UNIVERSITI TEKNIKAL MALAYSIA MELAKA

REDESIGN OF WEAVING DEPARTMENT LAYOUT USING SYSTEMATIC LAYOUT PLANNING (SLP)

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

by

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2016

ABSTRAK

Tujuan projek ini dijalankan adalah untuk mereka bentuk semula susun atur kemudahan dengan menggunakan kaedah Perancangan Susun Atur Sistematik (SLP). Sasaran projek ini adalah sebuah syarikat tekstil yang hanya memberi tumpuan pada bangunan tenunan. Berdasarkan pemerhatian, masalah susun atur yang dihadapi syarikat ini adalah ketidakcekapan aliran proses dan juga pengendalian bahan. Projek ini akan menganalisis susun atur semasa dan mereka bentuk semula alternatif susun atur baru untuk mengatasi masalah tersebut. Pengumpulan data termasuklah dimensi susun atur semasa, jenis pengeluaran, jarak antara jabatan-jabatan, saiz jabatan, aktiviti atau proses yang terlibat dan aliran proses produk. Selepas pengumpulan data, siri langkah-langkah asas mengenai Perancangan Susun Atur Sistematik (SLP) telah dijalankan. Langkah pertama ialah membina carta hubungan aktiviti yang menunjukkan keakraban dan keutamaan setiap bahagian. Kemudian dari carta tersebut, gambar rajah hubungan telah dijana, dan diikuti oleh gambar rajah hubungan ruang, dan seterusnya daripada langkah tersebut, susun atur alternatif telah direka. Susun atur alternatif kemudian dinilai berdasarkan peningkatan perubahan selepas dibandingkan dengan susun atur semasa dari segi jumlah pergerakan untuk pengeluaran produk bagi satu minggu . Kesimpulannya, susun atur alternatif yang dijana menunjukkan peningkatan dan perubahan dari segi jumlah pergerakan untuk pengeluaran dan akhir sekali projek ini menyediakan beberapa cadangan penambahbaikan yang lebih baik untuk susun atur pada masa depan.

ABSTRACT

The purpose of this project is to redesign facility layout by using Systematic Layout Planning (SLP) method. The target of this project is a textile company which is only focus at weaving department/building. Based on the observation, it was found that the current design of layout indicate some inefficiency in terms of process flow and material handling. This project will analyze the current layout and redesign the alternative new layout for the better improvement. The data collected were the dimension of current layout, type of production, distance between departments, size of departments, activities or processes involves and process flow of the product. After the data collection, serial of steps base on Systematic Layout Planning (SLP) was carried out. The first step is built the activity relationship chart which show the closeness of each section. Then from the chart, the relationship diagram was generated, and followed by it was the space relationship diagram, from those result layouts was generated. The alternative layout then be evaluated based on the most improvement expected to be perform from this layout in term of the total movement for one week production. As conclusion, the generated alternative layout provides improvement in term of total movement traveled in production and provides some recommendations for the better improvement to the layout in future.

DEDICATION

To my beloved parents and family

Razali Bin Tahir

Zawiah Binti Wahab

ACKNOWLEDGEMENT

Alhamdulillah, be grateful to Allah SWT for his blessings, so this thesis could be finished to fulfil one of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons.) at Universiti Teknikal Malaysia Melaka (UTeM). The title of this thesis is "Redesign of Weaving Department Layout Using Systematic Layout Planning".

I am indebted and would like to express the deepest appreciation to my supervisor Professor Dr. Adi Saptari for his guidance, opinions, and advises in preparing this final year project. His precious advices, contributions, and comments has given great help for me in order to complete my project successfully.

I would like to express my sincere appreciation and special thanks to the company under study which is textile company that give me contributions in order to fulfill the requirements of the project.

