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To cite this article: I F Febriandini and Yuniaristanto 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **495** 012027

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# Re-design Facility Layout using Systematic Layout Planning Method: A Case Study : Biopro Cosmeceutical Sdn. Bhd.

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**Abstract.** High material handling costs can trigger inefficiency in company productivity. In the Biopro Cosmeceutical Sdn. Bhd. in Malaysia, as long as its sustainability results in high material handling costs, which amount to RM 45,793 per month. Material handling costs are classified as very high, therefore, re-layout is needed to reduce material handling costs by using Systematic Layout Planning (SLP) method. From the results of improvements in the layout of the facilities that have been carried out, a savings of 40% are generated or equal to RM 18,209 per month for alternatives 1 and 47% or amounting to RM 21,333 per month for alternatives 2.

## 1. Introduction

Biopro Cosmeceutical Sdn. Bhd. is a spin off company under Universiti Teknologi Malaysia (UTM) ICC (Innovation and Commercialization Center). This company focused in cosmetics and skin care. Products that have been produced by this company are serum, cleanser, BB cushion, lipstick, perfume, moisturizer, etc. The income generated by this company is approximately 1 million RM every year. Biopro was established in 2014, and because this company is relatively new, there are still many problems in it as one of the problems is in the planning of facility layout.

Factory layout planning is essential for manufacturing company when designing or redesigning production system [6]. Facility location planning (FLP) involves finding the most efficient facility locations on the factory floor in order to optimize objective functions [4]. Considering the product portfolio of the company, both variety and volume affects the characteristics of the problem, as the applied production system type basically relies on these factors. One can distinguish among cellular, process and product oriented systems that ask for different modeling approaches. Characteristic of the problem is the configuration of the layout, which stands for the general arrangement scheme of the resources [2].

The systematic layout planning (SLP) is a procedure implemented to set the layout of workplace in a plant based on the logical relationship between workplace with high frequency are placed close to each other [5]. SLP seeks to identify among several alternative layout proposals, the one that best fits the department's operational procedures and the institution's strategies [11]. SLP technique applied to optimize the existing layout. The application is expected to make the fastest material flow with the lowest cost and least amount of material handling [5].

The previous research about SLP is Benitez [1] that have optimized the radiologists' performance by analyzed the reporting workplace layout using systematic layout planning (SLP). The re-layout procedure consists of these three steps: analyzing the existing layout, designing plant layout based on Systematic Layout Planning and evaluation and selection of alternative layout [8].



The purpose of layout planning is to minimize Material Handling Costs (OMH). Material Handling Systems are basically carried out to improve the efficiency of material movement from one department to another. Decisions regarding the system and material transfer equipment must be based on careful considerations [7].

High material handling costs can reduce the productivity of the company. And high transfer costs will reduce company profits. therefore, this study aims to re-layout the Biopro Cosmeceutical Sdn. Bhd. in order to reduce the material handling costs.

There are several methods to improve the facility layout in the company, one of them is Systematic Layout Planning (SLP) method that was previously done by Suhardini [8]. In her research, Suhardini designed the layout design of PT. Gunaprima Budiwijaya, the aim is to increase its production capacity. And after that, it will increase the company's output and production capacity.

## **2. Method**

### *2.1. Assumptions*

The proposed method can be described on the basis of the assumption that the production of serum can represent all of the products flow production.

### *2.2. Scope of Problem*

This study was only studied based on one product, serum. Serum was chosen because serum has the highest demand for the company, which is 900 pcs per month. So that the flow production of the serum is considered to represent the company's production flow.

### *2.3. Systematic Layout Planning*

The method used in designing this company layout is SLP method. SLP is a procedure used to set the layout of facilities in the workplace based on the proximity and frequency relationship between one work station and another work station [8].

Data needed to conduct this research are:

- Initial layout of the company. Initial layout needed to analyze problems that occur during the production process based on the material flow and operating flow of the company.
- Production process flow of serum. Serum was chosen because it has the highest demand in the company, which is 900 pcs per month.
- Distance data between work stations
- Material handling activities that occur during the process of making serum.

The following are the stages of the stages used during the study.

## **3. Result**

In order to produce alternatives for improving the layout of Biopro Cosmeceutical Sdn. Bhd. the available area must be identified.



