UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPLICATION OF RELATIONSHIP CHART METHOD IN FACILITY LAYOUT

Thesis submitted in accordance with the partial requirements of the Universiti Teknikal Malaysia Melaka for the Bachelor of Manufacturing Engineering (Manufacturing Management) with Honours

By

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DEDICATION

To my beloved Father, Mother, and Sisters
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ABSTRACT

A general facility layout problem is concerned with the physical organization or allocation of a production system. However, in practice, these problems are generally formulated and solved sequentially due to the complicated nature of the integrated problem. Specifically, there is close interaction between the formation of departments and layout of these departments. These problems are treated as separate problems that are solved sequentially. This procedure is mainly due to the complexity of each problem and the interrelationships between them. In this research, we take a first step toward integrating the flow-based department formation and departmental layout into comprehensive relationship chart and develop appropriate solution procedures. A heuristic placement procedure, which is capable of changing the orientation of facilities, is proposed to place the machines in the floor area, in order to obtain minimum flow distance travel. Relationship analysis is one of the tools for managing and arranging a layout and is the basic foundation plant layout. This method can be used to generate good solutions quickly. In this research, the relationship chart method is used to produce various layouts. The layouts are then compared to the current layout based on the total flow distance. Overall, the results show that the layouts developed through the relationship chart method are more efficient than the current layout. In fact, reduction in flow distance as low as 467.691m, which is equivalent to 32% reduction, is recorded.
1.0 Introduction

Having facilities arranged in an optimum manner is necessary for company survival. The optimum for facilities arrangement on certain performance measure is called facility layout (Pinto and Shayan, 2007). This research centers on designing an improved layout such that distance travel can be reduced. Specially, this chapter provides introduction to this research. Therefore, Section 1.1 describes the corrupt of facility layout. Section 1.2 presents the problem statement. Section 1.3 describes the research objectives. Section 1.4 presents research scope. Section 1.5 describes the research methodology. Section 1.6 presents research up to date. Finally, Section 1.7 describes the organization of this chapter.
1.1 Concept of Facility Layout

Facility layout is an important part in engineering field or industry. There are various definitions for facility layout. For variable capacity sizing and selection of connections in facility layout, manufacturing facility is the arrangement of a fixed number of departments so as to optimize a certain performance measure, such as travel time or manufacturing costs (Simin Huang, Rajan Batta and Rakesh Nagi, September 2001). Other researcher such as Pinto and Sahyan (2007) in their research about layout design of a furniture production line using formal methods, they defined that a plant layout problem is to find the best arrangement of physical facilities to provide an efficient operation. As a part of productivity improvement program, they conducted a project to optimize the layout design of the production line at the shop floor of the company aiming at overcoming the current problems attributed to the inefficient layout.

More than one reasons for describe the used of facility layout. For the industry, it commonly used to determine the area of the company. Area of work is important to give comfortable and easier for their worker in the production. Distance for each department and related for each section will not make the worker or product take too long time in the production. Beside it will make the control of production easier and in arrangement.

Requirement for facility layout depends on the problems that occur in the industry. For variable capacity sizing and selection of connections in facility layout, Huang, Batta and Nagi (2001), claimed that objective and goal of facility layout is to select the location and the capacity of connections (and to assign the flows) so as to minimize the sum of the fixed connections installation costs and material movement cost in the material handling system. This can be reduce to the incapacitated fixed charge facility location. In addition, in current industry, production innovation, production development and
shorter time to market are crucial aspects to face along with customers demands and increasing competition on global marketplace. Market timing and customer requirements are very important in order to meet the market window. Because of that, the industry needs to optimize their facility layout. An optimised facility layout ensures that manufacturing operations are run in optimum performance (Fruggiero, Lambiase and Negri, 2006).

The advantage of facility layout is to help any company to improve its business performance. Having good facility layout may reduce the total production time per unit along with reduction in material movement and material handling requirements. In addition, proper control of production flow may ease defect detection and control. Meanwhile, the facility layout may bring disadvantages such as increasing in the cost of new layout set up. Other than that, it requires greater skill of personnel to design and determine the best layout profitable to the company.

