
## Faculty of Manufacturing Engineering

# A STUDY OF THE PRODUCTIVITY IN STAYROD MANUFACTURING

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**Master of Manufacturing Engineering (Manufacturing System Engineering)**

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# A STUDY OF THE PRODUCTIVITY IN STAYROD MANUFACTURING

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A Master Project Report submitted

As a partial fulfillment of the requirements for the degree of Master of Manufacturing Engineering (Manufacturing System Engineering)

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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I declare that this Master Project Report entitle "A Study of the productivity in Stay Rod Manufacturing" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

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# APPROVAL

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

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# ABSTRACT

This report contains discusses about the productivity in the production line of Stayrod manufacturing using line balancing method. This project analyzed the problem that affects the productivity due to unbalance line. There were significant relationship between the processing time and the number of operators in production line. Current manufacturing system brings the line balancing ratio and line balancing efficiency is 63.09% and 81.64% respectively; with the line balancing method, it shows an increase of line balancing ratio and line balancing efficiency to 80.04% and 94.41% respectively. The simulation model was used to verify the result from the line balancing. Furthermore, this project also proposed some of the improvements in the production line regarding the line balancing such as idle time, working time, transfer time, and number of operators.

# ABSTRAK

Laporan ini mengandungi butiran projek kajian dan analisis produktiviti di produksi pembuatan produk Stayrod dengan menggunakan kaedah garis kesimbangan (line balancing). Secara umumnya, laporan ini mengkaji kesan dan faktor yang menyebabkan ketidakseimbangan proses. Sistem pembuatan sedia ada membawa kepada kadar dan keupayaan line balancing masing- masing adalah 63.09% dan 81.64%, dengan menggunakan kaedah line balancing ia menunjukkan peningkatan kadar dan keupayaan line balancing kepada 80.04% dan 94.41% y. Terdapt hubungan yang penting antara keseimbangan produksi terhadap masa proses dan juga bilangan operator. Selain itu, model simulasi boleh digunakan untuk memperolehi anggaran karakteristik dalam masa lebih daripada yang diperlukan untuk mengumpul data operasi yang sama dari sistem yang nyata dan dapat mensimulasikan pengeluaran Stayrod. Selain itu, projek ini juga mencadangkan untuk penambahbaikan di bahagian produksi mengenai penyeimbangan garis waktu yang terluang contohnya untuk operator boleh dikurangkan atau menetapkan semula waktu kerja dan menempatkan semula operator.

# DEDICATION

I would like to dedicate special thanks to my:

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| | | |
|---|---|---|
| ALB | - | Assembly Line Balancing |
| ASM | - | Available Seat-Miles |
| CPM | - | Critical Path Method |
| CZ | - | Czochralski |
| EMCS | - | Engineering Manufacturing Customer Services |
| ETC | - | Et cetera |
| FZ | - | Floating-Zone |
| GA | - | Genetic Algorithm |
| GT | - | Group Technology |
| HPFL | - | Homogenous Paralleling Flow Line |
| JIT | - | Just In Time |
| LB | - | Line Balancing |
| LBR | - | Line Balancing Ratio |
| LBE | - | Line Balancing Efficiency |
| OR | - | Operation Research |
| UTeM | - | Universiti Teknikal Malaysia Melaka |
| WBS | - | Work Breakdown Structure |
| TOP | - | Total Operation Productivity |
| TL | - | Transfer Line |
| TM | - | Theoretical Method |
| TOC | - | Theory of Constraint |

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Line balancing in the production is the problem of assigning operations to workstations along a production line, in such a way that the assignment be optimal in some sense. Therefore, in order to ensure that the particular production line is balance or not, it need to take takt time and then analyze the result. Essentially, line balancing can affect the productivity. Non value added activities can be analyzed from the standard operation compile chart. Then, it can be eliminated in order to increase the productivity.

The productivity is stated as the ratio of output to input. Productivity is a performance measure that indicates how effectively a production line is performed. Productivity refers to metrics and measures of output from production processes per unit of input. Productivity is distinct from metrics of allocative efficiency, which take into account both the value of what is produced and the cost inputs used and also distinct from metrics of profitability, which address the difference between the revenues obtained from output and the expense associated with consumption of inputs.

Productivity in production line obtained by many type of variables such as design of work station, design of assembly process, design of equipment, number of operator, skill of worker and others. Either one of the variable above improve will brought to whole productivity improvement.

Moreover, productivity can be improved by modifying the controlled variables through test and identify which production line design is the most productive by reducing the cost and producing time. The controlled variables to test are the number of workstation and operator, line orientation and process design. The other variables such as design workstation, design of equipment and skill of worker can contribute to productivity are kept remain constant.

Facility layout and design also being the important components of a production planning overall operations, both in terms of maximizing the effectiveness of production processes and meeting employee needs/or desires. All of those terms will be influence the productivity. The criteria for a good layout necessarily relate to people (personal and customers), materials (raw, finished, and in process), machines and their interactions. Facility layout design determines how to arrange, locate and distribute the equipment and support services in manufacturing facility to achieve minimization of overall production time, maximization of operational and arrangement flexibility, maximization of turnover of work-in-process and maximization of factory output in conformance with production schedules and as a result it can be increased the productivity.

