



FACULTY OF MANUFACTURING ENGINEERING

LAYOUT ANALYSIS AND IMPROVEMENT IN A MANUFACTURING INDUSTRY: A CASE STUDY

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LAYOUT ANALYSIS AND IMPROVEMENT IN A MANUFACTURING
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ABSTRACT

The objective of this study was to analyse the production floor layout of Winco Precision Engineering and to redesign the production line layout to maximize the utilization of manpower and machines in this company. This study was conducted at Winco Precision Engineering, a manufacturing company located in Bukit Rambai, Melaka. This company was originally located in Taman Perindustrian Cheng and will be moving to a new factory in Bukit Rambai. They had been using the same layout for the past 13 years and with the relocation of the factory, they wanted to take the opportunity to use a new layout which could optimize the utilization of their manpower and machines. The current layout can be seen to be having high cross over frequency for Shafts and Bearings products between two buildings. There was high flow intensity between machines which have high interrelationship. This led to high travelling distance and time. Two alternative layouts were proposed using the analysis of product routing and machine part matrix. The proposed alternative layout involves grouping the machines that involves in certain products in one cell. The proposed layouts were evaluated in terms of total travel distance, total travel time, total travel cost, number of cross-over, output, average resource utilization, total average WIP level, total average waiting time and total time spent in the system.

ABSTRAK

Objektif kajian ini adalah untuk menganalisis susun atur lantai pengeluaran Winco Precision Engineering dan untuk mereka bentuk semula susun atur barisan pengeluaran untuk memaksimumkan penggunaan tenaga manusia dan mesin di syarikat ini. Kajian ini dijalankan di Winco Precision Engineering, sebuah syarikat pembuatan yang terletak di Bukit Rambai, Melaka. Syarikat ini pada asalnya terletak di Taman Perindustrian Cheng dan akan berpindah ke kilang baru di Bukit Rambai. Mereka telah menggunakan susun atur yang sama untuk 13 tahun yang lalu dan dengan penempatan semula kilang, mereka mahu mengambil peluang untuk menggunakan susun atur baru yang boleh mengoptimumkan penggunaan tenaga kerja dan mesin mereka. Susun atur semasa boleh dilihat untuk mempunyai silang tinggi ke atas kekerapan untuk Aci dan produk Bearing antara dua bangunan. Terdapat keamatan aliran yang tinggi antara mesin yang mempunyai perhubungan yang tinggi. Ini membawa kepada jarak perjalanan yang tinggi dan masa. Dua susun atur alternatif dicadangkan menggunakan analisis perjalanan produk dan mesin sebahagian matriks. susun atur alternatif yang dicadangkan melibatkan kumpulan mesin yang terlibat dalam produk tertentu dalam satu sel. susun atur yang dicadangkan dinilai dari segi jumlah jarak perjalanan, jumlah masa perjalanan, kos perjalanan jumlah, bilangan pertindanan, output, penggunaan sumber purata, jumlah tahap WIP purata, jumlah purata masa menunggu dan jumlah masa yang digunakan di dalam sistem. Susun atur alternatif terbaik adalah Pelan 2, yang tidak memerlukan mesin tambahan atau ruang untuk semula susun atur.

DEDICATION

To

My beloved mother, Noraini Bt Wahid

My one and only sister, Puteri Nelissa Milani bt Abdullah Kamil

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LIST OF ABBREVIATION

SD	-	Spot Drilling
CM	-	Centre Machining
OHD	-	Oil Hole Drilling
OHS	-	Oil Hole Slot
MJ	-	Main Journal Turning
EC	-	Eccentric Turning
D1	-	Hole Drilling 1
CT	-	Crankpin Turning
D2	-	Hole Drilling 2
D3	-	Hole Drilling 3
FM	-	Face Milling
MD	-	Manual Deburring
PC	-	Packaging
WIP	-	Work In Progress
TP	-	Tapping
CD	-	Centre Drilling
RM	-	Reamer
BR	-	Boring
R&D	-	Research and Development

CHAPTER 1

INTRODUCTION

1.1 Background

In a manufacturing environment, plant and floor composition of the whole company or factory plays a very vital role. Each of the machine placement, inventory space and work station must be placed accordingly as they give impact to the worker's and product's performance. Every aisle and every other appropriate feature in the factory play an essential role because they will contribute to the flow of movement of both workers and products (Seifoddini, 1986).

Logically, in any building, let alone in a house or company, the layout subjects to various purpose. This is why we need to invent a layout which will be functioning in long term. Planning a factory layout is very crucial as we need very clear ideas we cannot afford of having a factory with poorly organized facilities (Rajagopalan, 1995). Every functional unit must be properly compose and optimally positioned in the factory, considering the company-specific constraints into consideration.

