

**APPLICATION OF GRAPH-BASED METHOD FOR
MANUFACTURING LAYOUT EVALUATION**

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) (Hons.)

By

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DECLARATION

I hereby, declared this report entitled “Application of Graph-based Method for Manufacturing Layout Evaluation” is the results of my own research except as cited in the references.

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Date : 23rd June 2015

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) with Honours. The member of the supervisory committee is as follow:

.....
(Profesor Dr. Adi Saptari)

ABSTRACT

One of the key elements to improve efficiency in manufacturing operations is facility layout. This study was conducted in Coraza systems Malaysia, Penang. The company produces industrial parts. Based on the observation and interview sessions, it was identified that there were found inefficiency on manufacturing facilities layout. It total travels distance was high. The objectives of this study are to investigate the current layout in production area and to propose an improved layout to minimize the travel distance by using Graph-Based Method. The dimension of layout were measured by using a measuring tape and the travel distance of current layout were generated by using Pythagoras Theorem to find the total of travel distance. The Graph-Based Method applied to rearrange the layout. The results show that final layout was arranged with same areas for each department but different arrangement and shape of layout. The result of proposed layout and current layout were compared. The proposed layout was proved better than the current layout with 36% reduced the travel distance between departments.

ABSTRAK

Salah satu elemen penting untuk meningkatkan kecekapan dalam operasi pembuatan adalah susun atur kemudahan. Kajian ini dijalankan di Coraza sistem Malaysia, Pulau Pinang. Syarikat ini mengeluarkan bahan-bahan industri. Berdasarkan pemerhatian dan temu duga telah dikenal pasti bahawa terdapat ketidakcekapan kepada susun atur kemudahan pengeluaran dengan jumlah jarak perjalanan adalah tinggi. Objektif kajian ini adalah untuk menyiasat susun atur semasa di kawasan pengeluaran dan cadangan susun atur yang lebih baik untuk mengurangkan jarak perjalanan dengan menggunakan Kaedah Graf Tani. Susun atur diukur dimensi dengan menggunakan pita pengukur dan jarak perjalanan susun atur semasa telah dijana dengan menggunakan Teorem Pythagoras untuk mencari jumlah jarak perjalanan. Kaedah Graf Berasaskan digunakan untuk menyusun semula susun atur. Keputusan menunjukkan susun atur akhir telah diatur dengan kawasan yang sama bagi setiap jabatan tetapi susunan dan bentuk susun atur yang berbeza Hasil daripada cadangan susun atur dan susun atur semasa berbanding. Susun atur yang dicadangkan telah terbukti lebih baik daripada susun atur semasa dengan 36% mengurangkan jarak perjalanan di antara jabatan-jabatan.

DEDICATION

For my beloved father and mother

MR. W ROSLAN BIN W MAHMOOD

MDM. FARIDAH BINTI AWANG

And for my Supervisor, family and friends. Thank you for their loves and supports

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Alhamdulillah, all my praise to Allah S.W.T for the bless that been given to complete Project Sarjana Muda 1 (PSM 1) and Project Sarjana Muda 2 (PSM 2) successfully. In this good opportunity, I would like to thank you to all people that involved directly or indirectly in completing this technical report. Firstly, I would like to thank to my supervisor, Profesor Dr.Adi Saptari, for his guidance, advices, ideas and support all of the way through the execution of this project. Not forgotten, my appreciation also goes to all lecturers from the Faculty of Manufacturing Engineering (FKP) for all the supports, contribution and cooperation during my investigation and completing my project. Finally, I would like to thanks to my family, especially to my parent and siblings for their love and support from behind. Not forget to all of my colleagues and members that help and give their opinions for completing this project and report either directly or indirectly.

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CHAPTER 1

INTRODUCTION

1.1 Background

Today, in manufacturing industry a good placement and arrangement of facilities contributes to the overall efficiency of operations and can minimize until 50% the total operating expenses (Tompkins et al., 2010). A facility layout is an alignment of everything required for production of goods or transportation of services. A facility is an something that facilitates the performance of any activity. It may be a machine tool, a work place, a manufacturing cell, a machine shop, a department or section, a warehouse, etc. (Heragu, 2008). In addition, the facility layout or working environment has a crucial full force on employment, maintenance, productivity and also on the organization's potentiality to target it business strategy (Gensler, 2005).