Special thanks also goes to the my parents and all my family who has provided continuous spritual, financial and material support. Last but not least, i want to thank all the lecturers, friends, and all the people who involved in this study. Never ending love from me to all of you. Finally, i am considers that there are many weaknesses in this thesis, any suggestions and comments are very expected from the readers.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

SLP - Systematic Layout Planning

OFF - Office

ME.R - Meeting Room

TR - Training Room

MA.R - Maintenance Room

TS1 - Temporary Store 1

TS2 - Temporary Store 2

S1 - Store 1

S2 - Store 2

S.OFF - Security Office

PPS - Pre-Production Process

WS1 - Warping Section 1

WS2 - Warping Section 2

SS - Sizing Section

BS - Beaming Section

LS - Leasing Section

PR - Prayer Room

RR - Rest Room

C - Canteen

CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays it is important for an organization or any company to have an effective and efficient manufacturing facility layout. While in industry sectors, it is important to manufacture the products that have good quality and meet customer's demand to ensure the continuity of the company over time. The processes could be conducted under existing resources such as machines, employees and other facilities. In order to make and distribute things that can be sold, all decision variables are set at a level in which, for both maximum production control and efficiency, goods are to be standardized and produced away from the market and then be held in inventory until demanded and then delivered to the consumer with profit (Vargo and Lusch, 2004).

Manufacturing layout improvement, could be one of the tools to response to increase industrial efficiency and productivity. Therefore, manufacturing layout design has become a fundamental basis of today's industrial factory that influenced the work efficiency. It is necessary to make a plan and position materials, machines, employees, equipments, and other manufacturing supports and facilities to bring the most effective plant layout. Facility layout is a positioning of dissimilar features of manufacturing in an appropriate way as to achieve desired production results. Facility layout considers final product, available space, safety of users and facility and also convenience of operations. An effective facility layout make sure that there is a smooth and steady flow of production material, equipment and manpower at least cost. Facility layout looks at physical distribution of space for economic activity in the plant.

Therefore, the main objective of the facility layout planning is to create effective workflow as to make equipment and workers more productive.

"Facility layout must be considered very carefully because we do not want to constantly redesign the facility," summarized Weiss and Gershon (1989). Some of the targets in designing the facility are to make sure a minimum amount of materials handling, to avoid bottlenecks, to minimize machine interference, to ensure high employee morale and safety, and to ensure flexibility. Essentially, there are two different types of layout. The first one is product layout which is synonymous with assembly line and is oriented toward the products that are being made. Then process layout is oriented around the processes that are used to make the products. Usually, product layout is applicable for high-volume repetitive operations, while process layout is applicable for low-volume custom-made goods.

Nowadays, an inefficient facility layout has been obstructive the efficiency of the operation and development of the manufacturing business in many years. This problem caused of organization that insensitive about the importance of efficient or optimal facility layout can bring the many benefits to its manufacturing operation in terms of cost, utilization of space, equipment, people, efficient flow of information, material and employee safety. Generally, design of facility layout recognized as an important study in modern manufacturing system. An effective facility layout is based on the layout of machinery and departments. It is controlled by how to arrange the machines and departments to achieve minimization or optimal of production time, material handling, and indirectly to minimize the operation costs .

Stevenson (2007), presented the basis reasons to invest in facility layout design, which are included desire fundamental investments of money and effort, long-term commitments, and cost efficiency of operation because rearrangement of the existing layout will cost large expense and hard to accomplished. Therefore, an effective and optimal facility layout is required to minimize the costs, thus increase productivity. An ineffective facility layout would cause serious consequences in manufacturing operation to prolong or extend the time in operation. It contributes the

movement of personal and material between facilities, and thereby rise the material handling cost, and also pulls down the efficiency of operation and productivity. *"companies will experience significant disadvantages when uncoordinated action plans are developed in an integrated facilities environment, and this usually results in higher capital expenditure, lower operational flexibility, higher operating costs, poor space and equipment utilization, reduce throughput, poor working conditions and a decline in productivity."* (Gopalakrishnan et al., 2004). Consequently, these companies been suffered by bottleneck of development of new equipments or products due to limits on flexibility of utilization space, thus these companies will lost their competitive of its business in the globalization market.

