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Comparison Study of Facility Planning and Layouts Studies

Bintang Bagaskara K.¹, Lina Gozali², Lamto Widodo³, Frans Jusuf Daywin⁴ Industrial Engineering Department, Faculty of Engineering, Tarumanagara University, Indonesia

E-mail: bintangkorda@yahoo.co.id¹ ligoz@ymail.com² lamtow@yahoo.com³
fransjusuf42@gmail.com⁴

Abstract. Facilities and layout planning is a study discipline that has take an important role in company management. There are a lot of problem and inflicts the company because of having a wrong layout of facilities. One of them are material handling in production area, cost of material handling will increase and inflicts the company just because the company has a wrong layout design. Because it takes a long time and a long distance to carry the material from the warehouse to the production area until to the finished goods warehouse. Systematic Layout Planning (SLP) can improve the effectiveness of the wrong layout, this method has other submethod that improve efficiency material flow and decrease the number of infliction, including time; distance; and money. Researcher has a result of literatures review that conclude other methods in facilities layout planning with 10 international journal.

1. Introduction

Facilities can be broadly defined as a buildings where people utilize material, machines, and other resources to make a tangible product or provide a services [1]. In many developed company facilities layout planning is the most important part in building a factory. The right layout will bring a company to the effective material flow that will profit the company. A wrong layout can be improved with some study methods, one of them is Systematic Layout Planning (SLP). This method will analyze the connectivity between each department that decrease effectiveness in company. Other methods such as BLOCPLAN, CORELAP, linear programming, etc. will be reviewed on this research.

2. Literature study

Factory layout is a procedure for managing factory physical facilities to support the smooth production process [2]. Facility layout is a function that involves analysis (synthesis), planning and design of the interrelationships between physical facility arrangements, material movements, activities associated with personnel and the flow of information needed to achieve optimum performance in the range of related activities [3]. The design of facility layout yields advantages, one of which is reducing the waiting time (delay). Product layout is generally used for factories that produce one kind or group of products in large numbers and for a long time. With a layout based on production flow, machines and other production facilities will be arranged according to the principle of the machine after the machine. Machines are arranged in the order in which the process is determined in order of production, no matter the type / type of machine used. Each component runs from one machine to the next through the entire operating cycle required. With this type of layout, a product will be done until finished within the department without needing to be moved to another department. Here raw materials will be moved directly from one operation to the next so that it can be concluded that the main purpose of this layout is to reduce the process of moving materials and facilitate supervision in production activities [2].

Group of product is a layout based on grouping of products or components to be made. In this case the grouping is not based on the similarity of types of end products, but is grouped according to the processing step, shape, machine, or equipment used [2]. Process layout is a method of regulating and placing all production machines and equipment that have the same type/ type into one department. So



machines are grouped according to the similarity of processes or work functions. This layout is suitable for the production of products with high product variations and low production volumes [2].

A warehouse is a building used to store goods [4]. Goods stored in warehouses can be raw materials, semi-finished goods, spare parts, or processed goods that are prepared to be absorbed by the production process. The warehouse is a location for storing products until the demand is large enough to carry out its distribution [5]. Raw material is something that is used to make finished goods. So that raw materials are the main ingredients to undergo the production process into consumable goods / finish good that can be sold. Production is any activity that aims to increase or increase the use of an object, or all activities aimed at satisfying others through exchange [6]. A company needs resources to be used for the production of goods. These resources are in the form of raw materials, auxiliary materials, machinery, other equipment, labor, capital and land. Besides these resources, the amount of demand is the most profitable determinant of production area [7].

In calculating the distance of transfer of raw materials, the earliest data needed is the coordinates of the center points of each raw material and the coordinates of the points of entry and exit points (receipts and expenditures). However, if the stored raw material has more than 1 storage area, the coordinates of the center point of the raw material can be calculated using the formula of the combined center of gravity of homogeneous objects [8]. Material flow patterns will refer to the overall pattern in the production flow from the beginning of the production process (receiving raw materials) to the final process (finished products). And in general will be divided into two types, namely material flow patterns for the production process and for the assembly process [9]. Systematic Layout Planning (SLP) is widely applied to a variety of problems including production, transportation, warehousing, support services and activities encountered in offices [2].