In short, the productivity improvements can be achieved by:

i. More output for the same input;

ii. The same output from less input;

iii. Much more output for slightly more input; and

iv. Getting slightly less output for much less input.

## 1.2 Problems Statement

Productivity is a key competitiveness of manufacturing company. One of ways to increase productivity is thru keeping the same output with less input. The company under study has a problem in productivity due to unbalanced production line. This problem has made the company losing some of their resources, particularly their worker time.

Due to the problem, company under study not only losing resources but also charging the product cost higher due to high labor hours needed to produce the customer order. This study is trying to reveal the problem in line balancing, analyze the situation and propose some improvement of efficiency thru line balancing methodology.

## 1.3 Objective Of Study

The objectives of this project are to analyze the production line of the Stay rod manufacturing based on the line balancing method.

In details, the objectives of study are:

a) To analyze the problem that affects the productivity which caused of the unbalanced line.
b) To verify the result of line balancing by using simulation model.
c) To propose the improvement in the production line of Stayrod.

## 1.4 Scope Of Study

This study discusses about the productivity in the production line of Stayrod component manufacturing. The productivity is regarding the input and output. This study will focus on the input and factor or variable that influences the line balancing such as number of operators. By simulation, this study examines the productivity in terms of input variable in the production line. Cycle times are taken at each process in order to determine the time had been taken to complete each processes. Then, the efficiency and line balancing ratio are calculated to determine the line balancing. The term of layout will be not used, instead of the small modification of particular workstation probably will be done. Some improvement of efficiency thru line balancing methodology is proposed.

## 1.5 Project Outlines

Based on the thesis for Master Project I, an organization has been constructed for the process flow of completion in order to fulfill course of Master in UTeM. Below shows the format of the organization:

i. Chapter 1 represents the production of the project conducted which is background, problem statement, objectives, scope and project outlines. In this chapter, it explains clearly how the subtopics influence each other in this project.

ii. Chapter 2 represents the literature review on the background and basic information about the production line. By understand the basic of the process and types of different production line; it may enhance the progress of this project. It then reviews some basic tools used for determine and analyzing the line balancing in the production line.

iii. Chapter 3 represents the methodology used for conduct this project. It's described the selection of product and suitable assembly line used to conduct this project. This chapter included the planning of the research, flowchart, and source of data.

iv. Chapter 4 represents the discussion on the result of the study. It is stressing the significance and implications of the findings of the project. This include the line balancing before and after improvement, verify whether each different factor showed various to productivity, verify the most contribute factor to productivity, and verify the productivity based on the simulation and mathematical model.

v. Chapter 5 presents the conclusion of the whole study and recommendation for future research.

# CHAPTER 2

# LITERATURE REVIEW

The literature review explores the dominant themes includes study and research of published materials like journals, thesis, case study, technical document, and online library. Generally, the purpose of a review is to analyze critical segment of a published body of knowledge through summary, classification and comparison of prior research studies, reviews of literature, and theoretical articles. This chapter will describe topics and related to line balancing such as productivity, work study, Theory of Constraint (TOC), layout and other relevant line balancing topics.

## 2.1 The Concept of Line Balancing

Assembly line balancing or simply Line Balancing (LB) is the problem of assigning operations to workstations along an assembly line, in such a way that the assignment be optimal in some sense (Falkenauer, 2000). On the other hand, according to Becker and Scholl (2003), assembly lines are traditional methods in the early stages of manufacturing and productions related but still are an attractive means of mass and large-scale series production.

Assembly line balancing consists the basic principle of division of labour, thus when applied to mass assembly of manufactured items, it takes the form of the progressive assembly line. The basic principle of division of labour is applied by assigning the set of tasks to the production line in sequence work stations, dividing the set of tasks into smaller tasks and specifically assigned to one operator or work stationed at each work stations to be performed. By organizing the work station in sequences, the flow of the product shall travel along the path of assembly line through some kind of product transportation systems for example conveyor belt and at each station, a specific manufacturing process is performed on it.

Thus, the objective of the Assembly Line Balancing (ALB) is to assign the set of task to successive workstations in order to meet specified production requirement (e.g., the desired throughput) so that the number of workstation needed is minimized (Mollenkopf et al., 2010). Therefore, in the long run each and every worker at the designated work stations shall be proficient with their job task resulting in high productivity, lower cycle time and lower rejection rate.

The purpose of balancing also is to make the cycle time at each work station to be less or similar to the takt time of the line. In order to do that, allocating appropriate number of operators at each workstations with specific job task and standard cycle time, will help to achieve the desired purpose. Therefore, according to the Cheikhrouhou et al (2009), less skilled operators can be employed by company and less cost will be used to train them to be effective in the production line thus making each operator become very proficient with their specific job tasks.