DEVELOPMENT OF FLEXIBLE ASSEMBLY LINE WITH LIMITED SPACE ALLOCATION FOR MANUFACTURING COMPANY

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ABSTRACT

Space is an important asset for contract manufacturing to compete with other companies. In order to compete that, manufacturing company must have industrial knowledge before developing assembly line and flexible assembly line is one of the factors contributed to the optimization of space. Then, in order to remain competitive and increase the output and optimize the man powers used, Assembly line balancing (ALB) must be identified and solved. Ultimately, the better line balancing will gives better impression on the space. Furthermore, single model assembly lines are not popular. Aim for this study is developing flexible assembly line with limited space allocation for manufacturing company. From here, flexible assembly line is able to save a space for manufacturing company and the significance of having a well-structured multi product assembly line in terms of resource reduction. At the first step, the first model (model A) demand, operation hours, number of man powers, method time measurement (MTM), equipment selection, process and activities are studied. In the second steps, based on the TAKT time calculation, line for model A is balanced. Model A and model B is studied using same approach. Flexible assembly line is introduced for model A and model B because of the process is almost same. Equipment selection has been introduced by changing conveyor to the pipe and concept to implement U-shaped assembly line to more further to optimize the space. Based on the result of space, man powers and line efficiency is showing that U-shaped assembly line has brought great savings to the company. Ultimately, the results shows that by implementing line balancing using TAKT time calculation, MTM, flexible multi model, manpower on line are reduced to 6 man powers, space reduced from 350sq ft to 238sq ft while line efficiency is increased until 77%.

ABSTRAK

Ruang adalah merupakan asset yang penting bagi pengilangan kontrak untuk bersaing dengan syarikat lain. Dalam usaha untuk bersaing, syarikat pembuatan mesti ada pengetahuan industri sebelum membangunkan barisan pemasangan dan barisan pemasangan fleksibel adalah salah satu faktor yang menyumbang kepada pengoptimuman ruang. Kemudian, untuk kekal berdaya saing dan meningkatkan pengeluaran dan mengoptimumkan penggunaaan operator pengeluaran, pemasangan yang seimbang (ALB) dikenalpasti dan diselesaikan. Pengimbangan talian yang baik akan memberikan gambaran yang baik pada ruang. Pengimbangan talian bagi model tunggal tidak begitu popular. Kajian ini untuk membangunkan pemasangan fleksibel dengan peruntukan ruang yang terhad untuk syarikat pembuatan. Barisan pemasangan fleksibel dapat menjimatkan ruang untuk syarikat pembuatan dan kepentingan mempunyai pelbagai barisan pemasangan produk berstruktur dengan baik dari segi pengurangan sumber. Pada langkah pertama, model pertama (model A) permintaan, waktu operasi, bilangan operator pengeluaran, pengukuran masa kaedah, pemilihan peralatan, proses dan aktiviti yang dikaji. Dalam langkah kedua, berdasarkan pengiraan masa takt, talian bagi model A adalah seimbang. Model A dan model B dikaji menggunakan pendekatan sama. Barisan pemasangan fleksibel model A dan model B diperkenalkan kerana proses adalah hampir sama. Untuk mengoptimumkan ruang, pemilihan peralatan telah diperkenalkan dengan menukar penghantar ke paip dan konsep untuk melaksanakan pemasangan talian berbentuk U. Berdasarkan kepada keputusan ruang, operator dan kecekapan menunjukkan pemasangan talian berbentuk U telah membawa penjimatan besar kepada syarikat. Akhirnya, keputusan menunjukkan bahawa dengan melaksanakan pengimbangan talian menggunakan pengiraan masa takt, MTM, model multi fleksibel, operator dikurangkan kepada 6, ruang dikurangkan daripada350kakipersegi kepada 238kaki persegi manakala kecekapan talian dinaikkan meningkat sehingga 77%.