Therefore, due to the facility layout problem that almost the factories had facing nowadays, there are various of method to solve this problem. For example, graph based method, pairwise exchange method, systematic layout planning and others. However, this project were used Systematic Layout Planning (SLP) in order to overcome facility layout problem at manufacturing industry. SLP is a technique used to arrange a workplace in a plant by locating two areas with high frequency and logical relationships close to each other. The process ensure the quickest material flow in processing the product at the lowest cost and least amount of handling. The systematic layout planning method more preferred because of it is step by step procedure. According to Rajshekhar (2010), he stated that SLP is advance because utilize graphic and schematic analysis for material flow. Beside that, SLP method in simple method which showed step-by-step of plant design from input data nd activities to evaluation of plant layout. This method provides the new layout that improves the process flow through the plant, and help to enlarge space in industries (Wiyaratn and Watanapa, 2010).

1.2 Problem Statement

Based on the preliminary observations and discussion with the staff of the company under study, it was found that the company facing facility layout problem in weaving department. This indication can be seen as:

- Improper department/section placing.
- Flow of the process not smooth and uncoordinated.
- Inefficient material handling.

Because of this, it contributes to the longer distance travelled to complete one product. The impact of this problem is the process is not running smoothly and indirectly contribute to the slower production. Besides, due to the improper department placing, the impact is to the uncoordinated utilization space of the factory.

1.3 Objectives

The objectives of this project as following :

i. To identify and analyze the weaknesses of current layout of weaving building.
ii. To redesign a new layout of weaving building by using Systematic Layout Planning (SLP) method.
iii. To validate the alternative layout of the company by comparing previous and recommended.

1.4 Scope of Study

The scope of this project is to investigate the company layout that focused on line production at weaving department. This project is mainly relate to facilities layout redesign. As for detail of scope of this project, it will include literature study of methods and type of facilities planning widely used in nowadays manufacturing around the world. Modified layouts will be designed recommend according to the shortcoming of the current layout. Redesign layouts will be evaluated and compared

before the alternative layout will be recommended. In addition, only one technique will be used to solve the problem in this research.

1.5 Significance of Study

Layout is very important because it can influence of an efficient layout on the manufacturing function. The improvement on layout can makes it smooth and efficient. The proper layout give impact to the working efficiencies such as economies in the cost of handling materials, minimization of production delays and avoidance of bottlenecks. Besides, the proper layout can contributes to the better working condition, better employee facilities and for the safety environment.

1.6 Organization of the project

Chapter 1, described about the introduction or background about the topic .It also covered about the problem statement, objectives, scope of study and also about the significant of the study. In this chapter, it explains clearly how the subtopics influence each other in this project.

Chapter 2, represents the literature review conducted for this project. This is summary of the journal nowadays and also the important information that are related to the topic of this project. This is about the discussion of the theories and approaches are required to solve the problems.

Chapter 3, represents the concept of method that is used for solving this project. It describe the selection technique that is used. In other word, the method, materials, methodologies are determined to handle this project and are implemented during the running of the project.

Chapter 4, represents all the data collection and measurement are covered in this chapter. The data that had collected at industry will be understand and analyse based on the problem statements to propose the best solution or alternatives by using Systematic Layout Planning method. This is followed by the detailed information carried out for the problems, and then an analysis of the existing layout.

Chapter 5, represents the summary and the conclusion of the overall of the project based on the objectives. Some recommendation were provided for the improvement in future.

1.7 Summary of chapter

The overall content of this chapter can be summarized as the introduction of project or more specific the Project Sarjana Muda (PSM) which is one of the compulsory subject for any student which will graduate from Universiti Teknikal Malaysia Melaka (UTeM). The title of this project is about manufacturing layout assessment and the content in this chapter is included the introduction, purpose of this project, background, problem statement, scope of project, objective and the structure of project was also briefly stated.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will generally focus on literature review that related on facilities layout and planning. Nowadays, facility layout is one of the most important research in manufacturing sector in order to minimize the operations costs and maximize the efficiency of the operation and utilization of spaces and facilities. A great positioning of facilities lead to the overall efficiency of operations and can reduce until 50% the total operating expenses (Tompkins et al., 1996). Therefore, the designer plays important role to design any facilities layout. Designer must consider their long-term impact and it is better to take into consideration both short and long-term manufacturing activities, because to redesign it is costly. For example, Heragu (1997) stated that once a plant is built in a particular location, it is difficult to move the plant to another location after only one or two years because the fixed costs would not have been fully recovered inside the time period. He also stated that the phrase facilities includes machines, inspection stations, workstations, washing stations, locker rooms, rest areas and other such support facilities in a manufacturing system. According to Tompkins and White (1984), about 20-50 % of manufacturing total operating budget can be reduced if the material handling activities reduced. Besides, Sule (1991) mentioned that material handling expenses can reduce to 30-75% of the cost of product. Consequently, material handling cost is greatly influence to the product's cost and in other word material handling could be reduced when the facilities is arranged optimally. So, the both things is highly correlated to each other. Thus, an optimal facility layout set out in manufacturing system can be reduced costs and significantly increased the competitive advantage.

