New Layout Design for PT ABC Using Systematic Layout Planning and CORELAP Methods with ANN's Forecasting Production Capacity at Repackaging Company

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Abstract
PT ABC is a company engaged in manufacturing repackaging. PT ABC repackaged silicone sealant and continues to grow so that the company's current location does not have sufficient area and requires PT ABC to expand its production and storage area. Due to insufficient space, the current factory layout has an unorganized flow of manufacturing operations, causing the production process to become ineffective and inefficient. Due to a lack of space, PT ABC's raw materials and completed goods are also stacked haphazardly. As a result, the new factory's layout design is carried out utilizing Systematic Layout Planning (SLP) and CORELAP methodologies and the Artificial Neural Network (ANN) method for forecasting. The results were presented in two SLP alternative designs and one CORELAP method design. The optimal option is the shortest distance and lowest material handling expenses. The SLP 1 design, with a distance of 223.14 meters and a material handling cost of IDR 5,810,741.66 per week, is the most effective solution. ProModel simulation is used to put the layout into action.

Keywords:
Factory layout, Systematic Layout Planning, CORELAP, ANN

1. Introduction
Factory layout is arranging numerous facilities in a factory so that the production process can work properly. The area will be used to place machinery, production facilities, smooth material flow, and material storage in this factory layout. (Wignjosoebroto, 2009) This industrial layout's design aims to minimize total costs, such as the cost of transferring materials or material handling. (Arif, 2017)

PT ABC is a repacking manufacturing company. PT ABC is a growing company, and its current location is insufficient. The necessitates PT ABC to expand its production and storage facilities. Due to insufficient space, the factory layout currently has an unorganized flow of manufacturing operations, causing the production process to become ineffective and inefficient. Due to the lack of space, PT ABC's raw materials and completed goods are also put haphazardly.

The Artificial Neural Network (ANN) approach is used to forecast the company's future demand. As a result, the new location's production layout must be developed so that it becomes effective and efficient and is set to meet a high number of future requests. Systematic Plan Planning and CORELAP will be applied in this research, and the two methods will be compared to determine the optimal layout.

The goal of this study is to develop a new industrial layout design with a minimal displacement distance that is both effective and efficient and has a low Material Handling Cost.

2. Literature Review
The literature reviews that are used in this research are:

2.1 Material Handling
Material handling is the process of lifting, transporting, and placing materials in the industry, starting from the

first incoming material to the finished product. (Heragu, 2006) Material handling costs (OMH) are incurred when a material is moved from one work station to another. The following formula can be used to determine OMH: (Arif, 2017)

Total OMH= frequency x OMH/m x distance

2.2 Distance Measurement

Distance measurements are carried out using a rectilinear distance which can also be referred to as the Manhattan distance. The formula for the rectilinear distance is as follows: (Heragu, 2006)

$$dij = |x_i - x_j| + |y_i - y_j|$$

2.3 Artificial Neural Network (ANN)

Forecasting is done using the Artificial Neural Network (ANN) method. The artificial neural network is an information processing system similar to biological neural networks. Backpropagation is an ANN training method that uses a multilayer architecture with supervised training methods and has several units in one or more hidden layers. (Siang, 2005)

2.4 Systematic Layout Planning (SLP)

The SLP method uses both quantitative and qualitative inputs. Quantitative inputs such as distance and frequency of displacement, while qualitative inputs include the degree of activity relationship. (Heragu, 1997)

2.4.1 Operation Process Chart (OPC)

An operation process chart (OPC) shows the transformation of raw material into a final product. Only operations and inspection activities are documented in OPC; occasionally, storage is recorded at the end of the procedure. (Heragu, 1997)

2.4.2 Routing Sheet

A routing sheet is a list of the steps to produce a particular component. Routing sheets, also known as process sheets, calculate the number of machines required to create a certain quantity of items. The sequence of processes for each product, the type of equipment or machine utilized, the proportion of scrap, and the machine's efficiency are all needed to calculate this routing chart. (Apple, 1990)

2.4.3 Multi-Product Process Chart (MPPC)

The Multi-Product Process Chart is a diagram that can be used to analyze the flow of materials in a factory, whether it's an existing facility or one built. (Harahap, 2006)

2.4.4 From to Chart (FTC)

FTC (from-to chart) is a standard technique for plant layout planning and material transfer in a manufacturing process. On road maps, you'll typically see a from to chart that shows the entire weight of the load (Wignjosoebroto, 2003)

2.4.5 Activity Relationship Chart (ARC)

The Activity Relationship Chart (ARC) is a tool to visualize the interdependencies between activities and the proximity required between departments to reduce overall material movement. (Kiran, 2019) Table 1 shows the ARC Proximity Degree symbols: (Apple, 1990)

Table 1. ARC Proximity Degree Symbols

Symbol	Information	Color
A	*Absolutely necessary*	Red
E	*Especially important*	Yellow
I	*Important*	Green
O	*Ordinary*	Blue
U	*Unimportant*	White
X	*Undesirable*	Brown

2.4.6 Activity Relationship Diagram (ARD)

The Activity Relationship Diagram (ARD) displays the relationships between the activities of departments and machines depending on the priority degree of closeness to achieve the shortest possible movement distance. (Wignjosoebroto, 2003)