3. Comparison study and research gap

3.1. Research Of Improvement Layout With Systematic Layout Planning (SLP)

Research of Ojaghi Y. (2015) explained about improvement layout using systematic layout planning (SLP) method, according to the number of competitors in the global marketplace, it is important for companies to reduce their costs and expenses in order to be a sustainable competitor. As a case study, a company producing meatball and soup paste located at Bayan Lepas, Penang was selected with a view of finding a sustainable layout that minimizes travel distance, material handling and losses. A few steps were taken to achieve this aim. Firstly, several layouts were generated using two types of construction techniques, viz. Systematic Layout Planning (SLP) and Graph Based Theory (GBT). In the next step, the Efficiency Rate (ER) of each layout was calculated. The layout with the highest ER was then selected and optimized by using Pairwise Exchange Method (PEM). The result showed that the ER of the selected layout improved from 90.43% to 94.78% after optimizing. Based on this study, it was found that even the best selected layout could be improved, and it is necessary to conduct facility and layout planning before any factory set up to ensure sustainable process and reduce losses [10].

Research of Ali Naqvi S. (2016) explained about improvement layout using systematic layout planning (SLP) method, and talked about the implementation of lean manufacturing principles and believing in continuous improvement are the tools which help industries to sustain global competition. With the escalation in population, the demand for technology is increased more than ever. This leads to the steady increase in production rates of existing models and even introduction of new product models. These factors often results in "layout modification" of manufacturing industries. Plant layout improves resource utilization and provides means for application of lean tools such as 5S, seven wastes, kanban, Just In Time (JIT), etc. These tools not only contribute in reducing cost but also benefit the organization by improving product quality. This paper provides a comprehensive comparison of different approaches used in layout design. The study also simplifies the application of systematic layout planning (SLP) in the development of new layout. SLP is a technique used for layout development and material flow improvement. A case study of layout design using SLP is presented for a multinational company which manufactures a product with high variety. The results include four

possible rearrangements of production departments. These layout alternatives are evaluated on basis of improved accessibility and material flow efficiency criteria. Thus, the economic benefits achieved by overall integration of facility are highlighted. The results illustrate the impact of layout design on elimination of waste and the economic benefits achieved by reducing overall material flow and lead time [11].

3.2. Research of Improvement Layout and Area With Integer Linear Programming Model

Research of Zhang G. (2017) explained about improvement layout using integer linear programming model method in warehouse area, studying a real-world production warehousing case, where the company always faces the challenge to find available space for its products and to manage the items in the warehouse. To resolve the problem, an integrated strategy that combines warehouse layout with the capacitated lot-sizing problem is presented, which have been traditionally treated separately in the existing literature. We develop a mixed integer linear programming model to formulate the integrated optimization problem with the objective of minimizing the total cost of production and warehouse operations. The problem with real data is a large-scale instance that is beyond the capability of optimization solvers. A novel Lagrangian relax-and-fix heuristic approach and its variants are proposed to solve the large-scale problem. The preliminary numerical results from the heuristic approaches are reported [12].

3.3. Research of Relayout and Area in Industry Through Multiple Methods

Research of Faisal M. (2017) explained about improvement layout and re-layout using multiple method in industry area, a good layout can streamline transportation within the factory, it contributes to lower cost and delivery time. This research is based on the case in a food company in Indonesia. This company produces snack. The characteristic of this production process is made to stock system with 24-working hours. From the observation of the production process, it indicates that layout planning is ineffective. This showed on long distance to move design items, a high number of worker and low throughput as well. The aim of this research is to re-layout in order to improve throughput and also reduce the number of workers and the distance. A conceptual model was developed to determine factors and responses of the system. Three scenario layouts were developed by using MULTIPLE methods. These scenario layouts were then translated and analyzed into operational models using the ProModel 6.0 Simulation Software. The results indicate an improvement of throughput by 15% for scenario 1, 28% for scenario 2, 21% for scenario 3. And for the number of workers reduce 13% for scenario 1, 2, and 3. For the over distance reduce 83% for scenario 1, 87% for scenario 2, 86% for scenario 3. Generally, scenario 2 give the largest improvement than other although need more expensive cost investment [13].