2.1.1 Definition of facilities layout

Based on definition from the Compact Oxford English Dictionary, facility or facilities is described as a building, service, or piece of equipment provided for a certain purpose. In this situation, facilities can be referring to workspaces or workstation which is consist of people, machine and material for the purpose to produce some products, services or both equally. While based on the same dictionary also, for the layout, it was defined as a thing set out in particular way. As a conclusion, the term of facility layout it means arrangement and planning for the location of all machines, utilities, employee workstations, material storage areas, and all the available area and department in a factory or workplace for the purpose of products. The flow patterns of materials and people in the workplace also one of the important element in the facilities layout study.

However, some researcher have their own clarity beside the definition that have stated above. So it contributes to the variety of the definition. A facility layout is an arrangement of everything needed for production of goods or delivery of services. A facility is an entity that facilitates the performance of any job. It may be includes a machine tool, work centre, manufacturing cell, machine shop, and department also a warehouse and etc. (Heragu, 1997). Some researcher stated that it as the arrangement of work space which is in general term smooth the facilities access way facilities that have strong interaction between each other (Canen and Williamson, 1998). As for Stevenson (2007), layout refer to configuration of department, work centres and equipment with particular value on movement of work through the system. There are several of definition from the researchers before that can be understand.

Besides that, any layout in manufacturing or other organization are impossibly perfect. There have a problem in layout even slightly. Based on the Koopmans and Beckmann (1957), which is are the first researchers to consider this class of problems, and they defined the facility layout problem as a common industrial problem in which the objective is to configure facilities in order to minimize the cost of transporting materials between them. According to Shayan and Chittilappily (2004), the definition of the facility layout problem can be defined as an optimization problem that tries to make layouts more efficient by taking into account various interactions between facilities and material handling systems while designing layouts. Then, Shayan and

Chittilappilly (2004) also defined that the facility layout problem as an optimization problem that try to make layouts more efficient by taking the consideration of various interactions between facilities and material handling systems while designing layouts. In other words, facilities and material handling need to analyse first because there have interaction between it in order to get efficient layout and indirectly optimize the layout problem. Other than that, Azadivar and Wang (2000) defined that the facility layout problem as the determination of the relative locations for, and allocation of the available area among a given number of facilities.

2.1.2 Significance of proper facilities layout

Layout design decisions are important for three basic alternatives, investment of money and effort, long-term commitments, and significant impact on the cost and efficiency of operation (Stevenson, 2007). In other words, a layout design need to be proper planned by look into every elements which will direct or indirectly effect the outcome of industrial product or service, besides it is also need to be layout which will efficient for a certain period and have alternatives for further improvement from time to time. The need for layout planning arises both in the process of designing new facilities and in redesign current exist layout. The reasons of redesign an exist layout include inefficient operations, safety factor, to fulfil the requirement of act and regulations such as OSHA and machinery act, changes in the design of products and services, change in target volume, change or add of equipment and change environment.

2.1.3 Elements of good layout

A good layout should consider of elements such as cost, time, and safety in manufacturing a product or deliver services. The criteria of good layout must be able to reduce bottlenecks in moving people or material, minimizes material handling costs, reduce hazards to personnel, utilize labour efficiently, increases morale, utilize available space effectively and efficiently, provides flexibility, provides ease of

supervision, facilities coordination and face-to-face communication where appropriate.