2.5 Computerized Relationship Layout Planning (CORELAP)

Computerized Relationship Layout Planning (CORELAP) calculates the busiest activities or those with the most links in the layout. The closeness links between activities are totalled and compared, with the highest number of total closeness ratings (TCR) being placed first on the layout matrix. The activities that should be nearby are then chosen and arranged as close to it as possible. These activities are marked A (Absolutely necessary), E (Especially important), I (Important), O (Ordinary), U (Unimportant), and X (Undesirable). This degree of closeness is converted into a score (number) for A= 5, E=4, etc. The CORELAP method chooses workstation placements based on the proximity relationship rating represented in the Total Closeness Rating (TCR). TCR represents the total number of numerical values derived from a systematic close connection rating. (Apple, 1990)

The CORELAP method is divided into the following steps: (Kiran, 2019)

1. For each department, calculate the Total Closeness Rating (TCR). The TCR is calculated by adding all of the associated letters in each department translated to numbers.
2. The department with the highest TCR is chosen to be the first to be placed in the layout's centre. If the TCRs are the same, the department with the smallest number will be chosen first; if the areas are the same, the department with the smallest number will be chosen first.
3. Placing the departments with A linkages around the selected departments and then linking E, I, O, U, and X. If there are any identical, the conditions are the same as before. Locations close to the department will be multiplied by 1, and locations with diagonal positions will be multiplied by 0.5 when determining placement.
4. Continue iterating until all departments have adopted the new design. The iteration's outcome will be utilized to build the layout, considering specified factors.

2.6 ProModel Simulation

Promodel is a simulation program that allows users to model a discrete-event process system. Locations, entities, arrivals, processing resources, and network paths are the basic elements of the promodel. A location represents a defined place in which entities participate in activities. Products, raw materials, semi-finished commodities, and even humans are examples of processed things in the system. Arrival is a mechanism that explains how entities enter the system, while processing is a processing element that establishes each entity's itinerary and the actions they encounter at each destination. A path network is a tool used to determine the direction and path travelled by the entity while it moves. In contrast, resource refers to the resources utilized to accomplish particular action**s.** (Harrel, 2011)

3. Methods

The methods that have been done in this research can be seen in the flowchart in Figure 1.

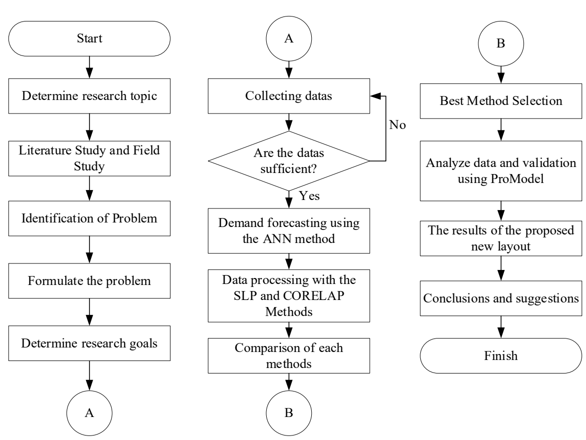

Figure 1. Method Flow Chart

4. Data Collection

The previous factory layout is seen in Figure 2, along with a three-year request for silicone sealant cartridges than can be seen in Table 2.

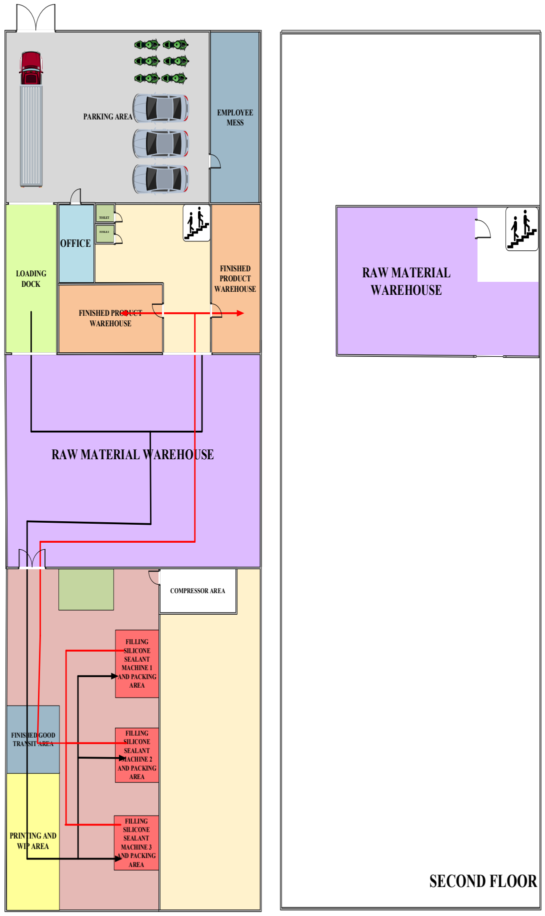

Figure 2. The Previous Factory Layout

Flow Description:

1. The flow of raw materials for creating silicone sealant from the raw material warehouse to the printing and filling process is represented in black.
2. The flow of the finished silicone sealant product until it is kept in the finished goods warehouse is represented in red.