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LIST OF ABBREVIATION

1.	ALB	-	Assembly Line Balancing
2.	BOM	-	Bills of Material
3.	FAL	-	Flexible Assembly Line
4.	JIT	-	Just – In - Time
5.	MTM	-	Method Time Measurement
6.	NPI	-	New Product Introduction
7.	SAL	-	Straight Assembly Line
8.	SOP	-	Standard Operation Procedures
9.	TPS	-	Total Production System
10.	PTS	-	Predetermined Time System
11.	WIP	-	Work in Process

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter explains on the introduction on the development of flexible assembly line with limited space allocation for manufacturing company located at Tampoi, Johor Bahru. Due to space constraints, the manufacturing company needs to change their assembly design from the straight assembly line to the U-shaped assembly line and ultimately change to flexible assembly line because has 2models involved in order to optimize the space. When the workers comfortable doing their task given, productivity will increase through ergonomic approach. Next, the problem statement, objectives and scope are defined.

1.2 Background

Nowadays, many types of production line had been introduced and implemented to optimize and fully utilized the production space especially for the manufacturing company that doesn’t has enough space to run the process until

complete in the one assembly line or in the lean manufacturing approach this is called as one piece flow production flow. There are few types of layout can be implemented in order to solve space problem such as straight assembly line, u-shaped assembly line and also flexible assembly line. Furthermore, layout is an arrangement of the space and facilities according to the type and size of activities to be carried out, convenience of operations, efficiency, productivity, economy and safety of the facilities and the users.

As a contract manufacturing company, to provide a space allocation as required by the main manufacturing for assembly activities is important for them. Sometimes there need to implement flexible assembly line due to not enough space and to ensure whole process can be perform in same floor in order to reduce the resources required likes man power, equipment and space as well. The world “flexible” is associated with such a system since it is able to manufacture a large number of different part types. The components of a flexible manufacturing system are processing equipment, the material handling equipment and also the computer control equipment. The computer control equipment is used to track parts and manage the overall flexible manufacturing system [1].

Groover [1] lists the following manufacturing situations for which a flexible manufacturing system might be appropriate:

- Production of families of work parts
- Random launching of work parts onto the system
- Reduced manufacturing lead time
- Increased machine utilization
- Reduced direct and indirect labor
- Better management control

In order to ensure the production is running in efficient and effective manner, ergonomic principles or human factor engineering need to be implemented and

practiced as well in order to avoid absenteeism and finally will impact on the productivity. Generally, principles for workspace design is considering during the development of designing the flexible of assembly line. The reason of putting this manner into designing of line layout is to reduce human error, increase productivity, and enhance safety and comfort. All the measurement of the work space height, work surface depth and work space inclination must be considered in order to achieve the successful of ergonomics.

The study identifies limited space allocation is one of the problem for the manufacturing company which is located at Tampoi, Johor Bahru. Furthermore, due to constraints on process design, one piece flow approach needs to be performed. And because of this, large space is required to perform this activity. AutoCAD software is used to visualize the development of flexible assembly line before setup into the real assembly line. Therefore, with the identification of problem and the source that were provided in this study, production system and processing can be improved and optimized in this manufacturing company. Other than that, this study also helps manufacturing company and others organization as well that flexible assembly line can gives biggest impact on the space of production floor.

1.3 Problem Statement

Space must be provided by the contract manufacturing once received a business from the main manufacturing or so called customer. But the problem is, when line has been designed by the customer, contract manufacturing don’t has enough space as per required and stated in main manufacturing’s assembly line design.

In order to solve this, main manufacturing need to change their layout based on the space available at contract manufacturing and main manufacturing need to design again the layout based on the space available not based on the space requirements. This task is not efficient where engineer need to design the assembly line two times due to space constraints.

