# MODELLING ASSEMBLY FOR PRODUCTION LINE OUTPUT- A CASE STUDY

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## LEE YEH YEE

**This report is submitted
in fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering (Design and Innovation)**

**Faculty of Mechanical Engineering**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**JUNE 2016**

# DECLARATION

I declare that this project report entitled "Modelling Assembly for Production Line Output

– A Case Study" is the result of my own work except as cited in the references

Signature : ...........................................

Name : ...........................................

Date : ...........................................

**APPROVAL**

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design and Innovation).

Signature : ...................................

Name of Supervisor : ...................................

Date : ...................................

# DEDICATION

To my beloved mother and father

# ABSTRACT

Production line output is the back bone of a successful manufacturing industry. However, it is a common situation where the production line output of a company is not sufficiently efficient. In this case study, an assembly process in specific factory is studied. The data of assembly line in a specific factory is collected and recorded. The data includes the explanation of task, duration of time needed to complete the task and number of workers and machines involved in a specific work station. From the data, analysis will be carried out to identify the root cause of inefficiency of production line output. After researching on methods to improve the production line output, a solution will be generated so as to improve the company's production line output. A simulation of the actual assembly line will be carried out to detect the cause of inefficiency. Lean manufacturing method which is to eliminate delay will be applied to increase the efficiency of production line. Apart from that, the skill of the operator in charge in the process and layout of the plant will be discussed as both factors give effect to the efficiency of production line. By considering these factors, the efficiency of production line can be improved significantly.

# ABSTRAK

Hasil pengeluaran adalah tulang belakang kepada sebuah syarikat pembuatan. Situasi syarikat pembuatan kini ialah mereka selalu berdepan dengan kadar pengeluaran yang kurang efektif. Dalam kes kajian ini, proses pembuatan sebuah kilang akan dikaji. Data daripada seksyen pembuatan kilang tersebut akan diambil dan direkod. Data tersebut termasuklah sedikit penerangan mengenai proses terlibat, masa yang diperlukan untuk menyiapkan sesuatu proses dan jumlah mesin dan pekerja yang terlibat dalam sesuatu proses. Darpiada data yang direkod, analysis akan dibuat untuk mengenal pasti sebab-sebab yang menyebabkan pengeluaran kilang tersebut tidak optimum. Kaedah-kaedah meningkatkan kadar pengeluaran kilang akan dikaji. Simulasi tentang pengeluaran kilang akan dibuat mengenalpasti sebab pengeluaran yang tidak efektif. Teori pembuatan lean akan diaplikasikan ke atas kilang ini untuk mengurangkan kelewatan dalam sesuatu process. Selain daripada itu, kemahiran pekerja dan susun atur kilang tersebut akan dikaji kerana ia juga memberi impak terhadap kadar pengeluaran sesebuah kilang. Dengan mempertimbangkan factor -factor ini, kadar pengeluran kilang akan bertambah menjadi lebih baik.

# ACKNOWLEDGEMENT

Finally this final year project has come to an end successfully. I thank the Lord for giving me this opportunity and strength to complete this project. FYP 1 and FYP 2 are a success as I have completed both of them as part of my Bachelor of Mechanical Engineering majoring in Design and Innovation course fulfilment. I would like to express my appreciation and gratitude to those who have helped me in one way or another. Thank you to my supervisor, Dr Siti Nurhaida Khalil who has showed great enthusiasm in guiding me. Thank you to other lecturers, Madam Rohana binti Abdullah and Dr Wan Zainal who have helped me in understanding the concept of manufacturing and the application of software in my case study. Apart from that, I would like to also thank my parents and course mates in Universiti Teknikal Malaysia Melaka (UTeM) for constantly supporting and giving me advice in completing this project. Lastly, thank you to the factory workers who have assisted in my case study.

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| | |
|---|---|
| SM | Simulation modelling |
| CT | Cycle time |
| DOE | Design of experiment |
| WIP | Work in progress |

# CHAPTER 1

# INTRODUCTION

## 1.1     Background

The assembly line is the root factor of successful manufacturing today. From our cars, electronic devices and food are produced from an assembly line model. Little did we know how much assembly processes have changed throughout the decades. Back then, manufacturing a product takes a long time. Complex manufacturing like cars may take up to 12 hours of production time. On December 1, 1913 Henry Ford introduced his assembly line that took the manufacturing world by storm.

