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Facility Layout Design At 'Mirasa' Crackers Smes Using Systematic Layout Planning Method And Blocplan Algorithm

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ABSTRACT

The cracker industry is a food processing industry that is spread across various regions in Indonesia, one of which is Small and Medium Industry (SMEs) Crackers 'MIRASA' Pekanbaru. At SMEs MIRASA Crackers there is a layout placement that is not in accordance with the production flow. This causes a decrease in productivity in SMEs where production activities become inefficient so that it takes a lot of time in the production process and there are bottlenecks at several stations. In designing the layout in this study, the Systematic Layout Planning (SLP) and BLOCPLAN methods were used to produce a systematic and efficient layout in increasing productivity and minimising distance transfer at MIRASA Crackers. The results of the calculation of the total displacement distance with the Systematic Layout Planning (SLP) method are 40.86 metres and 47.39 metres, while BLOCPLAN is 43.21 metres. From the results of these calculations, it is known that the proposed layout using the SLP method can minimise the path distance from the initial layout of 61.67 meters with a difference of 20.81 meters.

Keywords*: Layout Design, Distance, Systematic Layout Planning, BLOCPLAN Algoritm*

INTRODUCTION

The cracker industry is a food processing industry that is spread across various regions in Indonesia. As one of the typical Indonesian snacks, crackers are usually consumed by the community as snacks or complementary foods. The process of making crackers is relatively easy and the manufacturing costs are also small, so they are often produced in the household industry (Cahyani, et al., 2021).

Industrial development caused by the times and technological advances has resulted in a higher level of competition in the industrial sector. Small and medium industries (SMEs) play an important role in every country in helping to create jobs, boost the economy, and reduce poverty. One of the reasons why SMEs are measured as an instrument of growth, especially in developing countries, is because they can support entrepreneurship and innovation initiatives, which increase productivity and increase competition (Lita, et al., 2020).

Facility layout design is carried out to ensure the production process runs smoothly, prevent work accidents, optimise the movement of the workforce, and increase profits (Saputra, et al., 2022). Identical factors that must be considered in designing a layout are the distance between machines on the production floor and work stations in the production line (Nugroho, 2022). The purpose of the layout arrangement is so that the company can make good use of the area in placing production machines or supporting facilities, smooth flow of materials, material storage, workers and so on. The logic of the arrangement in the layout can be in the form of objective function provisions such as the total distance of material movement or the total cost of its movement (Nugrahadi, et al., 2023).

Small and Medium Industry (SMEs) of 'MIRASA' Crackers Pekanbaru is one of the food processing industries in Pekanbaru located at Jl. Rowo Bening, Sidomulyo Barat Village, Tampan District. There are two types of products produced,

including Palembang crackers and rice crackers. Cracker products produced at 'MIRASA' Crackers will previously pass the processing process starting from taking materials from storage, passing through various processes at several stations to the finished product. The area of each station at 'MIRASA' Crackers is as follows:

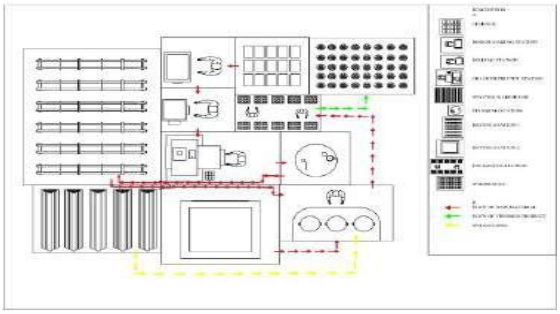


Figure 1. Initial Layout of MIRASA Crackers
Source : SMEs of 'MIRASA' Crackers Pekanbaru