Planning is vital for the efficient deployment of available resources. It is a necessary component in various areas of a nation's economy – in both the public and private sectors, manufacturing and service organizations, business, and education. As

stated by Purcheck et al, (1974), manufacturing organizations are especially challenging because they involve the operation of multiple activities; all must be planned, designed, coordinated and executed through a collective effort.

Although if the company hired a team of professional workers which consists of designer, production worker, material handler which is maybe an expert in each of their respective work field, the person must work to attain the company's main objective. This is because only an methodological and productive organization can produce a company's layout which could compete in today's market.

One might think that designing a layout is about arranging the facilities and machines accordingly but it consists of a lot more than that (McCornick, 1972). As on should consider various aspects before coming with a final plant layout because there is a frequent cause which after the machine is placed, they are quite difficult to rearrange everything again. The designer should always bear in mind to produce a layout which can ensure to make smooth material flow possible.

1.2 Company Background

Winco Precision Engineering (MELAKA) Sdn Bhd was established in 1993. Winco is located in the Cheng Industrial zone, with a build – up area of 22, 583 sq. feet. The factory is split up into four main plants which are M1, M2, M3 and M4. The buildings are divided into two groups but the production for both factories is practically quite similar. Winco specializes in Precision Machining with CNC Turning and Milling Processes for various types of products. They also specialized in Conventional Drilling and Milling processes. They accept the jobs on mass Production and also low volume, if job is constant and favouring.

The infrastructure of WINCO is laid out into three sections. Where CNC Milling and Sizing of Pattern Mold blocks are done in one section. Conventional Drilling process is also performed here. There is also semi – automation machine for only Turning process. CNC Turning, Milling and Drilling are the major processes carried out for various types of products in the other two sections. They also have machine iron – cast and other types of

from Singapore. Winco maintains relationship with their sub group in Singapore for the past decade. Its presence offers a distinct competitive advantage, with R&D, manufacturing, sales and support capabilities serving established customers.

1.3 Problem Statement

The most significant issue is the current layout had been used for about 13 years without experiencing any changes. The company has the intention of moving to a new factory at Bukit Rambai, Melaka. This is why the management want an experienced team to analyse the current layout and improved them to produce a new layout.

Moreover, there are a few issues that can be detected regarding their quality of product. Aside from that, the worker's productivity on how long they are being idle during the working shift. When the worker has been in idle state for a period of time, they tend to forget their working pace (p Kulkarni, 2007). This will result of longer lead time which will affect the whole system. Apart from the workers are not fully utilized, the way that managed the material handling is quite poor which the workers need to wait the worker which is performing the previous task to finish and they need to bring the work piece to their own workstation (Canen, 1998).

In response to the above problem, the need for a facility layout improvement and a model that is able of simulating workstation production on new layout proposals to evaluate the performance measures related to the manufacturing goals that the company intend to achieve.

1.4 Objectives

- To study the process flow for the current layout of the production line in the manufacturing factory.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will talk about the previous work conducted by other researchers to gain enough particulars that can be used to complete the project. All data are gathered related to the topic for this project which includes sources from books, journals, thesis and academic articles.

There are many studies that have been done regarding the analysis and improvement of layout in manufacturing industry. In order to do such analysis, one must acquire the original layout of a specific company which specializes in precision engineering in producing parts for refrigerator and air conditioner. Apart from gathering the data from observation in the factory plant itself, other information is obtained through analysis of other case study.

2.2 Facility Planning

A facility layout is positioning of everything needed for the production of goods or delivery of services. Basically, a facility is an object that facilitates the performance of any job need to be done which is maybe a tool, a work centre, a manufacturing cell, a machine shop, department, a warehouse, etc. (Meller et. al, 1991).

The importance to locate the machines, workers, workstations, inspection area, material and parts storage as well as the inventory all depends on the process flow. The whole design of layout will usually depends on the variation of products and also the quantity of the products being manufactured.. The different type of layout are referred to, namely fixed product layout, process layout, product layout and group technology layout. (Jafri Mohd Rohani, 2015)

