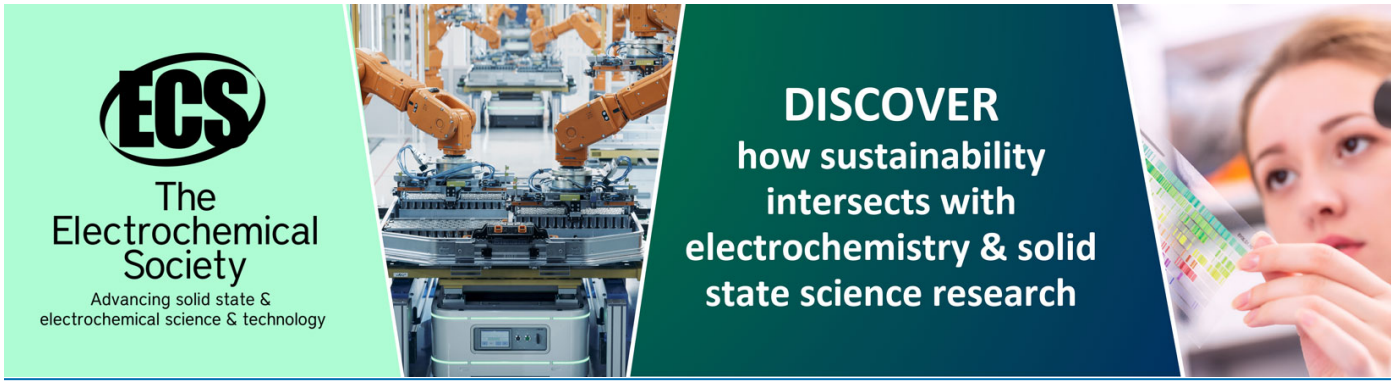
Production facility layout by comparing moment displacement using BLOCPLAN and ALDEP Algorithms



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Production facility layout by comparing moment displacement using BLOCPLAN and ALDEP Algorithms

M Tambunan*, E Ginting and R M Sari
Lecturer in Industrial Engineering Department, Faculty of Engineering, Universitas Sumatera Utara, Medan, Indonesia.

*Email : araapul_tambunan@yahoo.com

Abstract. Production floor layout settings include the organizing of machinery, materials, and all the equipments used in the production process in the available area. PT. XYZ is a company that manufactures rubber and rubber compounds for retreading tire threaded with hot and cold cooking system. In the production of PT. XYZ is divided into three interrelated parts, namely Masterbatch Department, Department Compound, and Procured Thread Line Department. PT. XYZ has a production process with material flow is irregular and the arrangement of machine is complicated and need to be redesigned. The purpose of this study is comparing movement displacement using BLOCPLAN and ALDEP algorithm in order to redesign existing layout. Redesigning the layout of the production floor is done by applying algorithms of BLOCPLAN and ALDEP. The algorithm used to find the best layout design by comparing the moment displacement and the flow pattern. Moment displacement on the floor layout of the company's production currently amounts to 2,090,578.5 meters per year and material flow pattern is irregular. Based on the calculation, the moment displacement for the BLOCPLAN is 1,551,344.82 meter per year and ALDEP is 1,600,179 meter per year. Flow Material resulted is in the form of straight the line.

1. Introduction

The main thing to consider in designing a layout of the production floor is the material movement system [1]. Effective and efficient material movement systems will affect a company's production capability to provide products on time to consumer [2]. Conversely, a poor material movement system will cause production to be hampered and will give a loss to the company. Good layout is the layout that can handle the material handling system as a whole.

PT. XYZ is a company engaged in the processing of *rubber* products with raw materials into rubber compounds and pre Cured Tread liner for tires with hot and cold cooking system.

Some problems were found in the company such as no spesific raw materials and products warehouse were available and hence, the raw materials and finished products were placed on the empty space of the production floor. Placement of raw materials and products hamper the production process. Also, the flow patterns of material contained in the production floor in the form of irregular flow patterns (odd angel) and production machines not placed in the order of processes. The using of BLOCPLAN algorithm solves the problem of backtracking, irregular flow material, distance the movement, and add one machine. The using of ALDEP algorithm solves the problem of a far material displacement [3].

