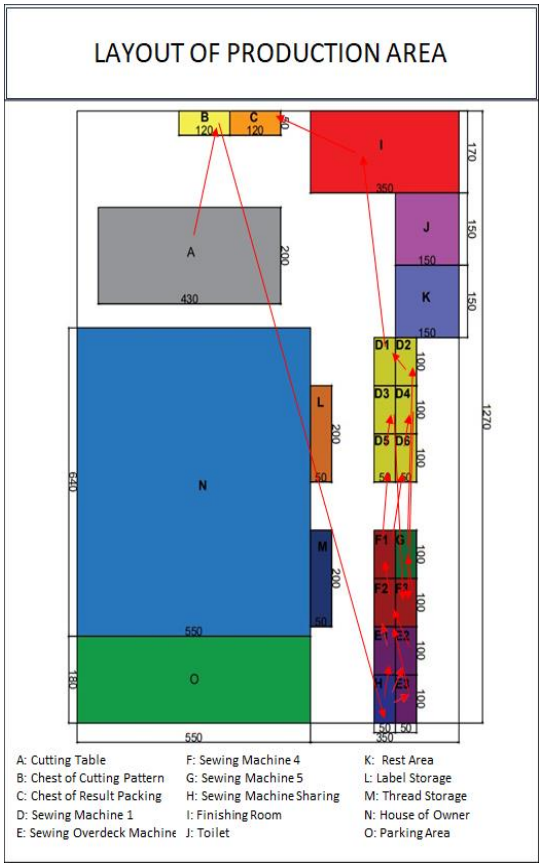

Figure 1. Initial Production Layout

From the data above, the block layout, distance between departments, and the total moment of movement are calculated by multiplying the transfer between departments by the frequency of movements. The frequency of movement is obtained from the results of field observations by looking at and counting directly how often goods are moved. The following is the result of calculating the distance between departments, the frequency of displacement, and the total moment of displacement:

Table 2. Total Movement of Moment

Material Flow	Movement Frequency	Distance of Departments (cm)	Total Movement (cm)
A-B	5	310	1550
B-H	5	1620	8100
H-E1	15	100	1500
H-E2	15	150	2250
H-E3	15	50	750
E1-F2	15	100	1500
E2-F2	15	150	2250
E3-F2	15	250	3750
F2-F1	15	100	1500
F1-D5	15	200	3000
F1-D6	15	250	3750
D5-D3	15	100	1500
D5-D4	15	150	2250
D6-D3	15	150	2250
D6-D4	15	100	1500
D3-F3	15	450	6750
D4-F3	15	400	6000
F3-G	15	100	1500
G-D2	15	400	6000
D2-D1	15	50	750
D1-I	5	435	2175
I-C	5	365	1825
Total	290	5980	62400

Furthermore, the calculation of material handling costs is carried out. The first step taken in determining the cost of material handling is calculating the depreciation of the equipment with the following results:

From the results of the calculations that have been done above, the cost of material handling per meter and per day can be calculated as follows:

Cost of Material Handling Per Meter

$$\frac{OMH}{m} = \frac{IDR\ 138.750 + 1.603{,}01}{78}$$

OMH/m = IDR. 1.799,4

Material handling costs per day

OMH / h = 624 m x Rp 1.799,4

OMH / h = IDR. 1.122.824,08

The From to Chart calculation is carried out based on the OPC and the total displacement moments that have been carried out previously. The results obtained from the total moment of displacement in one working day is 62,400 cm or 624m. The following is the result of the FTC calculation:

From / To	A	B	C	D1	D2	D3	D4	D5	D6	E1	E2	E3	F1	F2	F3	G	H	I	TOTAL
A																			
B	1550																		1550
C																		1825	1825
D1					750														750
D2																6000			6000
D3								1500	2250										3750
D4								2250	1500										3750
D5													3000						3000
D6													3750						3750
E1																	1500		1500
E2																	2250		2250
E3																	750		750
F1														1500					1500
F2										1500	2250	3750							7500
F3						6750	6000												12750
G															1500				1500
H		8100																	8100
I				2175															2175
TOTAL	1550	8100		2175	750	6750	6000	3750	3750	1500	2250	3750	6750	1500	1500	6000	4500	1825	62400