Table 1. Area of Each Department

No	Description	Length (m)	Width (m)	Area (m)
1	Dough Making Station	1,00	1,36	1,36
2	Milling Station	1,00	1,36	1,36
3	Cracker Printer Station	2,50	1,90	4,75
4	Steaming Station	2,20	1,39	3,06
5	Drying Station 1	6,21	4,50	27,95
6	Drying Station 2	2,48	2,08	5,16
7	Frying Station	2,50	2,78	6,95
8	Packaging Station	1,90	1,62	3,08
9	Storage	2,60	3,23	8,40
10	Wooden Storage	4,29	2,42	10,38
11	Warehouse	2,60	2,71	7,05

In the placement of the layout of each station there is a placement that is not in accordance with the production flow, which results in the distance of the transfer of raw material flow at each station whose processes are sequentially far apart. This causes a decrease in productivity in SMEs where production activities become inefficient so that it takes a lot of time in the production process and there are bottlenecks at several stations such as the boiling station which then results in unfulfilled production targets. The placement of a layout that is not in accordance with the production flow also causes workers to get tired easily because they move materials manually with long distances at several stations.

From observations and interviews conducted with employees, it is known that there are several problems at several stations such as the location of the steaming station which is located deep in the production department, which results in a long distance from the next process flow, namely the drying station. Wood storage that is far from the boiling and frying stations causes workers to spend a lot of time fetching wood from the storage area. The packaging station and product storage room located in the centre of the production site also results in the lack of active movement of workers in the production section. That is because workers in charge of distributing products pass through the production floor to pick up finished products, which can hamper the production process and can make the products being produced contaminated by dust.

Layout design in this study was carried out using the Systematic layout planning (SLP) and BLOCPLAN Algorithm methods. the Systematic layout planning (SLP) method is used to redesign the layout of the production floor of a factory (Hartari and Herwanto, 2021). The data required in the Systematic layout planning (SLP) method is the initial layout, material flow, production activities, labour data, area, and number of existing machines or facilities. The stages

in the systematic layout planning method are collecting input data and activity data, analysing material flow and operational activities, analysing Activity Relationship Chart (ARC) relationships, making Activity Relationship Diagrams (ARD), the amount of area requirements needed, considering the area available at this time, making Activity Relationship Diagrams (ARD) and analysing material movement using From To Chart (FTC) which results in the total distance of material movement (Yulia and Cahyana, 2022). After that, proceed with the BLOCPLAN algorithm which stages start from inputting data on the size of the area of each station and the initial layout form of the company. Then determine the Activity Relationship Chart (ARC) and Activity Relationship Diagram (ARD), input the value of the symbol on the ARC, determine the score value for each department, and select the layout form from the five length and width ratios displayed on the BLOCPLAN (Sholekhah, et all., 2022).

This study aims to provide an effective facility layout proposal design at MIRASA Crackers SMEs in increasing productivity and minimising displacement distance by applying the Systematic Layout Planning (SLP) method and BLOCPLAN Algorithm which can produce a systematic and efficient layout in increasing productivity by minimising raw material displacement distance to increase production output.

METHODE

Data collection is done by conducting direct field observations where researchers conduct interviews and collect data such as the flow of the production process, the machines used, the area of each department, which will then produce an initial layout which is a description of the existing processes in SMEs. From the results of the initial layout, it can be seen the location of all departments and the flow of the production process, of which there are three flows in the production process, namely raw material flow, wood flow, and finished product flow. In the initial layout, problems can be seen in several departments by looking at the flow of the production process by paying attention to the level of proximity.

The method used in this study is the method of Systematic Layout Planning (SLP) and BLOCPLAN algorithm. in conducting data processing, the first step that needs to be done is to create a work map that is used as a tool to describe work activities (Dewanti, 2020). In this study used flow process chart that shows the sequence of the production process and its activities and contains information for analysis such as processing time and displacement distance (Ramadhan and Moengin, 2020). Furthermore, by making ARC, which is used to describe the level of connectivity between the activities of a production or department in the layout of the facility based on subjective considerations to be expressed in a qualitative assessment. The Activity Relationship Chart (ARC) facilitates research in determining which activities the placement of workstations are close together and which should be far apart (Amelia, et all., 2024). In making ARC, various alphanumeric codes are needed that indicate the degree of importance of the relationship of one activity to another. The alphanumeric code used is as follows:

Table 2. Alphanumeric Code ARC

Code	Define	Score	Description
A	Absolutely necessary	*81*	*Absolutely* necessary, adjacent
E	Absolutely necessary	*27*	Very important, close together
I	Important	*9*	Important, side by side
O	Ordinary	*3*	Normal, it doesn't matter

		position
U	Unimportant *1*	No need for connection
X	Undesireable *0*	Don't to be close each other

Figure 2. Research Methodology

Stages in the method of systematic planning layout (SLP) as in Figure 2, namely creating worksheets, calculating Total Closeness Rating (TCR), and creating block diagrams based on Activity Relationship Chart. TCR calculation is done to determine the highest to lowest rank as a guide in the placement of facilities. In calculating the value of TCR using the following formula (Wardhani, et al., 2024):

$$TCR=(A\times N)+(E\times N)+(I\times N)+(O\times N)+(U\times N)+...,. \quad (1)$$

Description:

N : Number of rooms than have the same degree of proximity value A

A : 34 = 81

E : 33 = 27

I : 32 = 9

O : 31 = 3

U : 30 = 1

X : 0

Activity Relationship Diagram (ARD) and Area Allocating Diagram (AAD) are continuous stages where ARD has been known to conclude the level of closeness between activities. The Area Allocation Diagram (AAD) describes the block template in general, in which there is information about the utilization of the area only, while the complete visualization image can be seen on the template which is the final result of the analyzer and planning of facility layout and material transfer (Zimartani, et al., 2023). After that, it is continued by making a From to Chart which is used to analyze the movement of materials to determine the relationship between cross-production and show the existence of dependence on one activity with other activities (Hartari and Herwanto, 2021).

The BLOCPLAN algorithm contains entire departments with long set forms and grouped in advanced mode. the data obtained in analyzing data with the BLOCPLAN algorithm is from graphs and Activity Relationship Chart (Santoso and Heryanto, 2020). the steps in the algorithm BLOCPLAN namely: determine the ARC and Activity Relationship Diagram, input the value of the symbol on the ARC, determine the score value in each department, and choose the shape of the layout of the five ratios of length and width displayed BLOCPLAN (Sholekha, et al., 2022).

RESULTS AND DISCUSSION

Work Map

Flow Process Chart (FPC) or process flow map is used to determine the sequence of Palembang crackers production process in 'MIRASA' Crackers SMEs. The following is the process flow map at 'MIRASA' Crackers SMEs

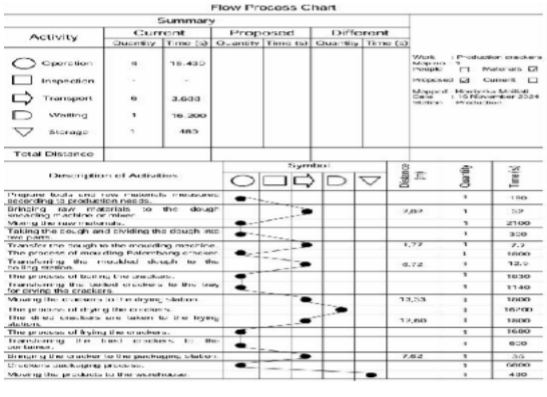


Figure 3. Flow Process Chart (FPC)
Source : SMEs of 'MIRASA' Crackers Pekanbaru

In the Fig.3 shows a process flow map that contains the production flow including the sequence of operations, inspection, waiting, transportation, and storage. Where the production process time for 16,430 seconds and a long waiting time of 16,200 on the drying activity

.