Table 2. Three-Year Request for Silicone Sealant Cartridge

No	Year	Month	Amount (Pcs)
1	2018	September	231,696
2		October	182,760
3		November	173,376
4		December	205,632
5	2019	January	105,384
6		Ferbuary	164,832
7		March	192,072
8		April	134,784
9		May	240,384
10		June	304,224
11		July	220,200
12		August	180,312
13		September	208,392
14		October	249,024
15		November	160,248
16		December	140,520
17	2020	January	156,888
18		Ferbuary	101,880
19		March	185,904
20		April	107,832
21		May	88,320
22		June	95,304
23		July	119,376
24		August	67,032
25		September	98,376
26		October	148,296
27		November	102,384
28		December	125,232
29	2021	January	268,464
30		Ferbuary	225,024
31		March	185,904
32		April	226,776
33		May	104,256
34		June	116,496
35		July	109,560
36		August	129,336
TOTAL			5,856,480

5. Results and Discussion

5.1 Artificial Neural Network Forecasting

The ANN forecasting method is used in this research to forecast demand for the next five periods. The forecasted results for the next five periods are listed in Table 3, and the graph can be seen in Figure 3.

Table 3. Forecasting Results for the Next 5 Periods

Periods	Month-Year	Normalization Number	Forecasting Result (Pcs)
4	Sep-21	0.1154	94,404
	Oct-21	0.0076	68,835

Periods	Month-Year	Normalization Number	Forecasting Result (Pcs)
	Nov-21	0.1049	91,914
	Dec-21	0.0076	68,835
	Jan-22	0.0792	85,818
	Feb-22	0.9350	288,807
	Mar-22	0.3845	158,233
	Apr-22	0.4623	176,686
	May-22	0.7948	255,553
	Jun-22	0.1963	113,593
	Jul-22	0.9615	295,093
	Aug-22	0.2326	122,203
5	Sep-22	0.6363	217,958
	Oct-22	0.1722	107,877
	Nov-22	0.0190	71,539
	Dec-22	0.4719	178,963
	Jan-23	0.0055	68,337
	Feb-23	0.4439	172,322
	Mar-23	0.0065	68,574
	Apr-23	0.0214	72,108
	May-23	0.1860	111,150
	Jun-23	0.0116	69,784
	Jul-23	0.9862	300,951
	Aug-23	0.2106	116,985
6	Sep-23	0.7890	254,177
	Oct-23	0.1744	108,399
	Nov-23	0.2185	118,859
	Dec-23	0.5667	201,449
	Jan-24	0.4302	169,072
	Feb-24	0.5972	208,684
	Mar-24	0.0368	75,761
	Apr-24	0.4789	180,624
	May-24	0.0065	68,574
	Jun-24	0.0193	71,610
	Jul-24	0.9085	282,521
	Aug-24	0.0793	85,842
7	Sep-24	0.5268	191,985
	Oct-24	0.0199	71,753
	Nov-24	0.0719	84,087
	Dec-24	0.1653	106,240
	Jan-25	0.2256	120,543
	Feb-25	0.5850	205,790
	Mar-25	0.1730	108,067
	Apr-25	0.8937	279,011
	May-25	0.0153	70,662
	Jun-25	0.1161	94,570
	Jul-25	0.8329	264,590
	Aug-25	0.2229	119,903
8	Sep-25	0.4459	172,796
	Oct-25	0.0404	76,615
	Nov-25	0.0683	83,233
	Dec-25	0.0272	73,484
	Jan-26	0.0291	73,935
	Feb-26	0.1292	97,678

Periods	Month-Year	Normalization Number	Forecasting Result (Pcs)
	Mar-26	0.2843	134,466
	Apr-26	0.9006	280,648
	May-26	0.0115	69,760
	Jun-26	0.3140	141,511
	Jul-26	0.9083	282,474
	Aug-26	0.7162	236,909
TOTAL			**8,642,804**

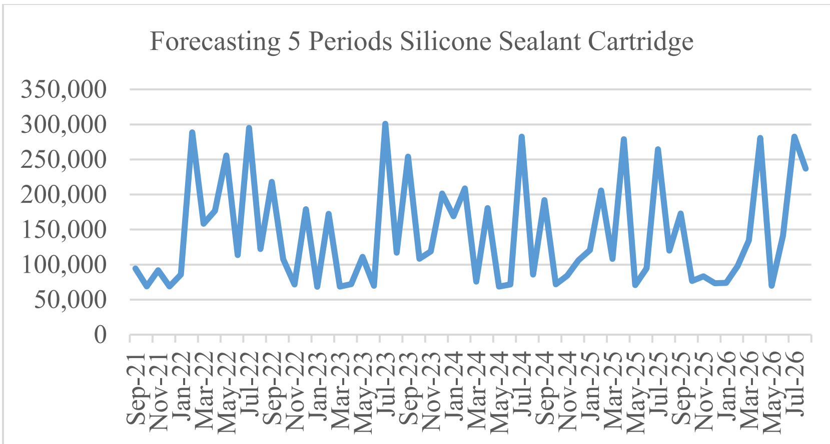

Figure 3. Forecasting Graphs for Silicone Sealant Cartridge Products for The Next 5 Periods