**Figure 1.** Initial Layout of Biopro Cosmeceutical Sdn. Bhd.

**Table 1.** Available area.

Available Area	Code	Dimension		Area (m <sup>2</sup> )
		Length (m)	Width (m)	
Raw Material Storage	RM	3.4	3.4	11.2
Packaging Material Storage	PM	3.7	3.4	12.3
Receiving Area / Quarantine Starting Material	RA	11.6	2.7	31.8
Change Room	CR	2.7	2.1	5.9
In Process Quality Control	IP	2.7	1.8	5.0
Mixing	M	2.7	1.8	5.0
Homogenizer	H	2.7	1.8	5.0
Dispensing	D	2.7	1.5	4.2
Buffer	B	2.7	1.5	4.2
Wash Area	WA	3.0	2.1	6.5
Clean Equipment	CE	3.0	1.8	5.6
Intermediate Room	IR	3.0	1.8	5.6
Filling	F	3.0	2.4	7.4
Labeling & Packaging	LP	3.4	3.0	10.2
Finish Product Storage 1	F1	2.7	2.4	6.7
Finish Product Storage 2	F2	2.7	2.1	5.9
Retain Sample	RS	2.7	2.1	5.9
Return and Reject Storage	RR	2.7	2.1	5.9
Quality Control	QC	2.7	2.7	7.5

Quarantine Finish Product and Cartooning Etc.	FC	3.7	2.4	8.9
				350.5
	<b>Total</b>			<b>511</b>

From the data above, it can be calculated the distance from station one to other stations, as shown in table 2 below

**Table 2.** Distance each stations

<b>From</b>	<b>To</b>	<b>Distance (m)</b>
RM	B	21.0
B	D	5.8
D	H	5.9
H	CE	8.1
CE	H	8.1
H	F	5.3
F	CR	10.4
CR	PM	24.2
PM	B	16.9
B	F	8.1
F	LP	2.9
LP	B	4.4
B	F1	29.9
<b>Total</b>		<b>151.1</b>

The material handling cost per meter produced by human power is RM 0.22. Material handling costs per meter produced by the stroller is RM 4.24. While the material handling costs generated with conveyors belt is RM 11.23 per meter.

So that the OMH produced in the company's initial layout is RM 45,793 per month. High enough for the cost of material handling every month.

**Table 3.** Initial material handling costs

<b>From</b>	<b>To</b>	<b>Component</b>	<b>MH/meter</b>	<b>Total MH/ month</b>
RM	RM	Raw Material	RM 4.24	RM -
RM	B	Raw Material	RM 4.24	RM 3,116
B	D	Raw Material	RM 0.22	RM 180
D	D	Raw Material	RM 0.22	RM -
D	H	Formula	RM 0.22	RM 183
H	CE	Tank	RM 0.22	RM 36
CE	H	Tank	RM 0.22	RM 36
H	H	Formula	RM 0.22	RM -
H	F	Tank	RM 0.22	RM 23
F	CR	Container	RM 0.22	RM 46

CR	PM	Container	RM	0.22	RM	107
PM	B	Container	RM	4.24	RM	12,895
B	F	Container	RM	0.22	RM	323
F	F	Serum	RM	0.22	RM	-
F	LP	Serum	RM	11.23	RM	5,861
LP	LP	Serum	RM	0.22	RM	-
LP	B	Serum	RM	0.22	RM	175
B	F1	Serum	RM	4.24	RM	22,814
<b>Total</b>					RM	45,793

Then, the results of the material handling costs in each activity are made into from to chart (FTC) table. The selected FTC table is an outflow table, this is due to the back production pattern, so that the resulting FTC table is as follows.

**Table 4.** Outflow FTC Table

<b>To From</b>	<b>RM</b>	<b>B</b>	<b>D</b>	<b>H</b>	<b>CE</b>	<b>F</b>	<b>CR</b>	<b>PM</b>	<b>LP</b>	<b>F1</b>
RM		0.1336								
B			0.9831			0.0546				-
D				3.0821						
H					1	0.0040				
CE				0.6045						
F							0.4298		33.4516	
CR								0.0083		
PM		0.5530								
LP		0.0075								
F1										

The results from the FTC output table are then made into priority scale tables (TSP). TSP table is made by sorting the largest to the smallest value on the station and given 1st and 2nd priority. As in the table below.