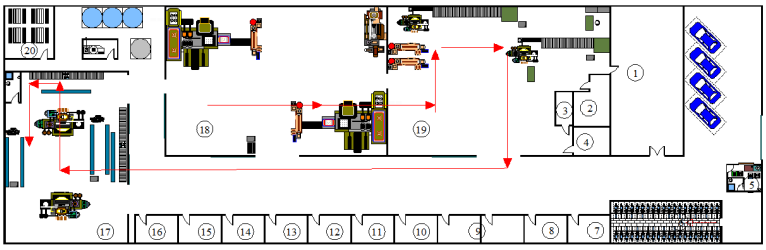
2. Methodology

The research was conducted at PT. XYZ from September 2016 to January 2017. The research object observed on the production layout. The research describes troubleshooting to a problem that exists now and get the findings of practical as operational decision making. So this study included the collection, presentation and data processing as well as Analysis and interpretation on PT. XYZ

This research has activities in the form of data collection and data processing. The variables are material flow type, production process sequence, material movement, material movement distance, and production capacity [4]. After data collection, data processing calculated by using software BLOCPLAN 90 and ALDEP algorithms. The design results of the two algorithms calculated the distance of material movement and calculated the moment of material displacement per year. The design results with the smallest displacement moment values are the best and with other assessments such as the flow patterns of the materials produced.

3. Results and Discussion

The initial phase of the study is the preliminary to find out the initial conditions for observation and interviews and literature studies on the methods of problem solving used and other supporting theories. The problem of this research is a long distance movement of materials and material flow away, causing big displacements moment can reduce yield. Therefore, it is necessary to design a layout which has a regular flow of material and minimum material movement distance so the moment is minimum. o the next stage is collecting data by observing and measuring directly on the production floor. Primary data obtained from observations, and direct measurements of the object of research in the field are: the data size of the production department, block the company's production floor layout and sequence of the process. Secondary data is in the form of production capacity [5].
The initial layout of PT XYZ can be see in Figure 1.



Symbol	Descripction	Symbol	Descripction
1	Office	11	Clinics
2	Cold Lateks Room	12	Rest Room
3	Plastic Storage	13	Mushollah
4	Warehouse	14	Wudhu Place
5	Security Room	15	Tankos Tank
6	Motorcycle Area	16	Boiler
7	arbon Balack Storage	17	Material Warehouse
8	Waste Storage	18	Production Floor 1
9	roduct Reject Storage	19	Production Floor 2
10	Chemical Storage	20	Canteen

Figure 1. Initial Layout PT XYZ

The work station size and encoding data can be seen at Table 1.

Table 1. Work Station Size and Encoding Data

Workstation	Size of Area (m)	Area (m^2)	Code
Main ingredient and cuts	11.15 x 7.65	84.9	A
Appolo Machine (External Mixer 22 Inch and Internal Mixer) 1	8.8 x 14.5	127.6	B1
Appolo Machine (External Mixer 22 Inch and Internal Mixer) 2	8.8 x 14.5	127.6	B2
Milling rubber hard	3.3 x 6.9	22.7	C
Milling with External Mixer 18 Inch	5.5 x 3.8	29.9	D

Formation with Extruder 1	16.2 x 3.5	56.7	E1
Formation with Extruder 2	14 x 3.5	49	E2
Pressing and Formation Screw	7.5 x 16.4	123	F
Smoothing with grader machine 1	10 x 1.9	19	G1
Smoothing with grader machine 2	10 x 1.9	19	G2
Quality Control and Packing 1	8 x 3	24	H1
Quality Control and Packing 2	8 x 3	24	H2

After collecting the size data collected other data such as the production capacity of 5.4 tons per day, the sequence data of the process and the depiction of Block Layout from the initial production floor. Next calculation of determining the point of coordinates X and Y on the block layout from the initial production floor with the formula:

- $X = X_0 + \frac{(X_1 - X_0)}{2}$
- $Y = Y_0 + \frac{(Y_1 - Y_0)}{2}$

The degree of proximity relationship or Activity Relationship Chart [5-8] can be seen at Figure 2.