5.2 Systematic Layout Planning (SLP) Method

5.2.1 Operation Process Chart (OPC) and Routing Sheet

The following are OPC which can be seen in Figure 4, and the routing sheet of cartridge silicone sealant, which can be seen in Table 4

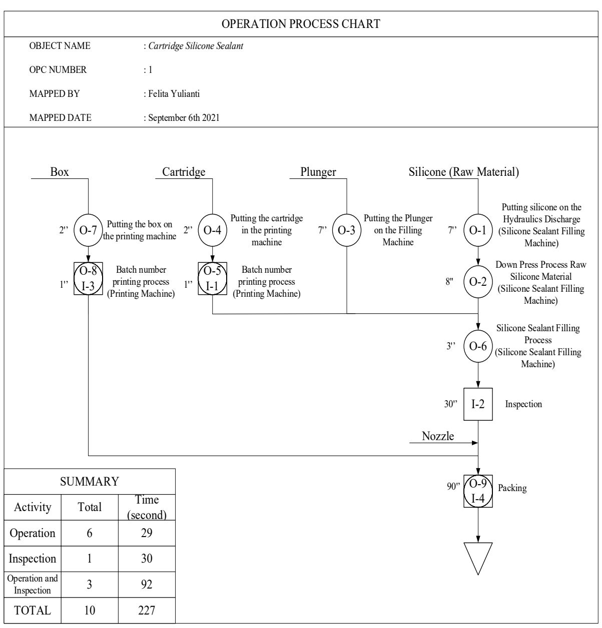

Figure 4. OPC of Cartridge Silicone Sealant

Table 4. Routing Sheet Cartridge Silicone Sealant

Operation	Operation Name	Machine/ Tool	Standard Time (Second)	Machine Set Up Time (Second)	Scrap (%)	Quantity Requested (Pcs)	Quantity Provided (Pcs)	Reability (%)	Quantity after Reability (pcs)	Efficiency (%)	Quantity after efficiency (pcs)	Theoretical Machine Capacity/ Week	Number of theoretical machines/ Week (units)
Raw Silicone Material													
O-1	Putting silicone on the Hydraulics Discharge	Hand	7	0	0	36,747	36,747	95	38680.99	95	40716.83	20571.43	1.97929033
O-2	Down Press Process Raw Silicone Material	Silicone Sealant Filling Machine	8	600	2	36,012	36,747	95	38680.99	95	40716.83	17925.00	2.27151072
Plunger													
O-3	Putting the Plunger on the Filling Machine	Hand	7	0	0	36,012	36,012	95	37907.37	95	39902.49	20571.43	1.93970452
Cartridge													
O-4	Putting the cartridge in the printing machine	Hand	2	0	0	36,012	36,012	95	37907.37	95	39902.49	72000.00	0.55420129
O-5	Batch number printing process	Printing Machine	1	120	0	36,012	36,012	90	40013.33	90	44459.26	143880.00	0.30900236
Filling Silicone Sealant													
O-6	Silicone Sealant Filling Process	Silicone Sealant Filling Machine	3	3600	2	36,012	36,747	85	43231.69	85	50860.81	46800.00	1.08676955
Box													
O-7	Putting the box on the printing machine	Hand	2	0	0	36,012	36,012	95	37907.37	95	39902.49	72000.00	0.55420129
O-8	Batch number printing process	Printing Machine	1	120	0	36,012	36,012	90	40013.33	95	42119.30	143880.00	0.29273908
O-9	Packing Process	Hand	90	120	0	36,012	36,012	95	37907.37	95	39902.49	1598.67	24.9598581

5.2.2 Multi-Product Process Chart (MPPC) and From to Chart (FTC)

The following are MPPC which can be seen in Figure 5, and FTC of cartridge silicone sealant, which can be seen in Table 5, along with the FTC Symbol, which can be seen in Table 6.

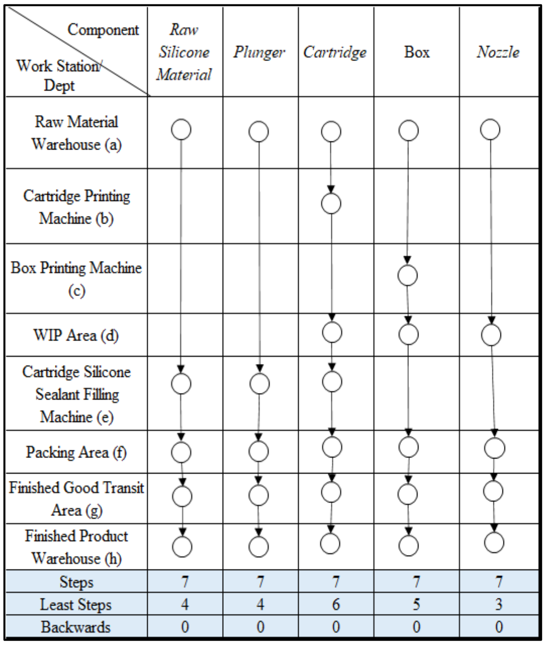

Figure 5. MPPC *Cartridge Silicone Sealant*

Table 5. From to Chart Cartridge Silicone Sealant

From \ To	a	b	c	d	e	f	g	h	Total	PP
a		36.012	36.012 72.024	36.012 108.036	72.759 291.036				180.795	507.108
b				36.012 72.024					36.012	72.024
c				36.012					36.012	36.012
d					36.012	72.024 144.048			108.036	180.060
e						108.771			108.771	108.771
f							180.795		180.795	180.795
g								180.795	180.795	180.795
h									0	0
Total	0	36.012	36.012	108.036	108.771	180.795	180.795	180.795	831.216	
PP	0	36.012	72.024	216.072	327.048	252.819	180.795	180.795		1.265.565