One of the important aspect in design of manufacturing layout is using for the implementing the material flows and physical relationship between activities. In a layout development project the layout should be structured first and then that the material handling system should be established. Later, material handling decisions can have a major impact on the efficiency of a layout.

There are four primitive of layout types which are fixed material location departments, production line departments, product family departments and process departments. A number of varied styles have been developed to serve the facilities planner in evolving layout selections. These procedures can be classified into two major groups which is

construction type and improvement type. Construction layout method generally involves the designing of new layout from scratch and improvement procedures is producing layout alternatives by looking for improvements in a current layout. On the other hand, improvement methods were expound for formal procedure that can assist the layout analyst develop or upgrade a layout and at the same time contribute with objective criteria to enable the evaluation of a variety of layout alternatives that emerge in the process. There are three algorithm classification which are relationship diagramming of new layout, pair wise exchange method, and graph based method. For this study, the evaluation of layout is applying the graph based method.

There are relationship between layout and lean manufacturing to maximize customer value while minimizing wastes which is simply creating more values for customers with fewer resources. By practice of the principle of lean thinking is identifying the wastes of waiting, inventory, transportation and motion can lead to evaluate the layout for improvement. Usually, the waste of waiting occurs due to the transportation and motion that need to eliminate to improve layout by application of Graph Based Method.

This study is taken place at Coraza System Malaysia (CSM) that is a international trader of high meticulousness sheet metal fabrication and joining. The company major in provision from beginning product concept and design, through manufacturing prototypes to finish production, assembly and integration. The company coordination services includes of punching, portable, stamping, sanding, spot welding, welding (TIG/MIG), clinching, riveting, CNC turning, CNC milling and assembly and also secondary processes such as of plating and anodizing, painting (wet paint, powder coat) and silk-screening. Coraza Systems Malaysia developed several small medium businesses to advance their capabilities and improve their business and they opened the doors to their new accommodations in 2005. In this three-acre area, 74,000 square feet of the 96,000 square feet built up area is developing to their production floor to serve customers satisfied. The application of graph based method is to improve the layout at Coraza System Malaysia by reducing space and cost of the manufacturing.

1.2 Problem Statement

Coraza System Malaysia Sdn Bhd is a US manufacturer for supply the metal sheet such as AG-DTL, Jambil, Keysight and so on. However, they are facing problems that related to the layout. This study will focussed in the production line department of Coraza System Malaysia Sdn Bhd. Based on the interview with Coraza engineers it has found that there are some problems faced. Among them are:

1. Based on the interview with supervisor of machining department and also observation at the company, it was found that the company layout arrangement were not organized. For instance, this material of metal part can expose of injury or harm to workers and damage to the materials. So, the Coraza need more space for placing the machine to avoid any facilitates flow of traffic during doing the work and prevent the injury from been happen. Figure 1.0 below shows the some of environment in Coraza.
2. Coraza faced the problem of longer time for transporting raw material, parts tools and finished goods between the departments, it was observed that the layout arrangement may be the cause. Hence, its need a smooth flow of process to reduce the waiting time.



Figure 1.0: Work areas in Coraza System Malaysia.

1.3 Objectives

The objectives in this study as follow:

- 1) To investigate the current production layout.
- 2) To propose a new layout that minimize the travel distance by using Graph-Based Construction Method.

1.4 Scope and Limitation

This study is to analyze the problem faced by Coraza System Malaysia Sdn Bhd. However, there are some limitations in the area that this study is made. This study is only concentrate on making the improvement for the production line department that involved the departments of CNC machine, level machine, grinding machine, clinching machine, laser machine, bending, power press, WIP area, stamping machine, sanding machine, laser welding, welding, spot weld, storage for shipping, shipping, machine room, storage for carton and quality assurance. Other departments in Coraza are not in the consideration of this study

Current layout is used for making analysis of the evaluation of layout. Proposed layout improves the layout by using Graph-based Method and the other method such as relationship diagramming and pair wise exchange method are all not in the scope of this study.

1.5 Organization of Thesis

The organization for this thesis according to the format in Projek Sarjana Muda 1 and 2 stated as below so that it can roughly shows the content in this case study.

Chapter 1: Introduction

This chapter includes the background of relevant topic, problem statement, objectives, and scope and limitation.

Chapter 2: Literature review

First of all, this chapter begins in explanation of the history of how the productivity can be related to the layout, following by explanation of application of graph based method in manufacturing layout evaluation. Besides, the findings in journal and articles are stated in a table.