Figure 2. Calculation Result of FTC

The next step is to repair the layout using the Automated Layout Design Program (ALDEP) software by entering data such as facility dimensions and Activity Relationship Chart (ARC). The following are the ARCs used in this study:

NO	Activity	Degree of Importance
1	Cutting Table	
2	Pattern Cutting Chest	
3	Result Packing Chest	
4	Sewing Machine 1	
5	Sewing Overdeck	
6	Sewing Machine 4	
7	Sewing Machine 5	
8	Sharing Machine	
9	Finishing Room	
10	Toilet	
11	Rest Area	
12	Label Storage	
13	Thread Storage	

Figure 3. Activity Relationship Chart

These data are entered into the ALDEP software input so that optimal layout results are obtained with a TRC value of 1290 as follows:

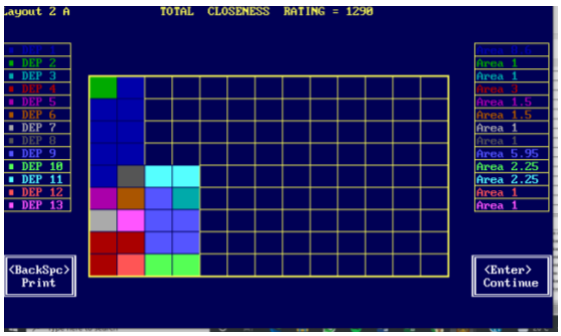

Figure 4. Software Result of ALDEP

From the results of data processing using the ALDEP software, a more optimal proposed

layout can be made with a TRC value of 1290. The following is a proposed layout from the results of calculations using ALDEP software.

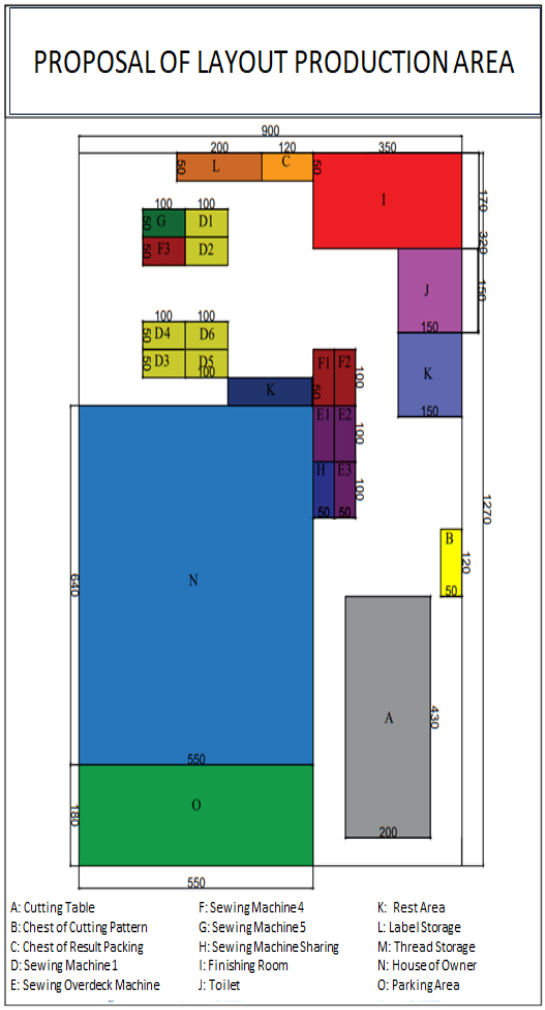

Figure 5. ALDEP Software Proposed Layout

From the proposed layout, we can calculate the total new displacement moments using the From to Chart method by making a travel chart for the steps of the method. It is obtained that the total moment of displacement in one working day for the proposed layout is 43,675 cm or 436.75 m. The following are the results of calculations using the FTC method.