Table 6. FTC Symbol

Station Name	Symbol
Raw Material Warehouse	a
Printing Cartridge Machine	b
Box Printing Machine	c
WIP Area	d
Cartridge Filling Silicone Sealant Machine	e
Packing Area	f
Finished Good Transit Area	g
Finished Product Warehouse	h

5.2.3 Activity Relationship Chart (ARC)

The following are ARC of the production floor, which is shown in Figure 6 and the entire PT ABC as shown in Figure 7

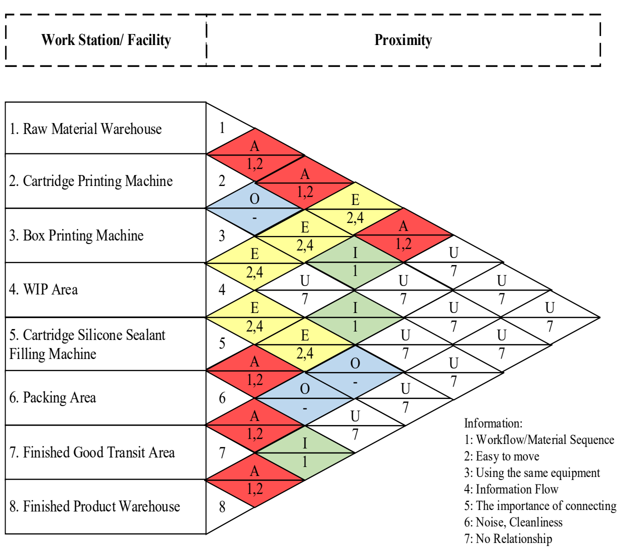

Figure 6. ARC of the Production Floor

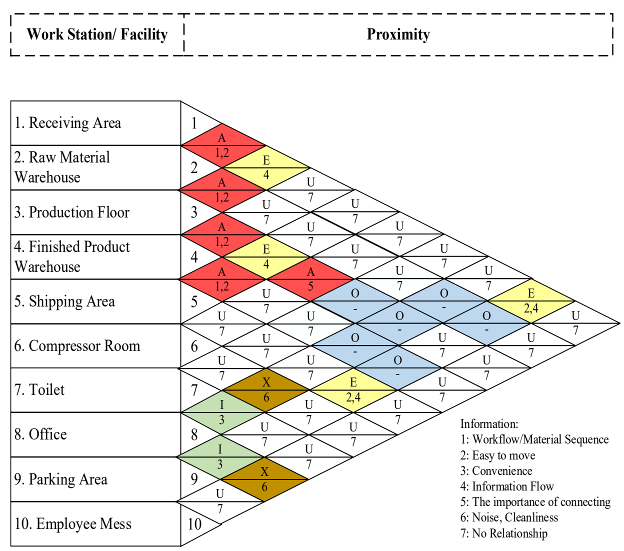

Figure 7. ARC of the entire PT ABC

5.2.4 Activity Relationship Diagram (ARD)

The following is ARD of the production floor and the entire PT ABC as shown in Figure 8, Figure 9, Figure 10, and Figure 11.

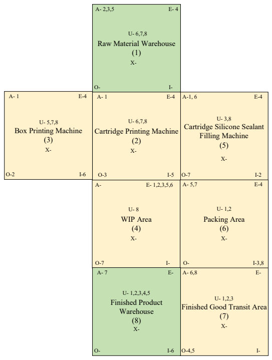

Figure 8. ARD of the Production Floor 1

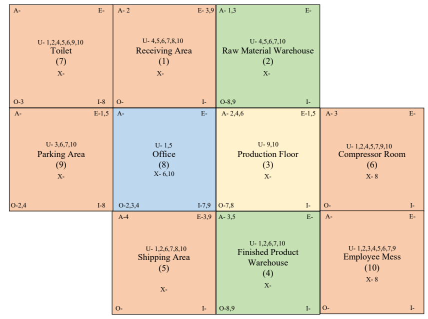

Figure 9. ARD of the entire PT ABC 1

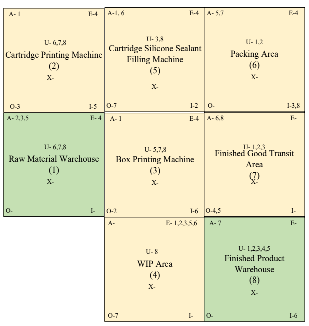

Figure 10. ARD of the Production Floor 2

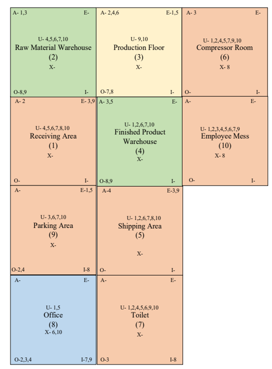

Figure 11. ARD of the entire PT ABC 2

5.2.5 Proposed Layout with Systematic Layout Planning (SLP) Method

Two alternative layout suggestions using the SLP method were developed after passing through multiple steps, as shown in Figures 12 and 13.

