Redesign of The Production Facility Layout by Using Systematic Layout Planning Method at Cahaya Bintang Mas Company Surabaya

Sunardi¹, Ananda Esya J², Budi Santoso³

¹Industrial Engineering Department, Faculty of Engineering, UPN “Veteran” East Java Surabaya, Indonesia, gitannar@yahoo.co.id
²Industrial Engineering Department, Faculty of Engineering, UPN “Veteran” East Java Surabaya, Indonesia, anandaelsya@gmail.com
³Industrial Engineering Department, Faculty of Engineering, UPN “Veteran” East Java Surabaya, Indonesia, budisantoso.ti@gmail.com

Abstract. On the production floor at Cahaya Bintang Mas Company Surabaya, the arrangement of production facilities is not optimal because the material handling distance is quite far. One effort to overcome the problems that occur, then do the redesign of the facility layout that occurs on the production floor using the Systematic Layout Planning Method. The research was conducted in December 2018 until the research was completed. The data needed in this research are primary data obtained through measurement methods and secondary data obtained through data that has been researched and collected by other related parties. The results showed that the total distance of material handling distance for the current layout has a total distance of 508.6 m. By SLP method it can reduce material handling distance, alternative 1 layout has a total distance of 324.8 meter (36,1%), and alternative layout 2 has a total distance of 215.5 meter (57,6)

Keywords: Layout, SLP Method, Material Handling Distance

1. Introduction

One effort to overcome the above problems is to redesign the facility layout that occurs on the production floor. In this problem the proposed design of appropriate facility layout is using the method of systematic layout planning (SLP). There are many approaches in purposed in creating facility layouts. One of them is advanced algorithmic techniques such as genetic algorithm technique (Resende 2015). Cahaya Benteng Mas Company is a manufacturing company engaged in building materials that produce roof and wave walls, steel roof truss, cast floor supports, ceiling frames, flashing, capping, and coil roll. This company is a job order company where work is done if there is an order from the consumer. The arrangement of production facilities is not optimal because the material transfer distance is quite far, such as the distance of raw material warehouse with uncoiler machines which are 12 m to 15 m which can be minimized by reducing the width of the entrance in accordance with the standard width pathway that is equal to 5 m. Another problem is the material transfer distance from roll forming machine 750 1 to the far crimping machine that is equal to 21 m where this distance only requires about 1 m to 2 m, roll forming machine 750 1 must also pass through several machines causing a bottleneck that has an impact at the time of waiting for a longer crane so that it inhibits the production process on other products. Varsha Karandikar et al, 2017, asked that instead of selecting from either of the two layout, the team extrapolated the advantages of each layout and developed a new layout which was considered to be the most optimal layout. D. Suhardini, et al, in their studying showed that the sue of systematic layout planning method reduce material handling cost of 10,98% . Furtermore Lei Wen and Lu Bai, 2015, a broad and detailed two stage index system of logistic facility layout has been establishes. Eliud Maina C, 2018 , SLP can be used to solve to study a viable procedure in solving a layout design and improvement problem. Result of a research showed that the rearrangement of the layout decrease distance-travel-time consumed in transportation and also consist of flow of material, result in a increase in productivity (Marthur Rashi, 2019)
Based on above description, then formulation of the problem is "How redesign the layout of production facilities with the systematic layout planning method, whether it can minimize the material transfer distance at Cahaya Benteng Mas Company Surabaya?"

The objectives of this study is to find out whether the systematic layout planning method can improve the layout of the product facilities currently in the light company.

2. Literature Review

Systematic layout planning is a systematic and organized layout design method. This method is used to design the best alternative layout and minimize the moment of material transfer that occurs on the production floor. To keep up with the pace, the facility layout, a key element of facilities planning, has to be adaptable to changes (Chen, 2013). Further the case study illustrations that it is viable procedure involving a layout design and improvement problem (Maina Eliud, 2018).