**Table 5.** Priority scale table

<b>Workstation</b>	<b>Code</b>	<b>Priority</b>	
		<b>I</b>	<b>II</b>
Raw Material Storage	RM	B	
Packaging Material Storage	PM	B	
Receiving Area / Quarantine Starting Material	RA		
Change Room	CR	PM	
In Process Quality Control	IP		
Mixer	M		
Homogenizer	H	CE	F
Dispensing	D	H	
Buffer	B	D	F

Wash Area	WA		
Clean Equipment	CE	H	
Intermediate Room	IR		
Filling	F	LP	CR
Labeling & Packaging	LP	B	
Finish Product Storage 1	F1		
Finish Product Storage 2	F2		
Retain Sample	RS		
Return and Reject Storage	RR		
Quality Control	QC		
Quarantine Finish Product and Cartooning	FC		

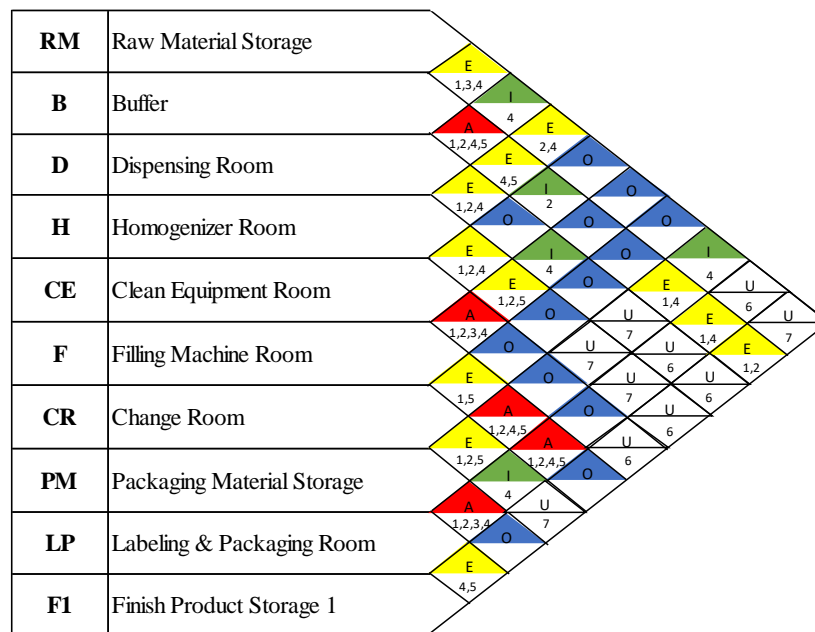
Then create Activity Relationship Chart (ARC) to provide a symbol to determine the degree of relationship between work stations. ARC is made for the following reasons:

**Table 6.** Reason for ARC

No		Reason
1	<b>Accepted</b>	Work flow sequence
2		Information flow
3		Easy transfer of goods
4		Using the same personel
5		Easy to monitor
6	<b>Push</b>	Work injury risk
7		Noisy

Symbol	Degree of Relationship	Reason
<b>A</b>	Absolutely Necessary	4 Reason Closer
<b>E</b>	Vary Important	2-3 Reason Closer
<b>I</b>	Important	1 Reason Closer
<b>O</b>	Enough	
<b>U</b>	Normal	1 Reason Away
<b>X</b>	Not Expected	2 Reason Away

So that ARC is produced as follows:



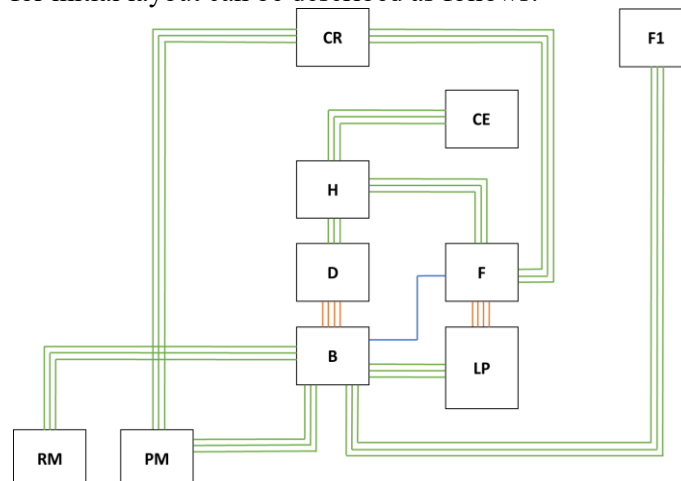
**Figure 2.** Activity relationship chart (ARC)