Even now, business owners are eager to find solutions to decrease the time needed to produce a product. Engineering has its flaws and this is also applied to the production line. There is a wide variety of inefficiencies that occur throughout the production line. The production field is facing a new challenge which various influences of society and environment have to be taken into account. Every day in production line there are many faulty products that cause more losses to the industry. Problems that occurred in the production line also include delay between processes, production errors, faulty equipment and lack of manpower. When the listed problems occur, the production efficiency is also affected. Production efficiency refers to how many products are produced without wasting resources. During the recent years, studies have been carried out massively to overcome inefficiency problem in the production line so as to increase efficiency and productivity to produce products of higher quality with lower cost.

There are many processes that are involved in assembly production line. In each process, there are improvements that can be made. For example, time taken for the assembly

of frame is too long or time needed to assemble the printed circuit boards to the machine is too long. Hence, improvement can be made to the process so that shorter time is needed for the process to take place. This will result in more frames being assembled and more circuit boards can be assembled on their designated location at a given time. Consequently, this will produce more machines at a given time and increases the efficiency of the company.

Besides that, there are also delays that occur throughout the production. This may be due to problem of information flow. In every production line, there is a standard of procedures (SOP) that is provided for workers to follow. Delays may be caused from the processes written in SOP are not according to a good flow. A good flow of information may save more production time. In many cases, the delays are caused by poor management of map processes. This may be due to process that can be carried out in parallel are practiced in series. With map processes also, the direction of process and time needed for a process to complete are well established hence processes can be carried out with a smooth flow.

## 1.2    Problem Statement

The inefficiency that occurred in the production line of the company represents the percentage of profit that is lost from the company. Companies emphasise on reducing production time. Many production lines are putting a lot of effort in improving the efficiency of the system. Unfortunately there are still many lacking points in the processes carried out in the production line. Many companies have their standard of procedures (SOP) ready but there are still elements to be improved. By using modelling assembly process, the efficiency of production line can be improved.

## 1.3 OBJECTIVE

The objectives of this project are as follows:

1. To study the activities involved in the production line.

2. To obtain the duration of processes involved in the production line.

3. To provide a complete analysis and solution to improve the efficiency of production line.

## 1.4 Scope of Project

The scopes of this project are:

1. Only processes that involved in the production line will be timed.

2. Improvements will be done with existing processes, equipment and man power.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1    Assembly Lines

Assembly lines are a common element especially in a system which emphasizes on its production. The first manufacturing assembly line is introduced by Henry Ford in the early 1900's. The principle of an assembly line is to have a set of workstation that is in linear manner with each work station connected by a material handling device. (W. Grzechca et al, 2015). At any point where task is carried out is called a station. Process time means the time taken to complete each task. Meanwhile, the cycle time is usually fixed according to the production rate. However, there are always problems that arise with the assembly line. Hence, line balancing is introduced to minimize imbalance between/among workers and workload so as to achieve required run rate (Nguyuen et al., 2016). In order to get to the root cause of the problem, the assembly process, workstation layout and workstation cycle time should be analyzed to justify the imbalance of assembly line. According to Bautista et al., (2015), there are two types of assembly line balancing problems. The two types of assembly line balancing problems are as follow:

- Simple assembly line balancing problem (SALBP)
- General assembly line balancing problem (GALBP)

In addition to that, Bautista et al., (2015) also states that SALBP is made of assembly problems that attempts to minimize the total idle time when two types of task that are exclusively considered and GALBP arises when there are problem with addition considerations like restricted assignment of task and the assignment in block of certain tasks.

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## 2.1.1 Types of Assembly Line Balancing

There are different types of assembly line structures such as serial line, parallel line, two sided line and many others. All of the types can be categorized into two major types, first, constant cycle time and minimization of workstations and second type is constant number of workstations and minimization of cycle time (W. Grzechca et al, 2015). According to (Aase, Olson and Schniederjans, 2004), a U-shaped assembly line shows more advantages as compared to a straight line assembly line.
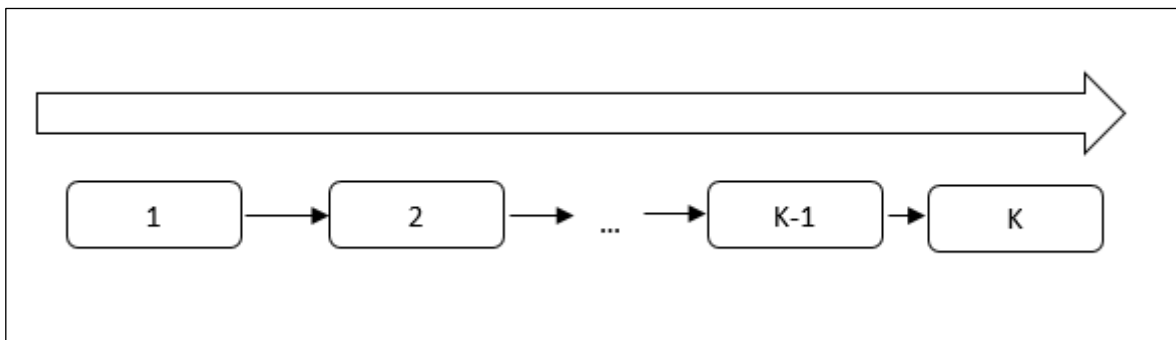