Facility layout problem (FLP) can be interpreted as a procedure for setting up factory facilities to support the smooth production process. According to Poormustafa, 2011, FLP can be formulated differently but it is usually considered as an optimization problem.

According Adil Baykasoglu T.D, 2009, it can be showed that these variables effect the facility layout and such, it should be flexible to accommodate them. Then Maryam hamedi, 2012, the facility designers select these layout based on the degree of uncertainty in the production mix, the volume data for future needs revision of layout costs.

The application is expected to make the fastest material flow with the lowest cost and least amount of material handling. (Muther R 1973/ And that corelap designed to accurate situation when constantly changing condition prohibit the collection of precise data. (Chee Ailing, 2009). Furthermore producing product with high quality and provides good service with low cost in short time using the resources is the objective of property managing a facility (Heragu SS, 2008).

The procedure to relayout the production floor consist of three steps, such analyzing the existing layout, design the plant base SLP and the evaluation and selection of alternative layout (Law AK 2000). According to Tompkins, 2010, there are several steps in systematic layout planning, like the figure 1.

![Figure 1: Systematic layout planning procedure (Tompkins, 2010)](image)

3. Methodology

3.1. Location and Time of Research

The location of this research was conducted at Cahaya Benteng Mas Company on Margomulyo Permai Street Surabaya. The time of the study was carried out in December 2018 until the research was completed.
3.2. Variable identification
Based on the research title, the variables related to this study can be identified as follows:
Independent variable (independent), consist of production floor area, number of production machines, production machine size, current layout, and distance of transfer of current layout material. And the dependent variable in this study is the distance of transfer of alternative layout materials.

4. Result and Conclusion
4.1. Result of Research
The First Lay Out can be illustrated as this bellow.

![First Layout](image1)

**Figure 2. First Layout**

**4.1.1. Material Flow**
Material flow pattern for the production process at Cahaya Benteng Mas Company Surabaya is a Straight Line or flow pattern based on a straight line because the production process is short and relatively simple, consisting of only a few kinds of production equipment (production equipment).

**4.1.2. Activity Relationship Chart (ARC)**
ARC on the production floor illustrates the close relationship between existing facilities which is characterized by the degree of relationship along with the reasons.

![Activity Relationship Chart](image2)

**Figure 3. Activity Relationship Chart SLP Layout**

**4.1.3. Activity Relationship Diagram (ARD)**
This diagram illustrates the close relationship between facilities expressed by line code. ARD can be made in this bellow (Sugandhi AD, 2016)
4.1.4. Area needs
Sum of area needs for storage and warehouse area is 768 m$^2$, machine production is 640.54 m$^2$, and production facility is 3744 m$^2$. The width of the entrance and exit of the raw material and the finishing goods are 12 meter and 5 meter, so that there is 7 m wide available. To utilize the area that is still available, an expansion of raw material warehouse and finished goods warehouse is carried out, so that the width of the raw material warehouse area and finished goods warehouse is added to 15 meter.