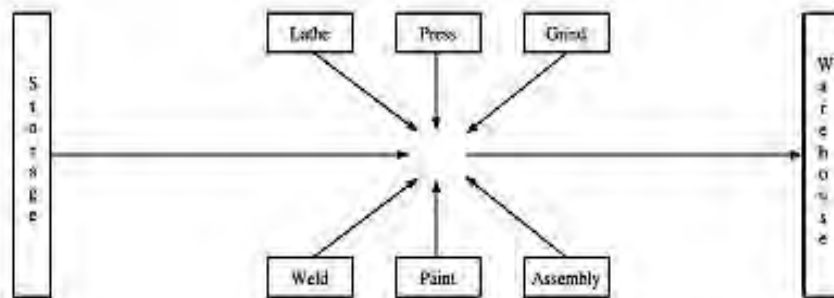


Figure 2.1 Fixed Product Layout

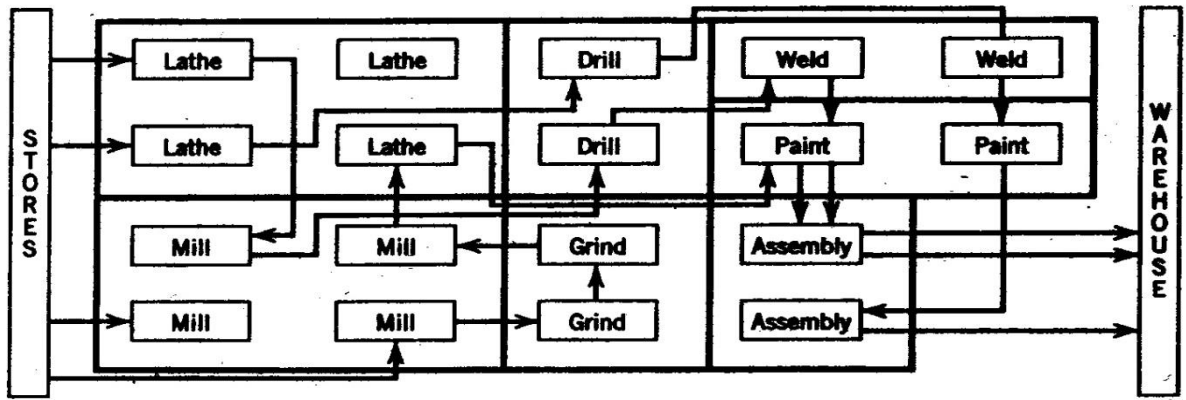


Figure 2.2 Process Layout

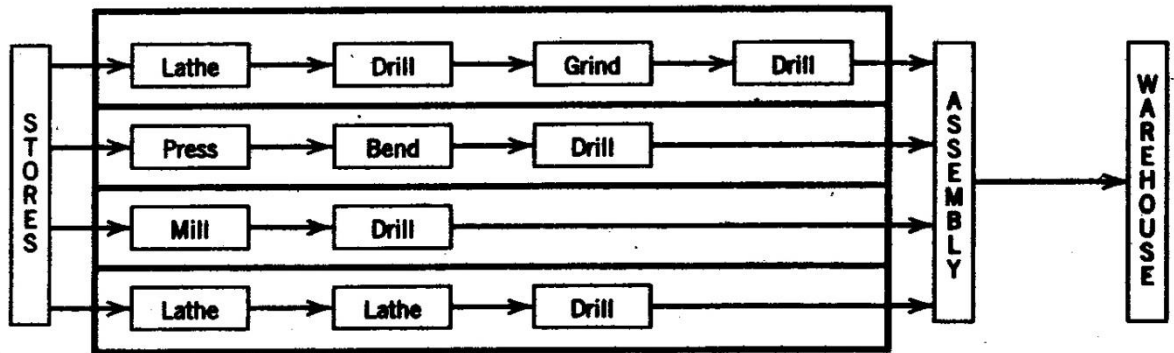


Figure 2.3 Product Layout

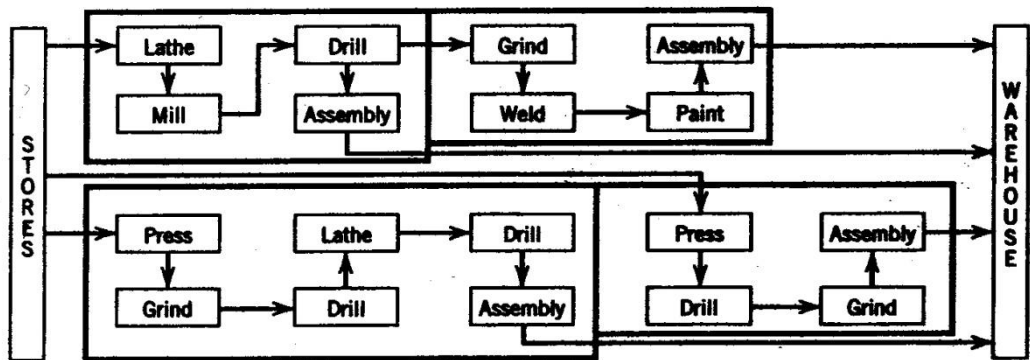


Figure 2.4 Group Technology Layout

2.1.1 Fixed Product Layout

Traditional types of layout are shown in Figure 2.1, Figure 2.2, Figure 2.3 and Figure 2.4. For Figure 2.1, the fixed product layout is seen to gather the machines which responsible for specific products. According to Tompkins (1996), item being worked on remains stationary and workers, materials and equipment are moved as needed. This type of layout is normally used in large construction projects such as buildings, power plants and dams.