And the resulting relationships between stations are illustrated by the Activity Relationship Diagram (ARD) as follows:

**Table 7.** Reason for ARD

Symbol	Explanation
	A = Absolutely Necessary
	E = Vary Important
	I = Important
	O = Enough
	U = Normal
	X = Not Expected

So the resulting ARD for initial layout can be described as follows:

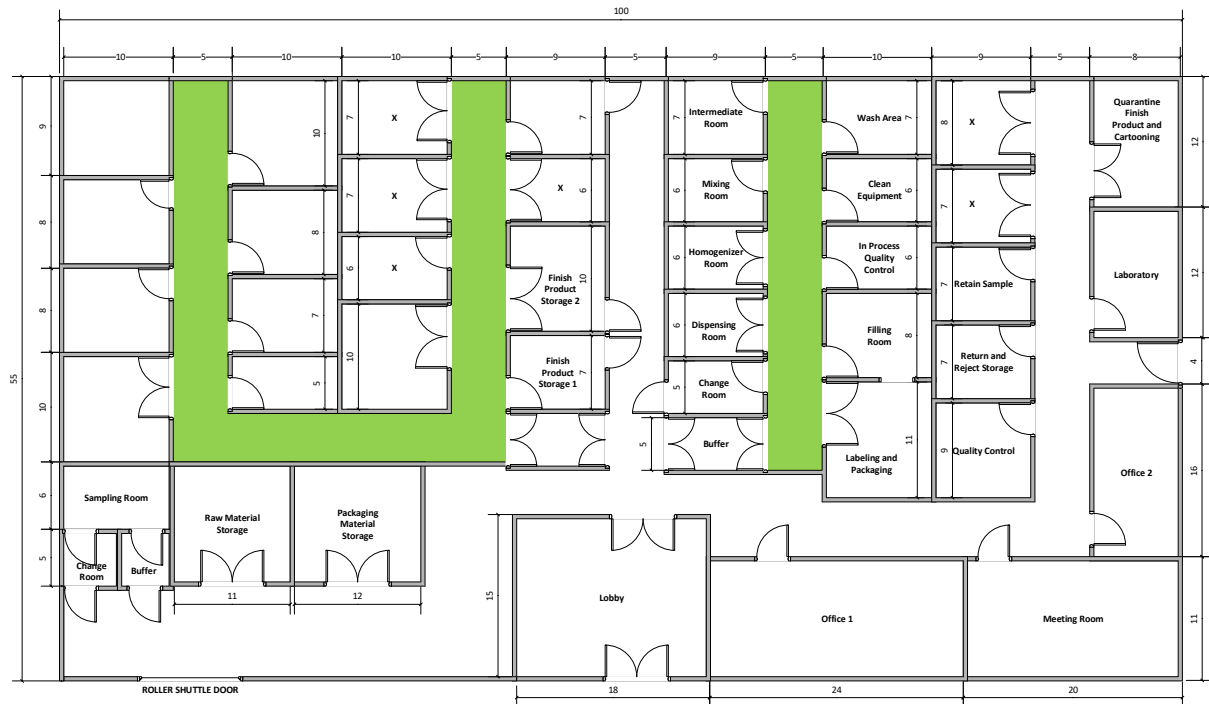


**Figure 3.** Activity relationship diagram (ARD)



After determining the ARC, the improvement can be made to re-layout the company. The parameter given to determine the improvement is the value of material handling costs.