Activity Relationship Chart (ARC)

Activity Relationship Diagram (ARC) shows the relationship and level of closeness in each department in 'MIRASA' Crackers SMEs Pekanbaru as shown in Figure 4 below:

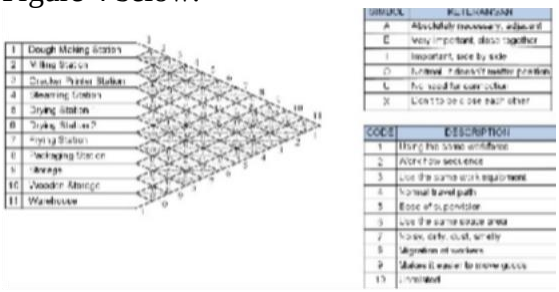


Figure 4. Activity Relationship Chart (ARC)
Source : SMEs of 'MIRASA' Crackers Pekanbaru

In fig. 4 contains information about the activity relationship at each station with Activity Relationship Chart (ARC) symbols and reason codes. as seen in the dough making station which really needs to be brought closer to storage because it uses the same labor, there is a sequence of work flow, normal travel paths, movement by workers to move raw materials so as to facilitate the movement of goods.

Total Closeness Rating (TCR)

Total Closeness Rating (TCR) is used to measure the level of closeness of the layout based on the Activity Relationship Chart (ARC) by performing a percentage of each closeness and calculating the Total Closeness Rating (TCR) using the calculation formula:

TCR=(A×N)+(E×N)+(I×N)+(O×N)+..,.. (1)

The recapitulation of Total Closeness Rating (TCR) calculation results are as follows

Tabel 3. Total Closeness Rating (TCR)

No	Facilities	A	E	I	O	U	X	TCR
1	Dough Making Station	1	1	1	1	6	-	126
2	Milling Station	1	1	-	2	6	-	120
3	Cracker Printer Station	1	1	1	2	5	-	110
4	Steaming Station	-	2	2	4	2	-	101
5	Drying Station 1	-	1	2	3	4	-	58
6	Drying Station 2	-	-	4	1	5	-	44
7	Frying Station	-	1	3	2	4	-	64
8	Packaging Station	-	1	1	2	6	-	48
9	Storage	1	-	-	3	6	-	96
10	Wooden Storage	-	1	2	-	7	-	70
11	Warehouse	-	1	-	2	7	-	40
	Total	4	10	16	22	58	-	877
	Percentage	3,64	9,09	14,55	20	57,72		100

Source : SMEs of 'MIRASA' Crackers Pekanbaru

Overall Block Diagram

Block diagrams are used to show the results of the degree of importance of the overall facility which simplifies the identification of each facility. The following is a block diagram for the entire department at 'MIRASA' Crackers SMEs Pekanbaru

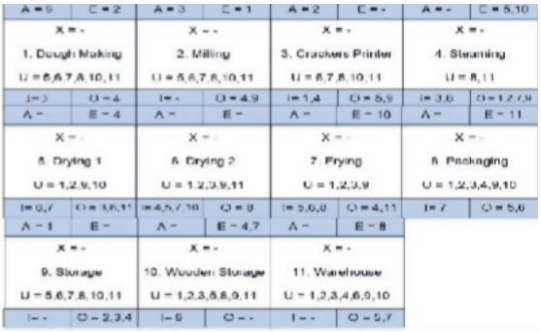


Figure 5. Block Diagram
Source : SMEs of 'MIRASA' Crackers Pekanbaru

Fig. 5 shows a summary of the results of the degree of importance of the overall facility based on the ARC in the form of blocks of each facility. The goal is to simplify the identification of each facility.

Area Relationship Diagram (ARD)

Based on the results of the Activity Relationship Diagram (ARD) which shows the proximity between departments, an Area Relationship Diagram (ARD) can be obtained:

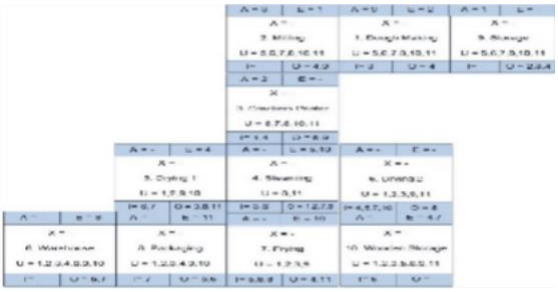


Figure 6 Area Relationship Diagram (ARD)