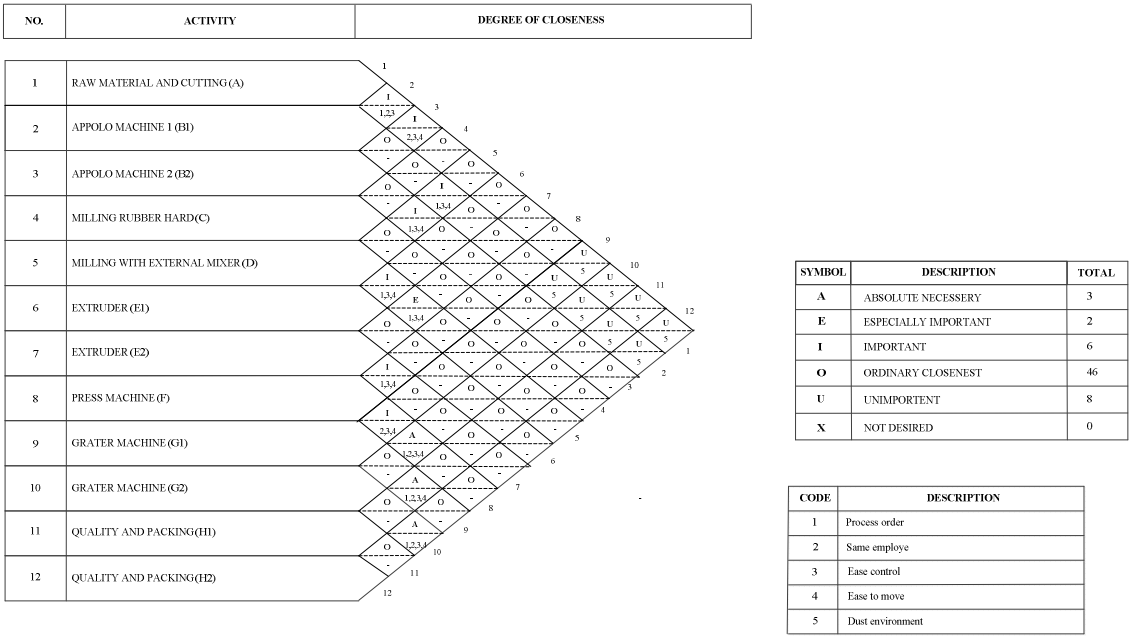


Figure 2. ARC PT. XYZ

Once obtained ARC PT. XYZ, then calculated by using BLOCPLAN algorithm. This calculation is done with BLOCPLAN90 software.

Then followed data with BLOCPLAN90 software to get the best results. Coordinate Point of software result BLOCPLAN90 is used to find the distance between work stations and total moment of movement.

The design result of BLOCPLAN algorithm resulted in total displacement moment of 1.551.344,82 m / year. Layout design with ALDEP algorithm is done by using ALDEP Software. ALDEP software is used to find the most optimal TCR (Total Closeness Rating) and layout values by entering the number of departments and production floor area [9].

From a distance between the work stations, calculated the total moment of material movement of ALDEP algorithm design results. The total movement time of ALDEP algorithm design is 1.600.179 meters per year. Total of moment displacement calculation can be seen at Table 2.

Table 2. Total Moment of Displacement Results of BLOCPLAN Algorithm and ALDEP Algorithm

No	First Station	Destination Station (m)	Distance of Displacement (m)		Moment of Displacement (m/year)	
			BLOCPLAN	ALDEP	BLOCPLAN	ALDEP
1	A	B1	9.75	26.12	43724.9	43724.9
2	A	B2	9.74	20.62	34517.9	34517.9
3	B_1	D	9.64	29.45	49299.3	49299.3
4	B_2	D	29.13	23.95	40092.3	40092.3
5	D	E1	23.02	17.1	204482	204482
		E2	10.92	9.6	114797	114797
6	E_2	F	29.69	6.7	11215.8	11215.8
7	F	G1	8.48	7.9	220410	220410
		G2	11.9	11.4	318060	318060
8	G_1	H1	8.69	10.65	297135	297135
9	G_2	H2	6.71	9.55	266445	266445
		Total			1.551.344,82	1.600.179

The results of the algorithm compared with the company's initial layout. The comparison made by assigning weight to each category. The weighting is:

1. Category moment of movement, weighted values are:
   A. 1.000.000 m / year – 1.500.000 m / year weight value = 3
   B. 1.500.001 m / year – 2.000.000 m / year weight value = 2
   C. 2.000.001 m / year – 2.500.000 m / year weight value = 1
2. Categories of building changes, weighted values are:
   A. The shape of the building does not change; the weight value is = 2
   B. The shape of the building changed; the value of weight that is = 1
3. Category of material flow patterns generated, weighted values are:
   A. The pattern of regular flow; the value of weight that is = 2
   B. Irregular flow pattern; weight value i.e., = 1
4. Space category for material handling, weighted values are:
   A There is a space for material handling; the weight value is = 2
   B. There is no space for material handling; the weight value is = 1

The results of the comparison with the weighting can be seen at Table 3.