Chapter 3: Methodology

Generally, this chapter stated the flow chart that carried out for the whole process of the methodology. Next the data collection that includes the primary resources and secondary resources that obtained from production department of Coraza is showed to help in the problem analysis.

Chapter 4: Result and Discussion

Again, this chapter covers the company background and the operation process chart for metal sheet process. Then, the data collections are done based on the layout evaluation of the metal sheet process for each product operator. For the discussion, involve about the discussion of the data analysis based on the evaluation obtain in chapter 4. The data of flow process of 5 products at CSM, the schedule of customer order, the quantity of product, material handling and the distance between spaces are used as the main tools for the improvement of productivity. Further explanation is discussed in this chapter.

Chapter 5: Conclusion

Lastly, this chapter concluded the main findings for the thesis. Besides, the suggestions for the further improvement of layout that are related to application of graph based method are also stated in this part.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the research review is focused on several main sections, for explanation of the history of how the productivity can be related to the layout, following by explanation of application of graph based method in manufacturing layout evaluation. This information is useful so that appropriate layout in manufacturing industry can be chosen by using the graph based method.

2.2 Layout in Manufacturing Industry

A facility layout is an alignment of everything required for manufactures of goods or transit of amenity. A facility is a something that facilities the performance of any activity. It may be a machine tools, a work place, a manufacturing cell, a machine shop, a department or section, a storeroom (Heragu, 1997). According to Liggett (2000), the problems of layout that related in the design, rearrangement and allocation of space in a new production area lead to the evaluation of layout by testing alternative options for production area. The layout evaluation also considers for reuse and rearrangement of space. Plant can be applied to determine such things as the optimal number of floors, perimeter of the plans, etc of the layout that respect to the better use of space. To solve the problem of space management, layout tool can be applied. Since the early 1960s, computer programs have been developed for the solution of the problems of layout.

Computer science/ engineering have been research about the problems of production layout and also the architects and interior designers suggest to design and develop of facilities area such as in manufacturing industry. Before the evaluation of layout in manufacturing industry, the researcher needs to identify the floor plan layout, dimensions of plan layout and the physical arrangement of space on a plan. The allocation of problems is identifying used to generate, compare and evaluate solution of plan layout.

2.3 Types of Layout

There are important in design of new facility layout due to design a layout that will upgrade the process flow and reduce wasted spot. Furthermore, the planning efficiency layout also can reduce the distance travel between the department or process, reducing cost and functionality. Usually, the new layout will be developing through experiences of the planner layout and the technical knowledge. Although, experienced person is important by using the skills in developing new layout, but the knowledge also essential due to the technical knowledge such the material handling, process flow and forecast of future needs. A capable understanding of the tools to reduce wasted space and motion however is readily educated and provides good fundamentals from which to start a facility layout (Stevenson, 2002). There are three main types of layout which are the product layout, the process layout and the fixed-position layout.

2.3.1 Product Layout

The product layout is commonly less flexible and required more basic appliances cost, but minimize process cycle time and increase equipment usage. This product of layout usually is used in the production area, where service or process are standardized and minimum variation is applied, for instance assembly line. The time for one to transfer through the workstation has almost the equal of cycle time due to the process in the

proper line. If one workstation uses much longer time than the next, then the second workstation is seemingly to spend much more time waiting for parts from the first workstation. Conversely, if the second workstation used longer than the first, then the first is like as not to spend much more time waiting to transfer parts to the second (Stevenson, 2002). Based on Figure 2.0 below shows the example flow of product layout.

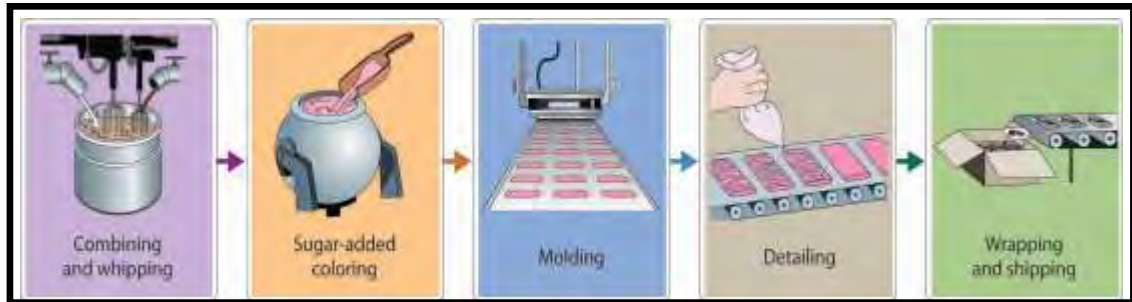


Figure 2.0: Production line product departments (Collins, 2012).