1.2 Problem Statement

ISUZU HICOM Malaysia Sdn.Bhd is one of the companies under DRB-HICOM which is located at Peramu Jaya Industrial Area nears the royal town residence of Sultan Pahang known as Pekan. Formerly known as Malaysian Truck & Bus Sdn Bhd, MTB formed in 1994 with the sole purpose of becoming the leader in producing commercial vehicles manufacturing industry in Malaysia, catering for both domestic and export markets.
As a factory that have been establish for more than 20 years, the area of production is not longer same and there are lot of changes have been made. The changes may also become of expansion to new area of buildings. The problem for this company is the forms of facility layout that they used are not arranged according to production flow process. Furthermore, sometimes the positions are too far and too close to each other department or section. Although, the production flow process is same, the layout of production for each department is not arrangement. This will affect to the company productivity. In this research, a new layout is design to improve the space utilization and distance travel.

### 1.3 Research Objective

In the general the objective of this research is to design a new layout that can improve space utilization and distance travel for the company (Isuzu Hicom Malaysia).

The specific objectives of this research are as listed below:

- To identify the performance measure suitable for facility layout.
- To improve new pattern layout using relationship chart method.
1.4 Research Scope

This research mainly focuses on the facility layout at Isuzu Hicom Malaysia. The data collection will be limited from the industry actual layout. This research will only use flow distance as a single performance measure. The productivity of the production and many more will not be covered in this research. In addition, only one technique will be used to solve the flow distance layout problem in this research.

1.5 Research Methodology

Based on the flow chart in figure 1.1, this research starts with identification of the problem that occurs in the industry specifically in the Isuzu Hicom Malaysia. After identify the problem, the suitable technique and performance measure for the problem are selected. The objective and scope will then be determined before processing to data collection on Isuzu Hicom Malaysia facility layout. Then, based on the existing layout, several new layouts will be designed to get more than one comparison between the existing layout and new design layout. The existing layout and new design layout will be analyzed analytically to identify which one of the layouts is more suitable and give advantage to the company. If the design layouts are rejected or have any problem, process of redesigning is repeated until new improved layout is found. The last step on the flow chart is making conclusion for this research.
Figure 1.1 The flow Chart showing the research step

START

IDENTIFY THE PROBLEM STATEMENT

SELECT TECHNIQUE AND THE PERFORMANCE MEASURE

DETERMINE THE OBJECTIVE AND SCOPE

DATA COLLECTION ON FACILITY LAYOUT

EXISTING LAYOUT

DESIGN THE VARIOUS NEW LAYOUTs

ANALYZE LAYOUT DESIGNs

RESULT

CONCLUSION

STOP
Chapter 1 represents the introduction of the project conducted which is concept of facility layout, problem statement, research objectives, research scope, research methodology, statement of work and organization of report. In this chapter, it explains clearly how the subtopics influence each other in this project.

Chapter 2 represents the literature review conducted for this research. It covers the background on facility layout. It explains about the basic information and definition facility layout according to journal. After that, it defines the reasons for the necessity for facility layout to industry. Lastly summary of the journal on the facility layout problem focusing on performance measures and the methods for each authors are presented before concluding the chapter.

Chapter 3 represents the concept of method that is used for solving this research. It describes the selection technique that is used. This chapter is consisted the of background on relationship chart, which is one of the tools to manage and arrange the facility layout. The advantages and disadvantage of the relationship chart were also presented to show effectiveness of using the relationship chart. These chapter also describes the activities that is required in using relationship chart for facility layout

Chapter 4 describes the case study industry. This chapter explains about the background of Isuzu Hicom Malaysia which includes the location, areas and product that they produced. Beside that these chapters also identify the actually problem of facility layout in this company. The current layout of this company will be shown in this chapter.
Chapter 5 presents the experimental design for this research. Specifically, this chapter presents the step by step procedures to be followed throughout the experiment.

Chapter 6 presents the result and analysis for this research. Initially, the current layout is presented. Then, the activity relationship chart, relationship diagrams and relationship space diagrams are developed. Based on the diagrams, the new layouts are proposed. Five new designed layouts are presented. The layouts are finally analyzed and compared the best layout is then selected.