4.1.5. Space Relationship Diagram

4.1.6. Alternative Layout
Description: The number on the SRD image is the same as the number on the ARC image SLP Layout

Figure 4. Activity Relationship Diagram Layout Alternative

Figure 5. Space Relationship Diagram SLP Layout

Figure 6. Block SLP Layout
Figure 7. SLP Layout

4.1.7. Comparison of total distance of material handling can be showed this bellow.

Table 1. Comparison of Total Distance of Material Handling

| No. | From                | To                     | Distance (meter) | First Layout | SLP Layout |
|-----|---------------------|------------------------|------------------|--------------|------------|
| 1.  | Storage             | Uncoiler 1 Machine     | 14               | 1            | 1          |
| 2.  | Uncoiler 1 Machine | Roll Forming 750 1 Machine | 3.5             | 4            |            |
| 3.  | Roll Forming 750 1 Machine | warehouse         | 21.1            | 9.6          |            |
| 4.  | Roll Forming 750 1 Machine | Crimping Machine    | 21               | 1.2          |            |
| 5.  | Crimping Machine   | warehouse             | 31.7             | 11.7         |            |
| 6.  | Storage             | Uncoiler 2 Machine     | 12               | 1            |            |
| 7.  | Uncoiler 2 Machine | Roll Forming 672 Machine | 4               | 4            |            |
| 8.  | Roll Forming 672 Machine | warehouse       | 21.4             | 8.4          |            |
| 9.  | Storage             | Mesin Uncoiler 3 Machine | 14              | 1            |            |
| 10. | Uncoiler 3 Machine | Roll Forming 680 Machine | 3.5             | 4            |            |
| 11. | Roll Forming 680 Machine | warehouse      | 15.1             | 3.6          |            |
| 12. | Storage             | Uncoiler 4 Machine     | 15               | 1            |            |
| 13. | Uncoiler 4 Machine | Roll Shear & Slitter Machine | 4              | 4            |            |
| 14. | Roll Shear and Slitter Machine | Rerolling 1 Machine | 3              | 3            |            |
| 15. | Rerolling 1 Machine | Meja Roll             | 0.4              | 0.4          |            |
| 16. | Meja Roll           | warehouse             | 27.5             | 15.2         |            |
| 17. | Storage             | Uncoiler 5 Machine     | 12               | 1            |            |
| 18. | Uncoiler 5 Machine | Roll Shear Machine     | 4               | 4            |            |
| 19. | Roll Shear Machine | Slitter Machine        | 2               | 2            |            |
| 20. | Slitter Machine    | Bending Machine        | 1               | 1.8          |            |
| 21. | Bending Machine    | warehouse              | 32.4             | 19.4         |            |
| 22. | Slitter Machine    | Rerolling 2 Machine    | 4               | 4            |            |
| 23. | Rerolling 2 Machine | Meja Roll              | 0.4              | 0.4          |            |
| 24. | Storage             | Uncoiler 6 Machine     | 15               | 1            |            |
| 25. | Uncoiler 6 Machine | Roll Forming 750 2 Machine | 4              | 4            |            |
| 26. | Roll Forming 750 2 Machine | warehouse       | 19.4             | 9.4          |            |
| 27. | Roll Forming 750 2 Machine | Curving Machine     | 2               | 1.2          |            |
| 28. | Curving Machine    | warehouse              | 24.6             | 12.6         |            |
| 29. | Storage             | Mesin Uncoiler 7       | 12               | 1            |            |
| 30. | Uncoiler 7 Machine | Truss Profil C Machine | 6               | 4            |            |
| 31. | Truss Profil C Machine | warehouse         | 27.9             | 15.9         |            |
32. Storage  Uncoiler 8 Machine 15  1
33. Uncoiler 8 Machine Truss Profil Reng 4  4
34. Truss Profil Reng Machine  warehouse 28.9  18.9
35. Storage  Uncoiler 9 Machine 12  1
36. Uncoiler 9 Machine Roll Forming 780/1030 5  4
37. Roll Forming 780/1030  warehouse 24.9  10.9
38. Storage  Uncoiler 10 Machine 15  1
39. Uncoiler 10 Machine Roll Forming Gelombang 4  4
40. Roll Forming Machine  warehouse 25.9  15.9

Total 512.6  215.5

Percentage of efficiency in reducing total material transfer distance.
Percentage of total distance reduction efficiency in the transfer of current layout materials and alternative layout 2 Percentase

\[
\text{Percentage} = \left( \frac{\text{Total distance first layout} - \text{Total distance layout alternative 2}}{\text{Total distance layout first}} \right) \times 100\%
\]

\[
= \left( \frac{512.6 - 215.5}{512.6} \right) \times 100\% = 57.9\%
\]

From the table above it is known that SLP layout can shorten the material handling distance from the first layout by 297.1 meter or 57.9%.