3.4. Research of Improvement Production Facilities In BLOCPLAN and Other Methods

Research of Triagus S. D. (2017) explained about improvement production facilities and layout using blocplan and other methods. The other method that Triagus S. D. used is corelap. By using a different method, blocplan and corelap gave also a different result for each analysis. This research had a result in improvement of efficiency and material handling cost. MMM is one of the growing SME located in Malang, producing fried soybean with a capacity of 12 quintals per week. Unfortunately, it is discovered that MMM occupies an overly large area to operate its production. While the industry only requires 19.063 m² for the fried soybean's cooling process, the area provides 83,6m² to occupy. This resulted on longer ingredients distribution track, incompatibility materials treatment, and higher risk of dam- aged production machines and equipment. In addition, the overly large production area hampers the workers while distributing the ingredients from one place to another. This obstruction can possibly increase the risk of work accidents during the production process, for instance, failure in distributing material or even finished products. Among the recommended methods, BLOCPLAN and CORELAP (Computerized Relationship Layout Planning) are considered as the most suitable methods to improve the MMM's area layout. Based on this research's find- ings, BLOCPLAN is approved to be the most

applicable method to improve the MMM's area layout with an efficiency percentage of 52.70% and OMH per year Rp2.384.981. Meanwhile, CORELAP can only show an efficiency percentage of 31.35% with OMH per year as much as Rp 3.461.765 [14].

Research of Tarigan U. (2018) explained about improvement production facilities and layout using blocplan algorithm, the problem experienced by the manufacturing company that produces soap bars is the waste in its production process. The research objective is to reduce waste in the production process flow in terms of distance of displacement of the material nor heap of material of the production process of laundry soap bars so it can increase the productivity. To solve the problem, implementation integration of lean manufacturing and BLOCPAN algorithm is used. In the early stages, value-added activities and activities that are not value-added is identified through the depiction of value stream mapping, and value-added activities that are not reducible to the application of the principle of 5W and 1H. To get the total minimal distance to move materials, it is necessary to re-layout production facilities with BLOCPAN algorithm. Future state mapping is used to get an idea of the final result, in which all non-value added activities can be reduced, and the shorter lead time obtained in the production process. With the application of those two methods, process cycle efficiency is increased 33.62% resulting in increased productivity of the company amounted to 204 packs of soap bars each day [15].

Description	Authors									
	Zhang G.	Ali N. S.	Puspita I.	Ojaghi Y.	Benitez G.	Flessas M.	Faishal M.	Triagus S. D.	Andriani D.	Tarigan U.
Improvement	X	X	X	X	X	X	X	X	X	X
Method/s	Integer Linear Programming Model	SLP	Blocplan Algorithm	SLP	SLP	SLP	Multiple	Blocplan and Corelap	ARC and Blocplan	Blocplan Algorithm
Number of Alternative Layoyt	1		1	1			3			
New Layout/ Re-layout	Re-layout	Re-layout	Re-layout	Re-layout	Re-layout	Re-layout	Re-layout	Re-layout	New Layout	Re-layout
Country	United Kingdom	Pakistan	Indonesia	Malaysia	Brazil	British	Malaysia	Indonesia	Indonesia	Indonesia
University/ Institution	University of Windsor	NED University of Engineering & Technology	Telkom University	Universiti Teknologi Malaysia	Universidade Federal do Rio Grande do Sul		Universitas Ahmad Dahlan	Universitas Brawijaya	Universitas Brawijaya	Universitas Sumatra Utara
Effectiveness of Layout			55 %	94.78 %		40 %	2.21 %	52.7 % 31.35 %		33.62 %
Industry	Production Warehouse	General	Paper and Plastic	Meatball and Soup Paste	University Hospital	Industrial Kitchen	Snack	Fried soybean	SMEs	Soap Bars
Production Capacity per Year					850 beds			62.400 kg		74.460 pcs
Material Handling Cost								Rp 2.384.981		

								Rp 3.461.765		
Benefit Cost			\$ 26479. 59 in 2 nd year							

Table 1. Research Gap

4. Research and discussion

By analyzing and studying all papers, the researcher found many methods to improve and make layout planning in any kind of industry. However every methods has their own advantages and disadvantages, so using a method for improvement layout must sincronizing the problem and the method by verification and validation. These are the conclusion of the papers, first paper of Ojaghi Y. (2015) and Ali N. S. (2016) are about systematic layout planning (SLP) method. The second research are the paper of Zhang G. (2017) is about integer linear programming model method. The third research are the paper of Faisal M. (2017) is about multiple methods. The final research are the paper of Triagus S. D. (2017) and Tarigan U. (2018) are about blocplan and other methods.

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