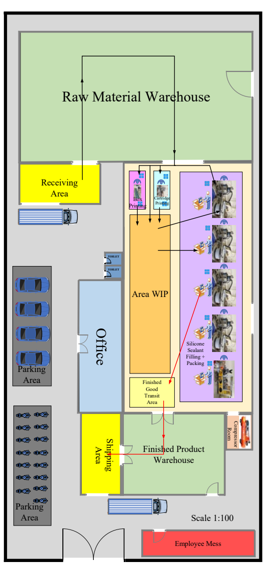

Figure 12 Proposed Layout SLP 1

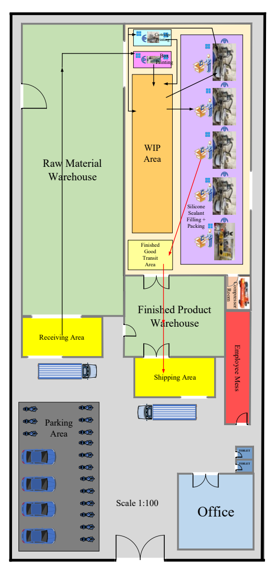

Figure 13 Proposed Layout SLP 2

5.3 Computerized Relationship Layout Planning (CORELAP) Method

The ARC is used to generate qualitative data, which is then transformed into quantitative data in a total closeness rating (TCR). Figures 6 and 7's ARC data will be converted to TCR using the following values: A= 5, E= 4, I= 3, O= 2, U= 1, and X= 1. On the CORELAP approach, the derived TCR value shows the order of departmental placement. Tables 7 and 8 show how departments and areas are assigned.

Table 7. Production Floor's CORELAP Department's Order of Selection

No	Department/ Area	TCR	Order
1	Raw Material Warehouse	22	2
2	Cartridge Printing Machine	17	5
3	Box Printing Machine	17	6
4	WIP Area	23	1
5	Cartridge *Silicone Sealant Filling Machine*	21	3
6	Packing Area	22	4
7	Finished Good Transit Area	17	7
8	Finished Product Warehouse	13	8

Table 8. Entire PT ABC's CORELAP Department's Order of Selection

No	Department/ Area	TCR	Order
1	Receiving Area	19	4
2	Raw Material Warehouse	19	2
3	Production Floor	29	1
4	Finished Product Warehouse	19	3
5	Shipping Area	19	5
6	Compressor Room	12	6
7	Toilet	12	9
8	Office	14	8
9	Parking Area	19	7
10	Employee Mess	8	10

The next step is using the CORELAP approach with several iteration steps after determining the order of all departments. Iteration is accomplished by inputting the department in a predetermined order. There will be 7 iterations on the factory floor of PT ABC since there are 8 departments or areas and 9 iterations on the entire PT ABC because there are 10 departments or areas. Figures 14 and 15 demonstrate the results of the CORELAP technique iteration on the factory floor and the entire PT ABC

15	14	13	12	
16	Cartridge Printing Machine	Box Printing Machine	11	
1	Raw Material Warehouse	WIP Area	Finished Product Warehouse	9
2	Cartridge SS Filling Machine	Packing Area	Finished Good Transit Area	8
3	4	5	6	7

Figure 14. Overall CORELAP Calculation Results for Production Floor

18	17	16	15	14
1	Raw Material Warehouse	Production Floor	Compressor Room	13
2	Receiving Area	Finished Product Warehouse	Shipping Area	12
3	Employee Mess	Parking Area	Office	11
	5	6	Toilet	10
		7	8	9

Figure 15. Overall CORELAP Calculation Results for The Entire PT ABC

Figure 16 shows the results of the proposed layout using the CORELAP method.

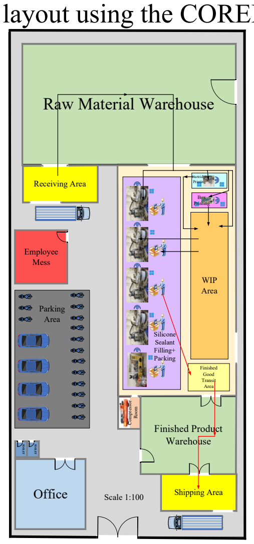

Figure 16. Proposed Layout Using CORELAP Method

5.4 Best Method Selection

The recommended layout is based on the distance and the lowest possible material handling costs. The following summarises the layout design calculation results, which can be found in Table 9.