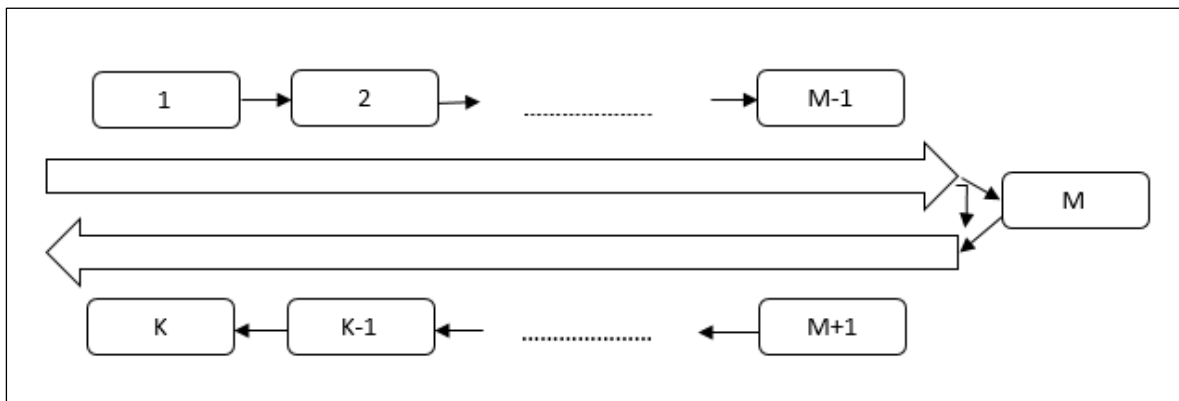Figure 2.1.1(a): Adapted from W. Grzechca et al, 2015 Single Assembly line



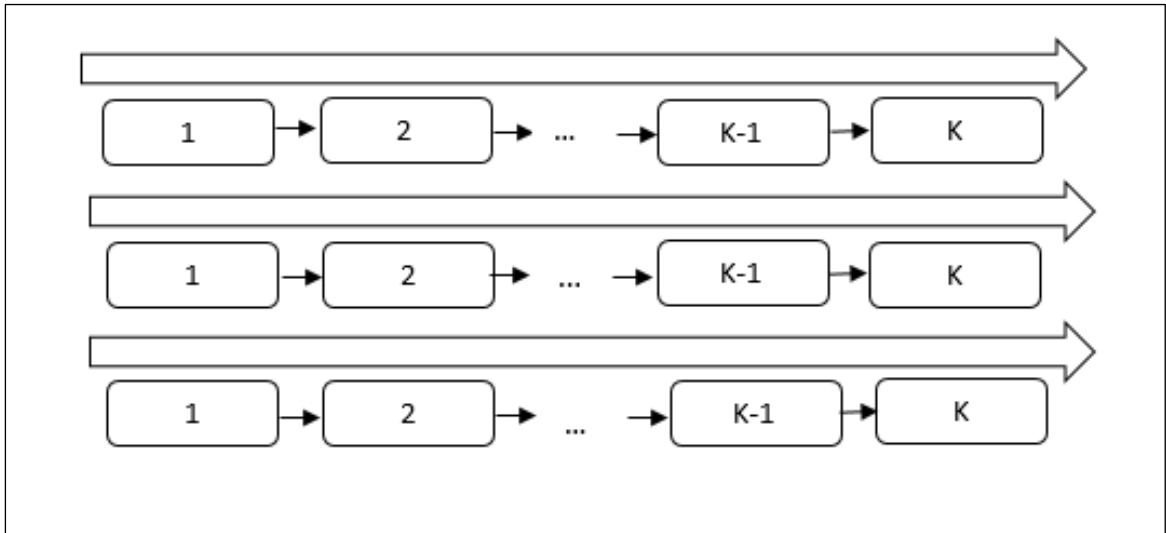Figure 1.1.1(b): Adapted from W. Grzechca et al, 2015  U-SHaped assembly line