2.1.1.1 Advantages of Fixed Product Layout

- Material movement of products are reduced
- Promote better quality of the products as the whole job is done simultaneously.
- Highly flexible which could accommodate changes in term of the product design and volume.

Disadvantages of fixed product layout

- Requires a worker that is experienced as they need to handle the work alone
- May requires more space for the work in progress
- Need to duplicate the machines that responsible for the same manufacturing process

2.1.2 Process Layout

Process (Job Shop) Layout , machines are grouped according to their functions. The product routing is according to the each individual products. Tompkins (1996) stated that this type of layout will includes departments or other functional groups which have similar kinds of activities are performed. The production is usually used when the production is in batch and mass volume. In this type of layout, the other workstations and personnel equipment will located in the

same area. However, the products will move from one departments to another, according to the sequence of the machining process.

2.1.2.1 Advantages of Process Layout

- The machines utilization is optimized.
- Have more flexible on allocating personnel equipment and workstations.
- Leaders could supervise the workers and products flow more effectively.

Disadvantages of Process Layout

- More complicated production control required.
- Longer production lines are required to accommodate all the machines.
- Increased work in progress storage.

2.1.3 Product Layout

In Figure 2.3, the product layout can be seen to follow a fixed path through the production resources. The resources are arranged to minimize the flow of materials movement. There are two type of flow that could occur in this type of layout which are continuous flow or repetitive flow. The continuous flow happens when the layout design and equipment (Kazeerosni ML, 1999). For the repetitive flow, the correct operations will be able to avoid problems generated by bottle necks.

2.1.3.1 Advantages of Product Layout

- Since the layout corresponds to the sequence of operations, smooth and logical flow lines result.
- Total production time per unit is short.
- Little skills are required by the operators in the production line which requires only simple training to them

Disadvantages of Product Layout

- Supervision by the production leaders will be more general instead of specialized.
- Workers may experience fatigues as they are stationed at the machines which have endless repetition of tasks.
- Lack of process flexibility since the layout is determined by products.

2.1.4 Group Technology Layout

According to Kulkarni and K. Shanker (2007), Group Technology is the technique of identifying and bringing together related or similar parts in a production process in order to utilize the inherent economy of flow production methods. This type of layout will introduced cell formations. In the cell, they will involves part family. The parts within family will starts from raw materials up to finished products in a single cell.

2.1.4.1 Advantages of Group Technology Layout

- Has benefits of combination product layout and process layout.
- Reduce set up time
- Improves operators skills handling the machines.

Disadvantages of Group Technology Layout

- Reduced shop flexibility
- Extended job flow times
- Lower machine utilization than process layout

Thus, for the study, the current layout being implemented in Winco Precision Engineering is more to Process type of layout which they grouped together all the machines according to their manufacturing type. For example, they gathered all drilling machines no matter if they are responsible for Shafts, Bearings or Cylinder Plates. The type of layout that is going to be pursue in this study is the combination of process and product layout. Which is also known as hybrid type of layout or Group Technology Layout.

This type of layout is more flexible in the term of material flow and machines arrangement. This could help the company to reduce any non value added activities like waiting time. Thus, this type of layout is further research on whether they could be implement in the factory.

2.3 Significance of Facility Planning

The facilities that we enjoy today are the achievement of the previous planner which has done their work with excellence. Since 1955, there are minimal cost of gross national product being spent yearly on building new facilities and it is generally accepted that effective facilities planning can reduce the material handling cost up to 10 – 30% (Tompkins, 1996).

The basic thing that we need to consider during the planning of any factory or warehouse is how we want to run the business in long term (Al-Hakim L, 2000) To have a business that can operate smoothly without failure, we have to plan every single details that will be place in the workspace. This does not only apply in factory, it is also have been implemented in hospitals, offices or even houses.

To stimulate our thoughts on the breadth of the facilities planning, we always need to question ourselves with:

1. What impact do facilities planning have on handling and maintenance costs?
2. What impact do facilities planning have on the work schedule?
3. What impact will the facilities planning have on the facility's capability to adapt with the changes and satisfy future requirements?

The most important purpose that we have in mind when we start to plan on this layout is we want to increase the productivity, which is in other word, we want to improve customer satisfaction by being easy to do business with, conforming to customer promises, and responding to customer needs (Abue-Zied, 2006). Aside from that, a proper plan will help to increase return on assets (ROA) by maximizing inventory turns, minimizing obsolete inventory, maximizing employee participation, and maximizing continuous improvement.