### 3.1. 1<sup>st</sup> Alternative



**Figure 4.** Layout for 1<sup>st</sup> Alternative

A reshuffle is made at the location of the placement of several work stations. Work stations are moved based on the results of the TSP. Then the resulting distance between stations and the total OMH is as follows:

**Table 8.** Distance in 1<sup>st</sup> alternative

From	To	1st Alternative Distance (meter)
RM	B	21.0
B	D	6.7
D	H	6.1
H	CE	6.2
CE	H	6.2
H	F	6.6
F	CR	6.4
CR	PM	17.2
PM	B	16.9
B	F	7.3
F	LP	2.9
LP	B	4.4
B	F1	6.1
TOTAL		<b>114.1</b>

Based on the distance table on the first alternative, it can be seen that there is a reduction in distance at the distance from station H to CE is about 1.8 meters, then the distance from station F to CR station is reduced by 4 meters. The distance of the CR to PM station is reduced by 7 meters from the distance in the initial layout of the company. And, for the greatest reduction in distance is between B to F1 station, which is reduced 23.8 meters, from the previous distance of 29.9 meters, becomes 6.1 meters. So that the total distance produced in the process of serum production is 114.1 meters.

**Table 9.** Material handling costs in 1<sup>st</sup> alternative.

From	To	Komponen	Material Handling	MH/meter (j)	Total MH / month (k)=(i)x(j)
RM	RM	Raw Material	Stroller	RM 4.24	-
RM	B	Raw Material	Stroller	RM 4.24	3,121.03
B	D	Raw Material	Human	RM 0.22	206.53
D	D	Raw Material	Human	RM 0.22	-
D	H	Formula	Human	RM 0.22	187.76
H	CE	Tangki	Human	RM 0.22	27.49
CE	H	Tangki	Human	RM 0.22	27.49
H	H	Formula	Human	RM 0.22	-
H	F	Tangki	Human	RM 0.22	28.83
F	CR	Kontainer	Human	RM 0.22	28.16
CR	PM	Kontainer	Human	RM 0.22	75.77
PM	B	Kontainer	Stroller	RM 4.24	12,910.60
B	F	Kontainer	Human	RM 0.22	289.68
F	F	Cleanser	Human	RM 0.22	-
F	LP	Cleanser	Conveyor Belt	RM 11.23	5,853.17
LP	LP	Cleanser	Human	RM 0.22	-
LP	B	Cleanser	Human	RM 0.22	175.02
B	F1	Cleanser	Human	RM 4.24	4,652.47
<b>TOTAL</b>					<b>RM 27,584</b>

Hence, from the calculation, the total of material handling costs on 1st alternative is approximately RM 27,584 per month. Reduced by 40% of the total material handling costs of the company's initial layout. So, the result of 1st alternative can saving RM 18.209 each month.

### 3.2. 2<sup>nd</sup> Alternative



**Figure 5.** Layout for 2<sup>nd</sup> Alternative

In 2<sup>nd</sup> alternative, the production area is focused on the left side of the company. The reason is to bring the production area closer to raw storage material and packaging storage materials. In addition, by moving the production area to the left area of the company, it can reduce the noise produced by the engines from the production process and heard to the company administration area.

The distance between stations and the total material handling costs in 2<sup>nd</sup> alternative as follows:

**Table 10.** Distance in 2<sup>nd</sup> alternative.

From	To	2nd Alternative Distance (meter)
RM	B	13.9
B	D	4.7
D	H	6.9
H	CE	6.7
CE	H	6.7
H	F	4.7
F	CR	9.1
CR	PM	17.5
PM	B	10.4
B	F	7.8
F	LP	2.4
LP	B	5.3
B	F1	11.1
TOTAL		<b>107.3</b>

Based on the distance in the second alternative, it can be seen that almost all stations have a reduction in distance from the initial distance in the company. Stations that do not have a reduction in

distance is from station D to station H, which increases by 0.9 meters from the initial layout. And from the distance of the LP to B stations which increased by 0.9 meters from the initial layout.

**Table 11.** Material handling costs in 2<sup>nd</sup> alternative.

From	To	Komponen	Material Handling	MH/meter (j)	Total MH / month (k)=(i)x(j)
RM	RM	Raw Material	Stroller	RM 4.24	-
RM	B	Raw Material	Stroller	RM 4.24	2,058.07
B	D	Raw Material	Human	RM 0.22	145.51
D	D	Raw Material	Human	RM 0.22	-
D	H	Formula	Human	RM 0.22	211.23
H	CE	Tangki	Human	RM 0.22	29.50
CE	H	Tangki	Human	RM 0.22	29.50
H	H	Formula	Human	RM 0.22	-
H	F	Tangki	Human	RM 0.22	20.79
F	CR	Kontainer	Human	RM 0.22	40.23
CR	PM	Kontainer	Human	RM 0.22	77.11
PM	B	Kontainer	Stroller	RM 4.24	7,909.19
B	F	Kontainer	Human	RM 0.22	307.79
F	F	Cleanser	Human	RM 0.22	-
F	LP	Cleanser	Conveyor Belt	RM 11.23	4,928.98
LP	LP	Cleanser	Human	RM 0.22	-
LP	B	Cleanser	Human	RM 0.22	211.23
B	F1	Cleanser	Human	RM 4.24	8,490.75
<b>TOTAL</b>					<b>RM 24,460</b>