2.1.4 The approaches for the facility layout problem

According to Heragu (1997), to design a good layout that minimizes the cost of moving material, people and enhance safety to optimum level, there are some basic data which compulsory for a facilities layout planner in order to design layout. The data stated are the frequency of trips or material flow or some other measure of interaction between facilities, shape, and size of facilities, floor space available, location restrictions for facilities, if any and adjacency requirements between pairs of facilities. There are two approaches for the facility layout problem (Sahin and Turkbey, 2009). The first one is the quantitative approach aiming at minimizing the total material handling cost between departments based on a distance function. The second one is the qualitative approach aiming at maximizing closeness rating scores between departments based on a closeness function. These two types of flow data are required to measure the interaction between facilities. These data required to indicate the importance of locating facility pairs next to each other.

(a) Qualitative Flow Data

As mentioned before, Muther (1973) was the first to use a systematic qualitative approach to solve the facility layout problem. This approach is based on the adjacency relationships for each departments or facility pair. He was developed specific letter code to classify the closeness rating.

A Absolutely necessary
E Especially important
I Important
O Ordinary
U Unimportant
X Undesirable

The above letter codes are to define the closeness between the departments. For example the relationship between department B and C closeness is rating A, it means that department B and C have to locate as close as possible when designing layout project. These codes help designer to construct the relationship chart. According to (Heragu, 1997), generally the relationship chart is needed only when other than flow factors influence the layout decision. Most practical layout problems are likely to have some other than flow factors. Therefore, designer always need to construct a relationship chart. However, to construct a relationship chart, the first step is the designer have to analysis all the activities involved in the layout project. For example, the departments, work areas, and other facilities. Then, the second step is listing all the activities on chart, and then the third step is to determine the relationship by using code for each facility pair.

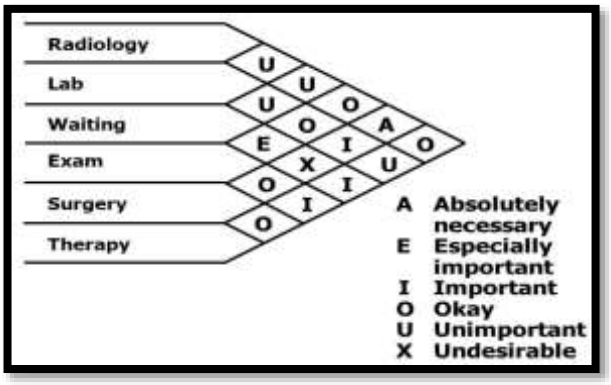

Figure 2.1: Example of relationship chart (Tompkins & White, 2002).

(b) Quantitative Flow Data

As stated above, the facility pairs with greater interaction should be placed closer each other than those with lower interaction. Generally frequency of trips between facilities is often used to analysts the quantitative flow measurement. Heragu (1997), suggested that to capture the frequency of trips between facilities two types of matrices are generally used is from-to frequency of trips matrix and the other is frequency of trips between facilities matrix. The different between these two matrixes is the number of trips between facilities, whereas the number of trips from one machine to another.

2.1.5 Material Handling

According to the (Tompkins, et. al, 2003), the definition of material handling is the art and science of moving, storing, protecting and controlling: and material handling means providing the right amount of the right material in the right condition, at the right place, in the right position, in the right sequence, and for the right cost by the right methods. In case minimizing the storage and material handling cost, machine layout should have a good warehouse layout storage effectively. The location of warehouse and type of material handling device used have to be considered by designer. Other than that, the aisles of the layout also important to allow the material handling devices to make sure the material flow smoothly.

2.2 Type of layout

There are generally 5 types of layouts in facility layout planning and design. Each type of the layout can be implemented in both service and manufacturing applications. Each of the layouts has its own characteristic, advantage and disadvantages. Five types of layouts stated above are:

1. Product Layout (Repetitive Processing)
2. Process Layout (No repetitive Processing)
3. Fixed Position Layout
4. Cellular Layout
5. Combination or Hybrid Layout

2.2.1 Product Layout (Repetitive Processing)

A product layout is a layout which used to achieve a smooth and rapid flow of products which are similar or the same or in other word, is a layout for repetitive processing for a highly standardized products or services. The work in product layout usually is divided into a series of standardized tasks, permitting specialization of equipment and division of labour (Kumar and Suresh, 2008). As summary for this type of layout, the main criteria of a product layout are the material is flow from one workstation to