Table 9. Summary of The Layout Design Calculation Results

Comparison / Design	Factory Area (m^2)	Distance (meter)	OMH/ Week	Production capacity (pcs/ hour)
Previous Factory	1,000	220.70	IDR 5,350,017.12	678
SLP 1	**1,616.59**	**223.14**	**IDR 5,810,741.66**	**904**
SLP 2	1,616.59	227.34	IDR 6,413,753.52	904
CORELAP	1,616.59	248.06	IDR 6,724,403.03	904

The recommended layout is the first design using the Systematic Layout Planning (SLP) method. The first SLP design was originally picked as the most effective layout proposal based on the results of the calculation comparison between alternatives since it has the shortest displacement distance and lowest material handling expenses. Because each department's area expands in accordance with the company's capacity, the three layout proposals have higher area, distance, and material handling expenses than the previous factory. The proposed design's machine number was increased from three to four, bringing the total production capacity to 904 pieces per hour. The other two design proposals have a value of displacement distance and material handling expenses that are not too far off from the first recommended design of the SLP method. Thus, they can also be considered as an alternative for the corporation when designing a factory layout in a new location. Figures 17, 18, 19 show two-dimensional and three-dimensional images of the selected proposed plan.

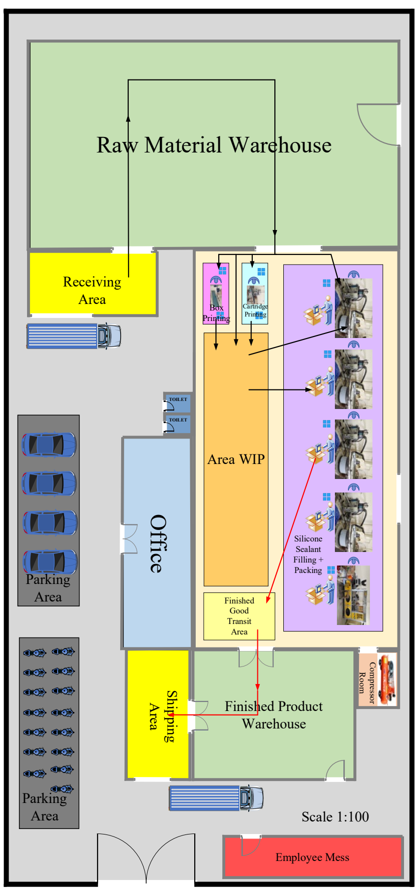

Figure 17. 2D Model of the selected proposed layout

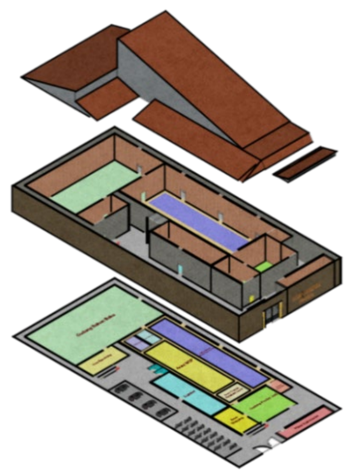

Figure 18. 3D Model 1 of the selected proposed layout

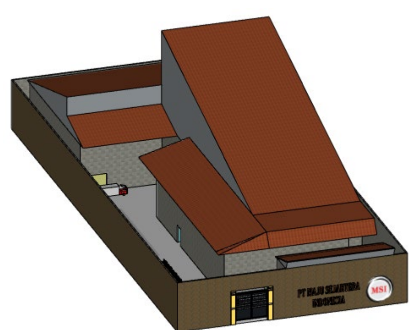

Figure 19. 3D Model 2 of the selected proposed layout

5.5 ProModel Simulation

The selected layout plan, namely the proposal using the first design Systematic Layout Planning method, will be generated in the Promodel simulation application. Figure 20 shows the layout simulation model for the proposed production floor for cartridge silicone sealant.

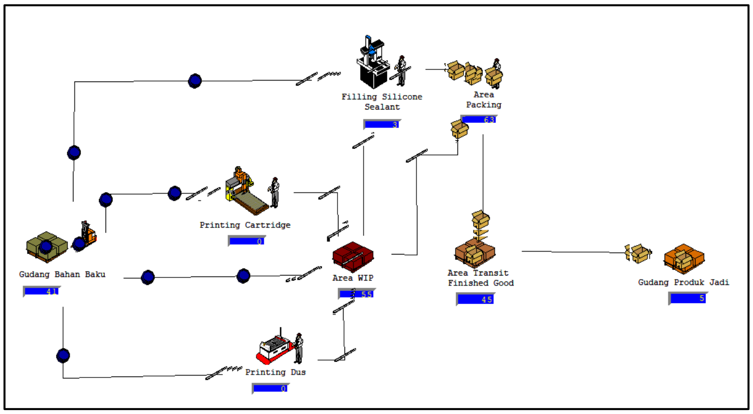

Figure 20. Simulation Model of Proposed Production Floor Layout

Table 10 compares the simulation results for the previous factory's production floor layout and the proposed factory's production floor layout.

Table 10. Simulation Results Comparison

Simulation	Total Production/ machine (Units)	*Average Time in System* (min)
Previous Factory	8,660	963.05
Proposed Layout	9,290	975.66
Total *Increase*	**7.28%**	**1.31%**

According to Table 10, the data in the last factory produced 8,660 units per machine with an average time in the system of 963.05 minutes. In contrast, the proposed layout produces 9,290 units per machine with an average time in the system of 975.66 minutes. There was a 7.28 percent increase in production per machine and 1.31 percent increase in average time in the system. The increase in average time in the system is due to the new layout's increased distance and size, which increases the time required.

5.6 Discussion

This research is different from previous studies. The difference between this research and other research is that it starts with a factory layout plan in accordance with the company's capacity, which is calculated using ANN forecasting. Layout planning is then performed by applying the SLP and CORELAP methodologies based on the predicted results.