Source : SMEs of 'MIRASA' Crackers Pekanbaru

After knowing the Area Activity Diagram (ARD), it is continued by making an Area Allocation Diagram (AAD) which is designed globally by utilising the area only. The description of the Area Allocation Diagram (AAD) is as follows:

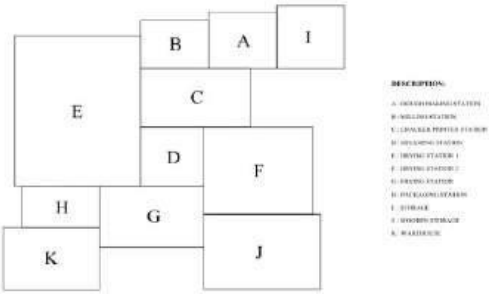


Figure 7. Area Allocation Diagram (AAD)
Source : SMEs of 'MIRASA' Crackers Pekanbaru

From to Chart

From To Chart (FTC) is used to find out what work stations are involved in production and analyse the interrelationship between cross-production on material movement. In the production of Palembang crackers at 'MIRASA' Crackers SMEs Pekanbaru, there are several processes in which the flow or stages of the process are:

I → A → B → C → J → D → E → F → G → H → K

The calculation of the distance between departments in the Palembang cracker production process is as follows:

Table 4. Distance between Departement

	Departemen		Departemen		Distance
	Area	Cout of arms	Area	Cout of arms	(m)
1	Storage	I	Dough Making Station	A	2,62
2	Dough Making Station	A	Milling Station	B	1,00
3	Milling Station	B	Cracker Printer Station	C	1,98
4	Cracker Printer Station	C	Steaming Station	D	2,65
5	Wooden Storage	J	Steaming Station	D	6,71
6	Steaming Station	D	Drying Station 1	E	6,29
7	Drying Station 1	E	Drying Station 2	F	9,93
8	Drying Station 2	F	Frying Station	G	5,27
9	Frying Station	G	Packaging Station	H	2,05
10	Packaging Station	H	Warehouse	K	2,36
		Total Distance			40,86

Based on the production flow in table 3, the From to Chart (FTC) of the distance between departments is as follows:

Table 5. From To Chart (FTC)

Ke	*I*	A	B	C	J	D	E	F	G	H	K	Total
I												0
A	2,62											2,62
B		1,00										1,00
C			1,98									1,98
J												0
D				2,65	6,71							9,36
E						6,29						6,29
F							9,93					9,93
G								5,27				5,27
H									2,05			2,05
K										2,36		2,36

Sumber : ditulis miring dan ukuran 9

Source : SMEs of 'MIRASA' Crackers Pekanbaru

Based on table 4, forward and backward analysis can be carried out in the study using the Systematic Layout Planning (SLP) method, namely the efficiency of the production flow can be said to be good because there is no alternating flow or crossover in the production flow:

BLOCPLAN Algorithm

The first step in running the BLOCPLAN algorithm is to enter Activity Relationship Diagram (ARC) data which includes the number of departments, names and areas of existing departments, after that input the proximity value between departments based on the Activity Relationship Diagram (ARC). After inputting the data, the BLOCPLAN software will show the score for each department followed by calculations on 20 alternative layout proposals that show the level of closeness and efficiency of the layout:

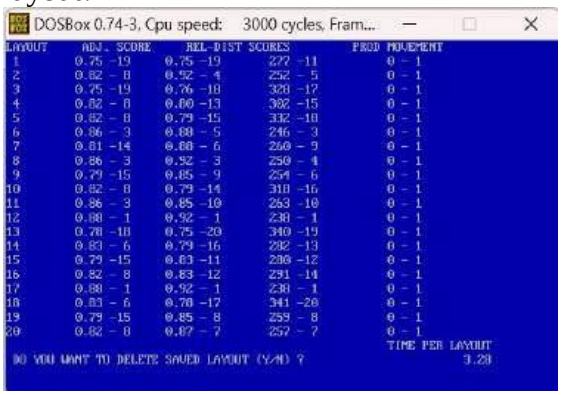
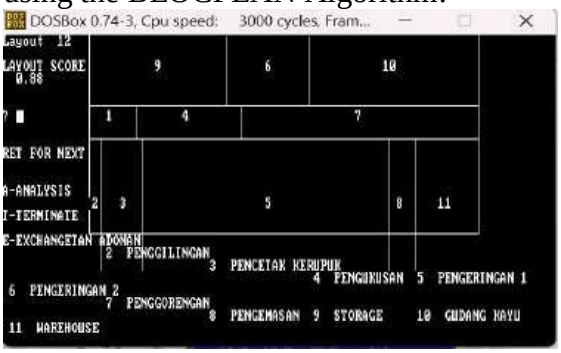


Fig. 8 BLOCPLAN Calculation Results

From the BLOCPLAN Algorithm calculation, it is known that the alternative layout is layout 12 with an Adj score of 0.88 and an R-score of 0.82, which indicates that the proposed layout 12 is the optimal layout. Here is the proposed layout using the BLOCPLAN Algorithm:



Source : SMEs of 'MIRASA' Crackers Pekanbaru

Fig. 9 BLOCPLAN Selected Layout

To determine the selected proposed layout that will be used in the study, it is determined on the smallest total displacement distance in each department. The following is the distance on the alternative use of Systematic Layout Planning (SLP) and BLOCPLAN:

Table 6. SLP and BLOCPLAN Process Flow Distance

Displacement	Material Handling	
	SLP	BLOCPLAN
I – A	2,62	2,62
A – B	1,00	1,00
B – C	1,98	1,98
C – D	2,65	2,36
J – D	6,71	6,91
D – E	6,29	6,20
E – F	9,93	7,91

F	–	G	5,27	4,96
G	–	H	2,05	6,96
H	–	I	2,36	2,31
Total			40,86	43,21

Sumber : ditulis miring dan ukuran 9

From the table above, it is known that from the comparison of displacement distances for each alternative, the alternative layout in the Systematic Layout Planning (SLP) method is the selected layout with the smallest total distance of 40.86 metres. The following is the selected proposed layout:

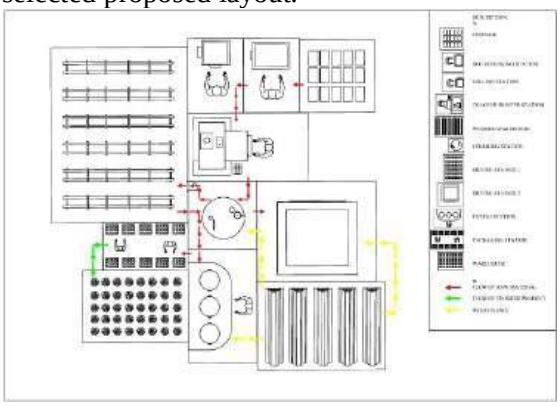


Fig. 10 Selected Layout
Source : SMEs of 'MIRASA' Crackers Pekanbaru

CONCLUSION

Based on the results of data processing layout design on SMEs MIRASA Pekanbaru crackers with Systematic Layout Planning method (SLP), the total distance of moving raw materials by 40.86 meters and the total distance of the use of algorithms BLOCPLAN by 43.21 meters. based on the results of data processing, it can be seen that the most optimal layout proposal is to use the proposed Systematic Layout Planning (SLP) with the smallest total displacement distance of 40.86 meters, a difference of 20.81 meters with the initial layout of MIRASA Pekanbaru crackers SMEs which has a total distance of 61.67 meters. In the layout of the selected proposal, it is known that several stations have activity relationships that need to be close and move departments that do not need links such as moving the wood warehouse to the production floor close to the boiling and frying stations, placing warehouses and packaging stations outside the production floor to make it easier for the distribution to take finished goods so as not to interfere with the production process, and positioning the production floor in accordance with the product layout type.

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