Table 3. Best Layout Comparison

	First Layout (Company Layout)	Result From BLOCPLAN Algoritm	Result From ALDEP Algoritm
Moment Displacement (m/year)	2.090.578,5 (1)	1.551.334,82 (2)	1.600.179 (2)
Changing Shape Of Building	Not Changed (2)	Changed (1)	Not Changed (2)
Flow System	Not Directed (1)	Not Directed (1)	Directed (2)

Material Handling Space	Exist (2)	None (1)	Exist (2)
Total Weight	6	5	8

From Table 3, the highest weighting values contained in the draft outcome Algorithm total moment ALDEP value material movements is 1.600.179 meters/year. Form of the building has not changed, the flow pattern which is irregular and there is still space for the material handling. Also, each design result of the ALDEP algorithm provides a warehouse facility for raw materials or a finished product. Layout result for both BLOCPLAN Algorithm and ALDEP Algorithm can be seen at Figures 3 and 4.

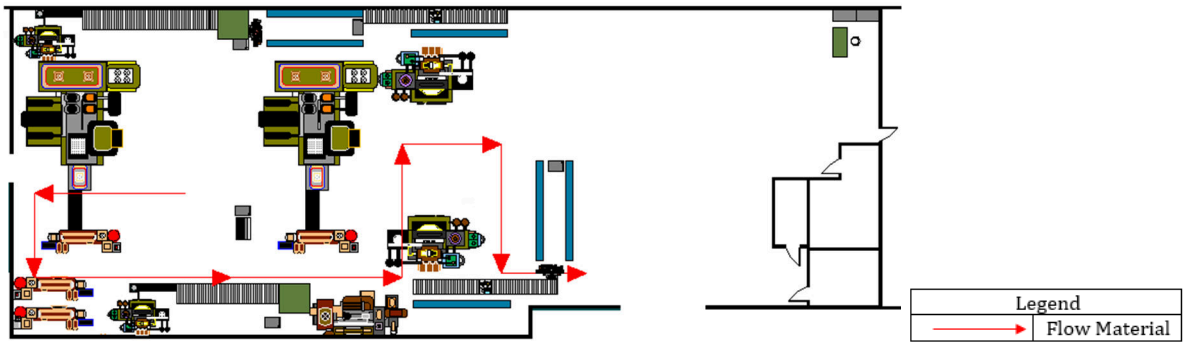


Figure 3. Layout Result BLOCPLAN Algorithm

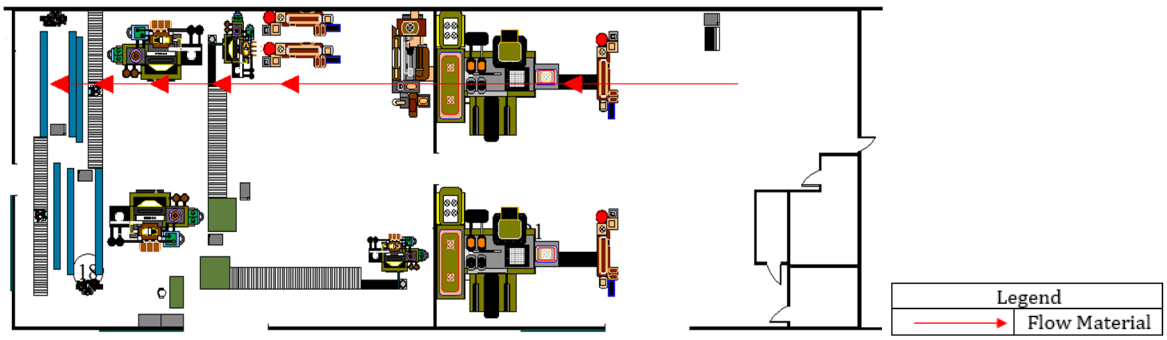


Figure 4. Layout Result ALDEP Algorithm

4. Conclusion

After data collection, data processing, and problem solving as well as alternative search algorithms using BLOCPLAN layout and algorithms ALDEP in redesigning the layout of the production floor to the PT. XYZ, it can take several conclusions, moment displacement of material from the production floor PT. XYZ is currently 2.090.578,5 meters per year. Moment of the existing layout of greater value than the displacement moment with an algorithm designed by BLOCPLAN which has a value of 1.551.344,82 meters per year and ALDEP is 1.600.179 meter per year. Comparison of results with BLOCPLAN algorithm and ALDEP has a smaller value than the initial layout. BLOCPLAN has the smallest displacement but must change the shape of the building and production flow pattern while ALDEP has a value of displacement is smaller than initial layout but bigger than BLOCPLAN, if ALDEP is adopted the shape of the building is not changed and production floor has a flow patern of straight line.

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