4.2. Conclusion

The results of the study showed that the layout design with systematic layout planning method could improve the transportation process of material handling, yet from the original distance of 512.6 meters to 215.5 meters or around 57.9 %. Thus systematic layout planning method can be applied very significance in this company as an effort to increase productivity.

Reference

[1] Adil Baykasoglu, 2009. An ant colony algoritm for solvingbudget constrained and unconstrained dynamic facility layout problems. Omega 34. 385-396.
[2] Apple, James M. 2016. Plant Layout and Material Handling, Third Edition. New York: John Wiley and Sons
[3] Chee Ailing, 2009. Facility Layout Using Sistematic Layout Planning & Area.
[4] Chen, G. Y. H. (2013). A new data structure of solution representation in hybrid ant colony optimization for large dynamic facility layout problem. International of Production Economic. 362-371
[5] Eliud Maina C, muchiri Peter , James Keraitam, 2018. Improvement of facility layout planning JOSR journal of engineering ISSN (e): 2250-302. Vol.8 p: 33-43
[6] G.C. resend, J.F. 2015. A biased random- key genetic algorithm for the unequal areafacility layout problem. European Journal of Operation Research. P:86-107
[7] Heregu SS. 2008. Facilities Design. CRS Press Taylor and Francis Group.
[8] Hiregoudar, Chandrashekar and Reddy, B. Raghavendra, 2007, Facility Planning and Layout Design, First Edition, Penerbit Technical Publications Pune, India.
[9] Law AK. 2000. Simulation Modelling and Analyzis. Singapore Ma-raw Hill Hihger Education.
[10] Lei Wen and Lu Bai. 2015. Sytematic Layout Planning and Comprehensiveevaluation in Manufacture Enterprise’s Logistic facilities. International Jounal of Applied Decision Science. Vol. 8, p: 358-375
[11] Maina Eliud C, Muchiri Peter, and Keratia James N, 2018. Improvement of Facility layout Using Systematic layout Planning. IOSR Journal of Engineering . ISSN (e): 2250-3021. Vol. 8 Issue 5
[12] Marthur Rashi, Dinesh Shri, rrind KV. 2016. Facility Layout Optimization Using Simulation: A case Study of The Steel Utensils Industry. International Journal Advanced Engineering and Research Development. Vol 3. ISSN O: 2348-4470

[13] Maryam Hamedi, N.B. 2012. Developing a method to Generate Semi-distributed Lay out by Genetic Algorithm. International Journal of production Research. Vol. 50 No 4. 953-975.

[14] Muther R., 1973. Ystematic layout Planning. (Boston :CBI Publishing Company.

[15] Patil, Subodh B. and Kuber, S.S., 2014. Productivity Improvement In Plant By Using Systematic Layout Planning (SLP) - A CASE STUDY OF MEDIUM SCALE INDUSTRY, IJRET:International Journal of Research in Engineering and Technology Vol:03 Issue: 04.

[16] Sugandhi SD, Bharule A, 2016. Five Blanking Plant Layout Improvement SLP,International Journal Scientific Engineering and Research IJSRE 4(4): 1-4

[17] Suhardini D, W Septiani, and S Fauziah, 2017. Design and Simulation Plant Layout Using Systematic layout Planning. 10th ISIEM. IOP Conf. Series: Material Science and Engineering

[18] Thomkins. J, J. 2003. Facilities Planning. 3rd Edition. New York: John Wiley & Sons. Inc.

[19] Thomkins. J, J. 2010. Facilities Planning. 4th Edition. New York: John Wiley & Sons. Inc.

[20] Varsha karandikar, Shriram sane, Darshan Rathod, AkashJaiswal, and Shubham Vispute, 2017. Layout Designing using Systematic layout Planning for Electronics Division of a Manufacturing Facility. International Journal of Current Engineering and Technology (e) INPRESSCO, All Rights Reserved.