However, it can be solved when main manufacturing has a using all the technical and manufacturing knowledge for designing the layout with the minimum space by considering material supply movement, material transport equipment, equipment selection and also ergonomics in order to ensure line has been designed with the minimum space. Furthermore, AutoCAD software will helps them to solve this problem also where contract manufacturing and main manufacturing can viewed design layout on the paper before transform it into actual production floor. The details flow of the problem statement has been shown in figure 1.1.

1.4 Research Objectives

The objective of this project is to design a new and efficient assembly line with limited space provided by the contract manufacturing. And also to implement flexible assembly line for two models due to space limitation at contract manufacturing.

1.5 Scope of the Study

The scopes of the study for this project are as below;

i. This study is done in assembly line of the contract manufacturing company.
ii. A single model, U-shaped assembly line is selected as a main focus of the study using AutoCAD Software.
iii. Balancing loss, process flow, method time measurement, task distribution and material supply movement also considered in order to improve the assembly line.
iv. Considered ergonomics principles during developing of assembly line.

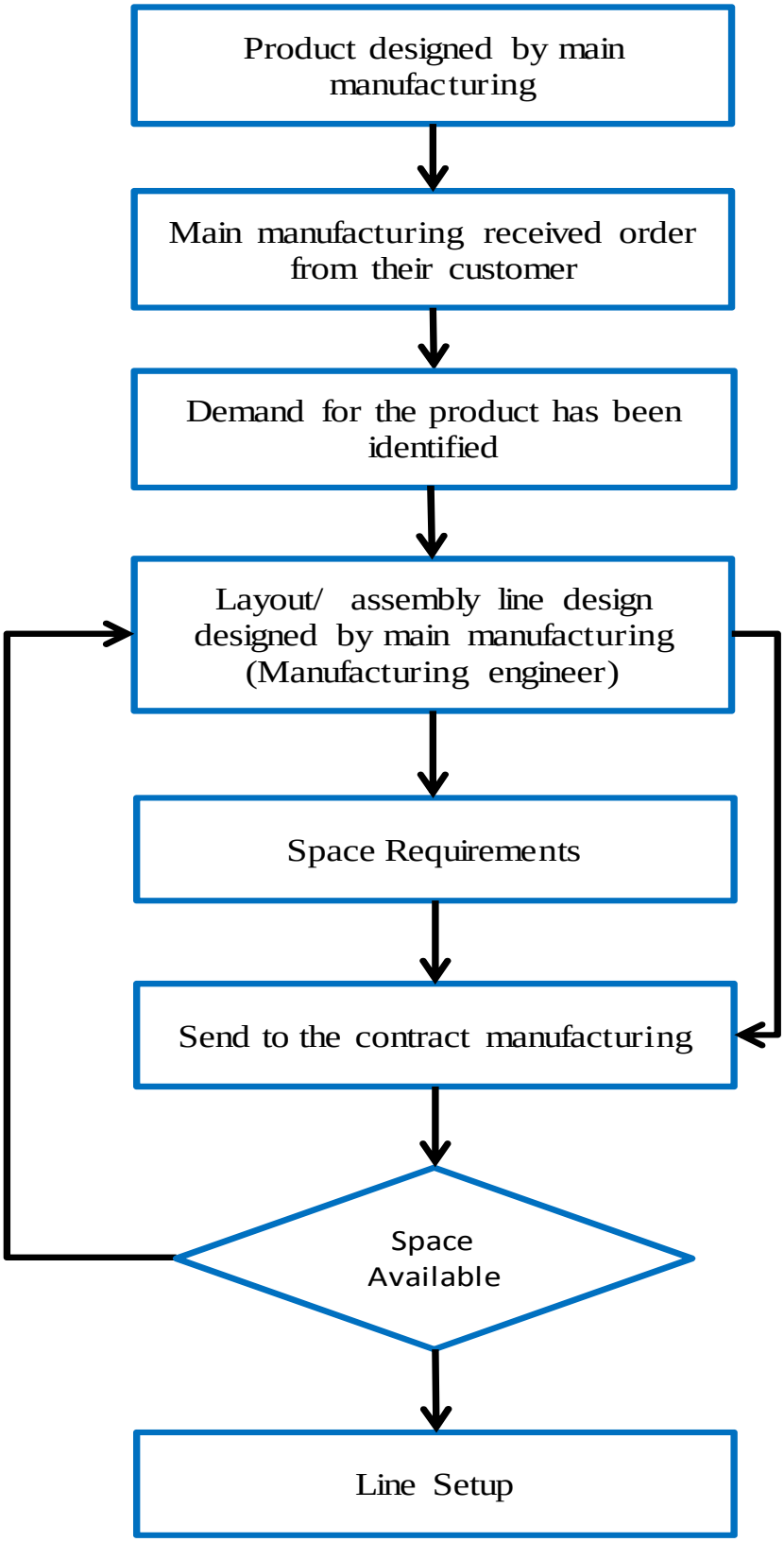

Figure 1.1 Flow of problem statemen

1.6 Significance of Findings

The result of this project is essential as it is able to provide an optimum solution for the manufacturing company to solve on the limited space allocation for complete assembly process by implementing the flexible assembly line. This optimum solution was achieved by comparing the straight line assembly with the flexible line assembly by implementing U-shaped assembly line, line balancing, material supply movement and selection equipment to more reducing the space used and also ergonomics.

The significance of this project can be shown through space where two models can be running in the same production floor. Space is fully utilize eventhough demand is not higher because of this model is still new and under new product introduction stage.

Therefore, following advantages are expected to be obtained while studying and developing the flexible assembly line;

i. Assembly line is designing based on demand.
ii. Minimizing resource consumption (manpower, machines, number of workstation) through material supply movement such as one piece flow and kanban.
iii. Maximizing company's total profit in the NPI stage via space, manpower and machines optimization.
iv. Assigned task on man power using precedence diagram.
v. Efficient material supply movement.