2.3.2 Process Layout

Process layout is group type of process which is the areas, equipment and so on, jointly to present the most flexibility. The process layout tool in Figure 2.1 is involved in design by using the quantitative and qualitative factors in determine which departments should be closer or neighbourhood with each other. Qualitative factors are simply analyzed in a closeness rating chart create by Richard Muther knowing as Systematic Planning Layout (SLP). The codes take these elements into considerations:

- Similar tools or facilities are used
- Sharing the similar items, records and interaction
- Arrangement of workflow
- Risky or unpleasant conditions

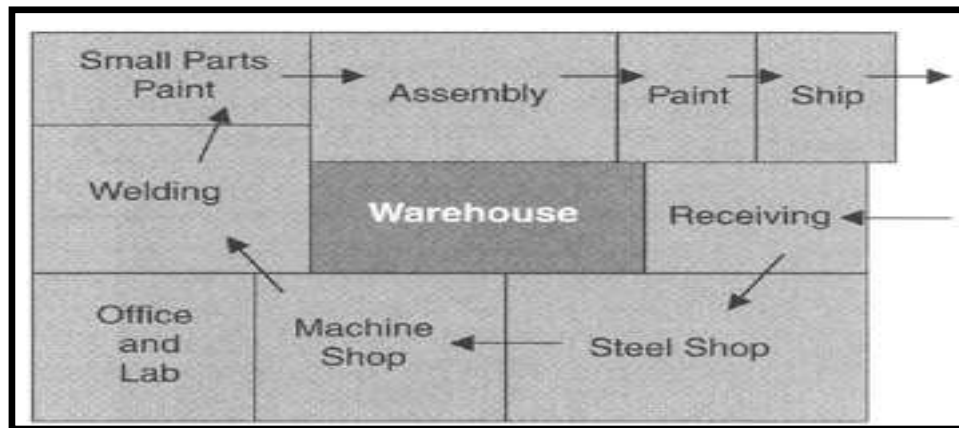


Figure 2.1: Process Department (Sheldon, 2014).

2.3.3 Fixed-position Layout

The fixed-position layout is a fixed service position where personnel and material simultaneously responsible to perform the service. Developing a fixed-position layout is more difficult due to problems about the space constraint and even timing has to be determined. The layout of the fixed material location department as shown in Figure 2.2 also involves the ordering, assigned and location of variable of workstations around the material or product.

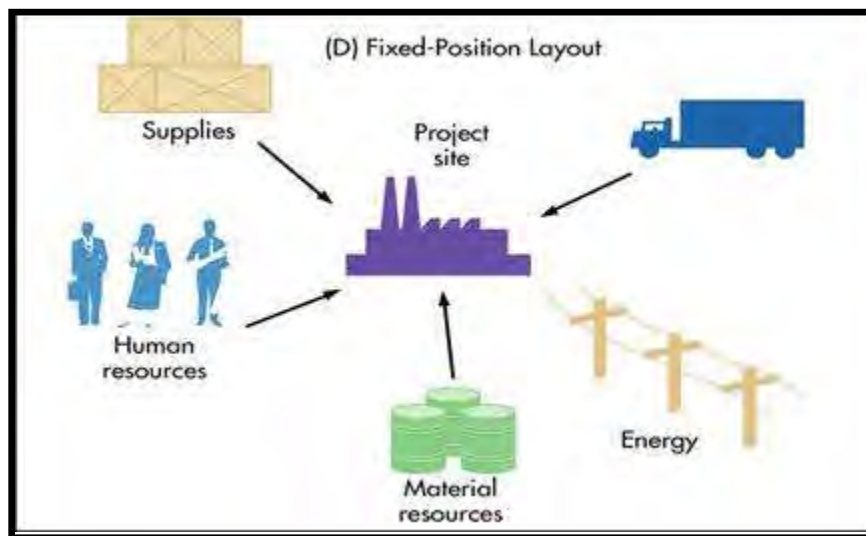


Figure 2.2: Fixed- position departments (SCRIGROUP, 2014).