6. Conclusion

This research implies three different layout recommendations for the new factory due to its analyses. Two designs were created with the Systematic Layout Planning (SLP) method and one with the Computerized Relationship Layout Planning (CORELAP) method. Alternative SLP 1 produces 223.14 meters with IDR 5,810,741.66 in material handling costs, while alternative SLP 2 produces a displacement distance of 227.34 meters with IDR 6,413,753.52 in material handling expenses. The CORELAP method results in a displacement distance of 248.06 meters and the design's material handling expenses of IDR 6,724,403.03. The three proposed designs have 1,616.59 m^2 with a production capacity of 904 pcs/hour. The SLP 1 design is the best of the three recommended designs because it has the shortest displacement distance and the lowest material handling expenses.

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Biographies

Felita Yulianti is an Industrial Engineering student at Tarumanagara University. She was born in Jakarta on July 12th 2000. She is the second of three daughters. She was graduated from Saint Vincentius Elementary School and Saint Vincentius Junior High School with the fifth-highest national exam score. She studied science in Fons Vitae 1 High School and was graduated with the highest national exam score. She participated in the 2017 National Mathematics Olympiad in chemistry and managed to pass the first preliminary. She entered Tarumanagara University in 2018 and dreamed of being a manager in a company and being a researcher in a laboratory.

Lina Gozali is a lecturer at the Industrial Engineering Department of Universitas Tarumangara since 2006 and a freelance lecturer at Universitas Trisakti since 1995. She graduated with her Bachelor's degree at Trisakti University, Jakarta - Indonesia. She got her Master's Degree at STIE IBII, Jakarta – Indonesia, and she recently got her PhD at Universiti Teknologi Malaysia, Kuala Lumpur – Malaysia, in 2018. Her apprentice college experience was in the paper industry at Kertas Bekasi Teguh, shoe industry at PT Jaya Harapan Barutama and automotive chain drive industry at Federal Superior Chain Manufacturing. She teaches Production System and Supply Chain Management Subjects. She researched the Indonesian Business Incubator for her PhD. She has written almost 70 publications since 2008 in the Industrial Engineering research sector, such as Production Scheduling, Plant Layout, Maintenance, Line Balancing, Supply Chain Management, Production Planning, and Inventory Control. She had worked at PT. Astra Otoparts Tbk before she became a lecturer.

Adianto was born in Semarang, Indonesia on 29th April, 1955. Adianto completed his “Sarjana Fisika Degree” in 1982 from the Physics Department of the Faculty of Sciences and Mathematics, Gadjah Mada University, Yogyakarta. In 1978 when he got his Bachelor of Science in Physics (B.Sc.) he started working as a Staff of “Field of Nuclear Physics Laboratory”,” Pure Materials Research Center and Instrumentation Yogyakarta”, Atomic Energy Agency (BATAN). In 1986 to 1993 he received a scholarship from the Ministry of Research and Technology of the Republic of Indonesia to continue his studies in England at the Department of Electronic and Electrical Engineering, University of Salford, England. He received his M.Sc. degree in the field of Computer Instrumentation in 1988 and a Ph.D. degree in the field of Material Science in 1993. He returned back to Indonesia, then in 1994 he moved to Jakarta and appointed as a “Head of Engineering and Advanced Technology”, (Echelon IIIA) at “Nuclear Science and Technology Empowerment Center”, Atomic Energy Agency, BATAN, Jakarta. In 2000 He was assigned to the Ministry of Research and Technology to serve as Assistant Deputy for Science Accreditation and Development Center (Echelon

IIA) and in 2005 he was assigned as Assistant Director for Academic Affairs, to Organize Graduate Research in PUSPIPTEK Serpong. In 2008, he took early retirement as a Government Official to take a full-time lecturer at Universitas Tarumanagara, Jakarta. Adianto started his profession as a lecturer in the Department of Mechanical Engineering, Faculty of Engineering, Universitas Tarumanagara and the Department of Mechanical Engineering, Faculty of Industrial Technology, Trisakti University of Indonesia from 1994 until now. He has taught mathematics, mechatronics, English and physics, but Physics is the main subject he teaches. As a full time, lecturer at Universitas Tarumanagara, in 2012 he was appointed as a Vice Dean for Academic and Student Affairs, Faculty of Engineering, and in 2016 up to now, he was appointed as a Director for Student Affairs, Universitas Tarumanagara. During his profession as a researcher at the Atomic Energy Agency, the Ministry of Research and Technology and as a lecturer at Universitas Tarumanagara, Adianto as an Associate Professor has published scientific and research papers of more than 35 titles at home and abroad.

Laurencia Tiffany is an industrial engineering student at Tarumanagara University. She was born in Jakarta on August 9th 2002. She was graduated from Pelita Anugerah Elementary School and St. Kristoforus Junior High School with the first general ranking. When Senior High School, she also got first ranking in St. Kristoforus. She was a participant in the 2016 and 2019 National Mathematics Olympiad. She was also the best of 10 finalists in the biology scientific work project in 2017. She entered Tarumanagara University in 2020 to achieve her goal of becoming a consultant and managing the company