vi. Better productivity through ergonomics principles.

1.7 Organization of Thesis

This thesis is divided into six chapters which are introduction, literature review, methodology, data gathering and analysis, result and finally is a conclusion. The detail explanation on thesis structure as below;

Chapter 1: Introduction

Chapter 1 is an introduction to the project which explains the background of the study, statement of the problem, research objectives, scope of the study, significance of findings, organization of thesis and conclusion. Furthermore, statement of the problem explained on the differentiation between straight line and the flexible line.

Chapter 2: Literature Review

The literature review of the project is being discussed in the second chapter. It contains several related issues found in the book, internet and also actual situation in the assembly line at the manufacturing company. Definition, principles and approach used in conducting the research. Broad areas has been discussed beginning from the assembly drawing, assembly chart, time study and predetermined time study has been used for line balancing since this product is still in the new product introduction (NPI) stage.

Types of assembly line, balancing loss and material supply movement and ergonomics has been covered in this chapter in order to develop efficient flexible assembly line even though space allocation is limited provided by contract manufacturing. The purpose is to study what have been studied before on this topic and find the gaps to more practical solutions regarding the nature of the problem.

However, ergonomics is not fully covered in this project but it is useful to increase the productivity.

Chapter 3: Methodology

The methodology of the research is discussed in the third chapter. Concept and problem solving tools used during the research process are described in this chapter. Case study, data collection method, conceptual framework, process mapping, line balancing and line design suite to knows on the effective of the flexible line design without actual line is being setup. Material supply movements have been considered in order to simply the process and ultimately reduce the space allocation. AutoCAD software to design industrial layout had been discussed also in order to ensure project can be running smoothly when start installing because this project is a new layout for new product.

Chapter 4: Data Gathering and Analysis

Main focus for this chapter is on the case study related with data gathering and analysis. We have studied why straight assembly line is not efficient in order to optimize the production space. We have chosen U-shaped assembly line in order to optimize the production space where it is also suitable for the flexible assembly line.