From the calculation, the total material handling costs was generated at RM 24,460 per month. Reduced by 47% of the total material handling costs of the company's initial layout. So, the result of 2<sup>st</sup> alternative can saving RM 21.333 each month.

To build a facility layout in the company with 1<sup>st</sup> and 2<sup>nd</sup> alternatives, investment is needed such as purchasing new doors, plywood boards for walls and the cost of repairmen or porters, as in the table below:

**Table 12.** Investment in 1<sup>st</sup> alternative.

No.	Investment	Cost	Quantity	Total
1	Material Cost	RM 62	4	RM 248
2	Workman	RM 80	3	RM 240
3	Paint	RM 50	2	RM 100
4	Overhead Costs	RM 30	1	RM 30
<b>Total</b>				<b>RM 618</b>

In the improvement layout of 1<sup>st</sup> alternative, 4 additional doors are needed in 4 different rooms. And 2 plywood boards to close the former wall of the door. So that it requires estimation of workmanship for 3 days. The costs of investment in 1<sup>st</sup> alternative was RM 618.

**Table 13.** Investment in 2<sup>nd</sup> alternative.

No.	Investment	Cost	Quantity	Total
1	Material Cost	RM 62	4	RM 248
2	Workman	RM 80	4	RM 320
3	Paint	RM 50	6	RM 300
4	Overhead Costs	RM 30	1	RM 30
<b>Total</b>				<b>RM 898</b>

The improvement of 2nd alternative, 4 additional doors are needed in 4 different rooms. And 6 plywood boards to close the used wall of the door. So that it takes an estimated workmanship for 4 days. The costs of investment in 2nd alternative was RM 898.

**Table 14.** Material handling costs comparison

From	To	Total MH per Month					
		Initial Layout		1st SLP		2nd SLP	
RM	RM	RM	-	RM	-	RM	-
RM	B	RM	3,116	RM	3,121	RM	2,058
B	D	RM	180	RM	207	RM	146
D	D	RM	-	RM	-	RM	-
D	H	RM	183	RM	188	RM	211
H	CE	RM	36	RM	27	RM	30
CE	H	RM	36	RM	27	RM	30
H	H	RM	-	RM	-	RM	-
M	F	RM	23	RM	29	RM	21
F	CR	RM	46	RM	28	RM	40
CR	PM	RM	107	RM	76	RM	77
PM	B	RM	12,895	RM	12,911	RM	7,909
B	F	RM	323	RM	290	RM	308
F	F	RM	-	RM	-	RM	-
F	LP	RM	5,861	RM	5,853	RM	4,929
LP	LP	RM	-	RM	-	RM	-
LP	B	RM	175	RM	175	RM	211
B	F1	RM	22,814	RM	4,652	RM	8,491
<b>TOTAL MH</b>		<b>RM</b>	<b>45,793</b>	<b>RM</b>	<b>27,584</b>	<b>RM</b>	<b>24,460</b>

#### 4. Conclusion

The effectiveness of the both alternatives above can be compared based on the material handling costs. The comparison can be seen from table XIV. It can be seen that material handling costs 1st and 2nd alternatives produce a smaller value compared to the initial costs. 1st alternative savings of 40% or RM 18,209 per month. And 2nd alternative savings of 47% or RM 21,333 per month. However, each alternatives still requires consideration of additional investment costs to improve the layout of the facility. In the 1st alternative, an investment of RM 618 is needed, while the 2nd alternative requires an investment of RM 898. So, from these results, it was decided to choose alternative 2 as the company's layout choice. This is because the profits generated can be long-term.

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## Acknowledgments

The research is supported by Institute for Research and Community Service, Sebelas Maret University with Hibah Riset Fundamental UNS (RF-UNS) Research Program (Contract No. 543/UN27.21/PP/2018).