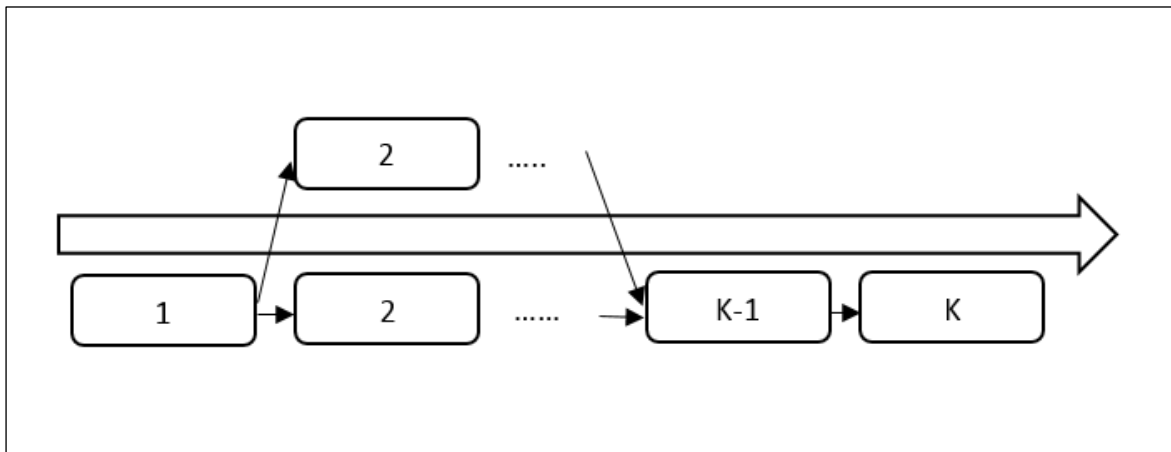Figure 2.1.1(c): Adapted from W. Grzechca et al, 2015 Parallel assembly line



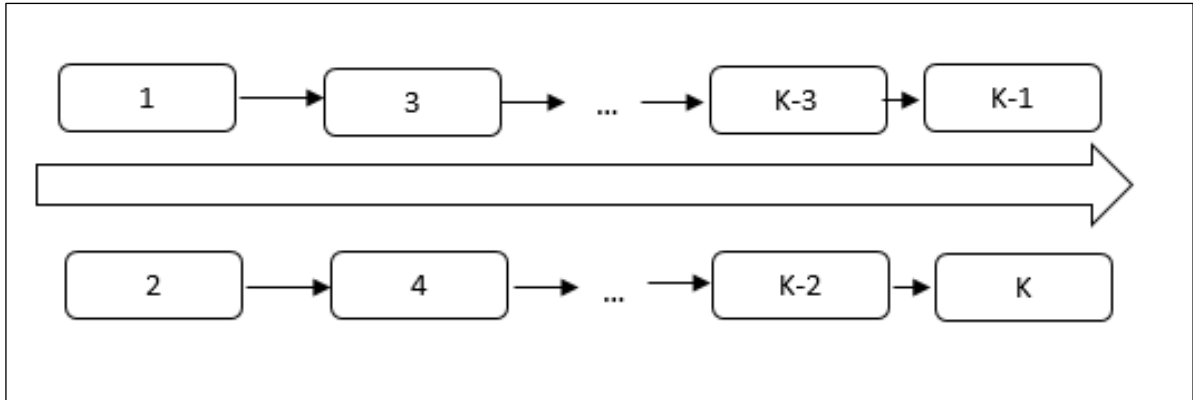Figure 2.1.1(d): Adapted from W. Grzechca et al, 2015 Parallel stations

Figure 2.1.1(e): Adapted from W. Grzechca et al, 2015 Two sided assembly line

## 2.2 Bottleneck

### 2.2.1 Introduction of bottleneck

Line balancing is a technique that is often used in production lines. However, bottleneck points also occur throughout the production line where the efficiency of production line will be affected. As a result of bottleneck, the amount of wastes will increase. The occurrence of bottleneck inhibits the performance of companies. Problems related to bottleneck have been studied for decades. According to J. Hinckeldeyn et al., (2013), bottleneck often appears when a capacity demand exceeds the supply of respective source.

### 2.2.2 Cause of Bottleneck

The major cause of bottleneck is the discrepancies that occur in the production rates among work stations (C.H Glock et al., 2013). This happens when there are production rates that are unequally higher than other stations. Consequently, this will cause the bottleneck to constantly change its position in the production line.