On this chapter, all the current and future documents had been studied to achieve the objective of this project which is to develop flexible assembly line with limited space allocation at contract manufacturing. The data related such as demand, MTM, line balancing, drawing are required as a main documents to develop a flexible assembly line with limited space allocation by contract manufacturing. On this chapter, there are two models has been studied and analyse and this two models will used same assembly line which is called as flexible assembly line due to demand for both models is lower.

Chapter 5: Result and Discussion

On the discussion stage, this project mentioned why U-shaped assembly line had been selected during developing flexible assembly line and it also helps to solve a space problem on the manufacturing company. Result had been achieved to optimize the production space through equipment selection, line balancing, material supply movement and also U-shaped assembly line. This chapter also includes discussion on performance measure, significance of study, findings and limitations of the project.

Chapter 6: Conclusion

This chapter includes the conclusion of the study, challenges when developing flexible assembly line with limited allocation and some recommendation for future study such as more examples related on ergonomics or human factors engineering and material handling. Briefly, ergonomics is important in order to reduce absenteeism among workers and ultimately able to increase the productivity. The organization of thesis is summarized in Figure 1.1 below;

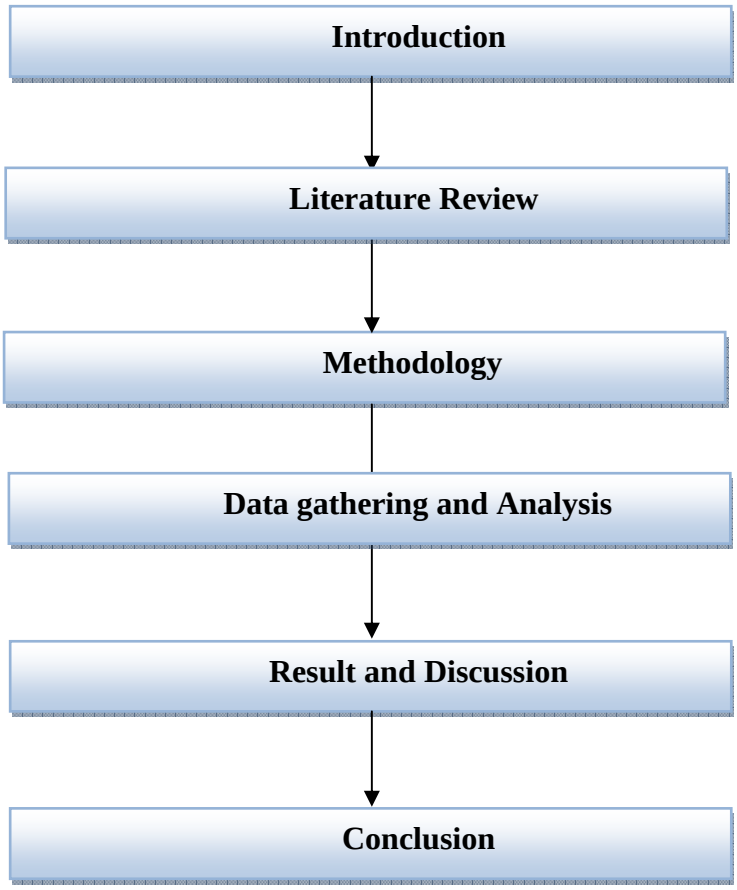

Figure 1.2 Organization of thesis

1.8 Conclusion

This chapter explained a general introduction about the entire research beginning from the introduction then follow by the background, problem statement, research objectives, scope of the study, significance of the findings, organization of thesis and end by the conclusion. In the beginning, space is a problem for the contract manufacturing when get a business from main manufacturing. However, it can be solved by developing the flexible assembly line design by considering few factors such as demand, line balanc8ing, equipement selection and so on. The next chapter need to be focus is a literature review.

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