After the total moment of movement of the proposed layout is obtained, then calculate the material handling costs to compare whether this proposed layout is proven to optimize the production process or not. The following is the calculation of material handling costs for the proposed layout.

OMH / h = Z x OMH / m
OMH / h = 436,75 x 1.799,4
OMH / h = 785.887,95

From the results of the analysis and calculations above, there is a difference between the initial layout and the proposed layout, which is located in facility A, which is a cutting machine. In the initial layout, the location of the facility has a distance from the storage pattern, namely facility B, but in the proposed layout, facility A and facility B are closer together. Furthermore, between facility B and facility H must be brought closer because the processes of the two facilities are related, so that facility B which is related to facility A in the ALDEP calculation must move positions because facility B is also related to the flow of production with facility H. The next comparison is on facilities F3 and G. In the initial layout the facilities were brought closer to F1 and F2, whereas in the proposed layout the facilities are placed far apart. The relocation of this facility is carried out so that the flow of the production process does not go back and forth so as to minimize material handling costs. The next comparison is in the thread storage area and the label storage area. For the two facilities, it is placed based on its use, such as thread storage which is placed in the middle of the sewing area because all sewing machines need thread and for label storage it is placed close to the D1 sewing machine because only that machine is used for labeling. The final difference lies in the D1 facility, where in the initial layout, if you want to go to the finishing room you have to go through the rest area and toilet, whereas if you want to go to the finishing room from the sewing area in the proposed layout, you don't need to go through the rest area and toilet. From the difference between the initial layout and the layout proposed by ALDEP above, it can minimize material handling costs so that the work is carried out more effectively and efficiently because there are shortened distances and pays more attention to the interrelatedness of process flows from interrelated processes.

Table 3. Comparison Initial Layout Between Proposed Layout

Calculation	Planning Layout	Proposed Layout	Change Precentage (%)
Total Movement	624 m	437 m	
OMH/day	IDR. 1.122.824,08	IDR. 785.887,95	
OMH/month	IDR. 26.947.778	IDR. 18.861.310,8	30,01%

From the comparison between the initial layout

and the proposed layout above, the difference from each calculation can be calculated. The following is the difference between the initial layout comparison and the proposed layout.
Difference Z= Z initial layout – Z layout proposed by ALDEP
Difference Z= 624 m – 437 m = 187 m

Difference OMH/day = OMH/day initial layout – OMH/day layout proposed by ALDEP
Difference in OMH/day = Rp. 1,122,824.08 – 785,887.9
Difference in OMH/day = Rp. 336,936.13

Difference of OMH/month = OMH/month of initial layout –OMH/month of layout proposed
Difference in OMH/month = Rp. 26,947,778 – 18,861,310.8
Difference in OMH/month = Rp. 8,086,467.2

3.2. Discussion

The results of the proposed layout by ALDEP experienced a decrease in material handling costs of Rp. 339,936.13 in one day and Rp. 8,086,467.2 in one month. So that from the decrease in OMH, ALDEP's proposed layout can be proposed to the Adelian convection to be applicable in the layout of its work facilities. This decrease in OMH can have a positive impact on the Adelian convection, which can increase production capacity which will have an impact on the company's sales results, minimize production time which will have a good impact on workers' wages, can increase the economic life of material handling equipment, and can solve problems that exist in the Adelian convection.

4. CONCLUSION AND SUGGESTION

Based on From to Chart calculations, the initial layout gets a value of 624 m. Meanwhile, in the proposed layout, the value generated from the From to Chart calculation is 437 m. From the initial layout and the proposed layout, there is a reduction in the displacement distance of 187 m. Optimization of facility layout using the Automated Layout Design Program (ALDEP) method can minimize material handling costs per one year by 30.01%. The percentage was obtained from comparing OMH/month from the initial layout of Rp.26,947,778 with OMH/month from the proposed layout of 18,861,310.8, resulting in a decrease in OMH/month of Rp. 8,086,467.2.

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