Chapter 7 presents the conclusion of this report. It consists the introduction for conclusion chapter, background of research, research finding, and recommendation for further research and conclusion for this chapter.
CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

Facility layout problem can be defined as to find the best arrangement of physical facilities such that to provide an efficient production operation (Pinto and Shayan, 2007).

Proper arrangement and allocation of facilities are necessary to ensure manufacturing activities operates at optimum efficiency. Realizing the necessary to have a good facility layout, this chapter laid foundation towards solving problem related to facility layout. Specifically, Sections 2.1 introduce the concept of facility layout. Section 2.2 explains the necessity to have proper facility layout. Section 2.3 is review of literature in facility layout before concluding the chapter in Section 2.4.
2.1 Background Facility Layout

Facility layout is an important part in engineering field or industry. Each researcher has their own definitions for facility layout. For example, in variable capacity sizing and selection of connections in facility layout, manufacturing facility is the arrangement of a fixed number of departments so as to optimize a certain performance measure, such as travel time or manufacturing costs (Simin Huang, Rajan Batta and Rakesh Nagi, 2001). The location and capacity sizing for a plan have a strong impact on the efficiency of a Manufacturing Material Handling System (MHS).

In research of design and optimization of a facility layout problem in virtual environment (Fruggiero, Lambiase and Negri, 2006), said that a general facility layout problem is concerned with the physical organization/ allocation of a production system. It can be considered belonging to the class of NP-hard Problems and is described as the generalization of a Quadratic Assignment Problem (QAP). Specifically, M facility needs to be allocated to M locations (where M represents the problem size). The aim is to find a criteria, which maximize/ minimize certain objectives (quantitative ones like production time, flexibility in volume and variety, allocation space, product quality, costs etc), such that the most efficient arrangement of M indivisible departments with unequal area requirement within a facility.

Other researcher such as Pinto and Sahyan (2007), in their research about layout design of a furniture production line using formal methods, defined that a plant layout problem is to find the best arrangement of physical facilities such that to provide an efficient operation. Specifically, the best layout was compared with the existing layout to demonstrate improvements gained by former approaches to layout design using multicriteria methods of layout. As a part of productivity improvement program, they
conducted a project to optimize the layout design of the production line at the shop floor of the company aiming at overcoming the current problems attributed to the inefficient of the layout.

Furthermore, Norman, Smith and Arapoglu (2004), provided different meaning to facilities layout. They defined facility layout as an integrated facility design using an evolutionary approach with a subordinate network algorithm from difference corners. They claimed that facility design problem is a common one in manufacturing and service industries and is one family of design problems involving the partitioning of planar region into departments or work centers of given area, so as to minimize the costs associated with projected interactions between departments.

2.2 The Necessary for Facility Layout

Requirement for facility layout depends on the problems that occur in the industry. For variable capacity sizing and selection of connections in facility layout, Huang, Batta and Nagi, 2001, claimed that objective and goal of the facility layout is to select the location and the capacity of connections (and to assign the flows) so as to minimize the sum of the fixed connections installation costs and material movement cost in the material handling system. This can be reducing to the incapacitated fixed charge facility location.

In addition, in current industry, production innovation, production development and shorter time to market are crucial aspects for industry to face customers’ demands and increasing competition in global marketplace. Market timing and customer requirements
are very important in order to meet the market window. Because of this, the industry needs to optimize their facility layout. An optimised facility layout ensures that manufacturing operations are run in optimum performance (Fruggiero, Lambiase and Negri, 2006).

Moreover, Pinto and Sahyan (2007), claimed that facility layout can reduce manufacturing cost and improve quality of the product. The layout will affect the cost of material handling, lead time and throughput. Hence, it affects the overall productivity and efficiency of a plant. Apart from that, facility layout are needed to provide an efficient operation where the best layout was compared with existing layout to demonstrate improvements gained by former approach to layout design using multi-criteria objectives.

Besides that, Norman, Smith and Arapoglu (2004), argued that facility layout aim is to produce an integrated design that have better translations into physical plant designs. They used the distance metric to produce facility designs that simultaneously optimize design of department shapes, department placement and location of the department input/output points. Their objective is to minimize the costs associated with the projected interactions between departments. These costs usually reflect material handling costs among departments.