CHAPTER I

INTRODUCTION

1.1 Background

In a production system, there are lots of processes and occurrences that must be considered and planned. It usually occurs in manufacturing companies when producing the product. One of production system aspect that must be managed well is the assembly lines. It is the place for the production itself, where the production line that consists of a number of assembly operations performed on several workstations and combined into assembly or subassembly objects. The important factor for the efficiency of assembly line is distributing the task evenly over the workstation. So that idle or waiting time of machine or man can be minimized. The goal can be achieved using line balancing procedure. It aims at grouping the facilities or workers in an efficient pattern in order to obtain an optimum or most efficient balance of the capacities and flows of the production or assembly processes (Kumar & Mahto, 2013).

The fundamental of assembly line balancing problems (ALBP) is to assign the tasks to an ordered sequence of workstations (Kriengkorakot & Pianthong, 2007). During the assignment of these tasks to stations, various constraints are discussed. Main constraints are cycle time constraint and precedence constraint of work items. In addition, side constraint such as assignment constraints. These constraints make the complicate of a complete line balancing and prevent the provision of workload balance. There will be more workload on some stations than the others, reductions in

efficiency and emergence of some losses are inevitable. But the purpose is to find line balancing solutions that will minimize the loss (Mercan, 2012).

Historically the traditional ALBP scenario leads to two types of optimization problems as can be an objective function, Type I and Type II. In the Type I problem, the cycle time (maximum amount of time units that can be spent at each workstation) is fixed and the objective is to minimize the required number of workstations. It is more frequently used in the design of a new assembly line for which the demand can be easily forecasted. Otherwise, the Type II problem attempts to minimize the maximum cycle time given a fixed number of workstations. It is deal with the maximization of the production rate of an existing assembly line (Ajenblit & Wainwright, 1998).

ALBP is a crucial question during design and management of assembly lines since it directly affects the productivity of the whole manufacturing system (Hu et al., 2014). Many manufacturers especially in automobiles industries are switching with their production line configuration. The production line from single product or batch production to mixed-model production. It is different products or models are produced on the same line with the models interspersed throughout a production sequence (Sparling & Miltenburg, 1998). On the same case, production line from one-sided assembly lines to two-sided assembly lines. It has a special type of assembly line in which workers perform assembly tasks in both of sides of the line. The workers are performing in each station that has a pair of stations directly opposite each other (left and right side). It is recognized to be of crucial importance especially in the assembly of large-sized products (Kim et al., 2000). Thus, the combining of those types called mixed-model two-sided assembly line. It can saving space and order products can be customized with customer demand (Simaria & Vilarinho, 2009).

The first mixed-model two-sided assembly line balancing problem (MTALBP) issued in modeling especially in mathematical model is presented by researchers. Simaria & Vilarinho (2009) stated that due to the high complexity makes it impossible to be solved to optimality. Furthermore, researchers presented the assembly line balancing procedures to solve MTALBP. Metaheuristic approach was selected by

researches as assembly line balancing procedure. The researches purpose to get the optimal solution from their procedure. Although it finds the better solution using metaheuristic approaches. However, the procedure still does not guarantee best results. Moreover, these solutions involve complex calculations and thousand constraints which uncertain result. Also, it is not easy to derive a solution for systems other than small scale systems. In other approach, simulation is an innovative approach that is used to gets around these limitations. It is best suited to analyze complex and large practical problems when it is not possible to solve them through a mathematical method (Hürlimann, 1999). By using a simulation model to initial the random processes as accurately as user like. It is comparatively flexible and can be represent of real situations (Zupan & Herakovic, 2015). The technique are quick generate with no complex calculations.

In the situation, Huang et al. (2012) stated that the computer simulation arises at the historic moment, which can quickly and accurately finish simulation. There are many computer simulation software especially Tecnomatix Plant Simulation. It is object-oriented, graphical, integration of modeling, simulation tools, which used to call eM-Plant until the takeover of Siemens. They proposed modeling method and genetic algorithm to solve assembly line balancing by using the software. The results can greatly improve the efficiency.

The second issued that also arised from (Qi et al., 2015), it is the only research that solved mixed-model two-sided assembly line balancing problem (MTALBP) Type II until now. They develop MTALB in automobile company. In data processing, they convert the data from three process time in product A, B,C to be one process time. It uses poisson distribution and work sampling method. It can't be guaranteed that it is concrete data, even the researchers didn't recommend to try their method to convert the data. The solution for this problem is implement the MTALBP Type II without converting the process time data of each product to be one process time. This solution is to ensure that the data is suitable to used.

Based on the issues, simulation approach procedure is selected for MTALB Type II problem implementation in automobile company. PT. Toyota Motor

Manufacturing Indonesia (TMMIN) was selected as location research. The company focuses in automotive car especially in car assembly product. The types of production line are assembling large-sized high volume products and mixed-model two-sided assembly line. That's why the assembly line there assembles more than product such as fortuner and innova in one assembly line at Plant 2 with high volume product. In order to produce products efficiently, the company needs to implement the takt time in each workstation. However, the existing assembly line still has problem with the cycle time in each workstation. There are several cycle time on the workstations that exceed or far less than the takt time. As a consequence, the waiting time is still high which is 09:18.55 and 10:04.25 for Innova and Fortuner products. The higher waiting time causes the production target cannot be reached. In the field, the production target is 175 units that can be produced from 281 units of product target. Thus, improvement of the assembly line there is needed to reduce the waiting time and maximize the production target. In addition, weighted smoothness index (WSI) and line efficiency (WLE) as problem test will be added from (Yuan et al., 2015). WSI is a way to measure the level of relative waiting time, minimize the WSI can reduce the difference of workload between workstation and to distribute workload between stations as balanced as possible. On the other hand, WLE can check the line length efficiency.

Based on the problem, this study aims to implement the MTALBP Type II which is minimizing the cycle time when the workstation is fixed using simulation approach in TMMIN company. Tecnomatix Plant Simulation by Siemens would be facilitate to this research.

1.2 Problem Formulation

This research aims at systematically collecting and critically analyze the existing contribution of an in manufacture industry. Considering this the main research question addressed in this review, there are a research question need to be answered:

a. How is the proposed assembly line performance of mixed-model two-sided assembly line balancing problem type II by using Tecnomatix Plant Simulation?

b. Is there any improvement on the proposed assembly line performance? If yes, how is the improvement?

1.3 Research Objective

Based on the problem defined above, there are objectives need to be achieved:

a. Analyzing the proposed assembly line performance of mixed-model two-sided assembly line balancing problem type II by using Tecnomatix Plant Simulation
b. Identifying the improvement of the proposed assembly line performance.

1.4 Problem Limitation

The research is conducted under following scope and limitations:

a. This study focused on automobile company which is assembling large-sized high-volume and variants products in manufacture industry.
b. Tecnomatix Plant Simulation by Siemens is the software to build the assembly line model.
c. The MTALBP focuses on type II which is minimizing cycle time for given number of the workstation..
d. The task that will be assigned must be appropriate with the assignment restrictions, precedence and cyle time constraint.

1.5 Significance of The Research

Here are expected that by conducting this research, some benefits can be earned:

a. The research can fulfill the gap of the state of the art and can be used as a scientific reference in other research.
b. The research can be used as the base of correlated further research.
c. The research methodology can be used as the new way of thinking and consideration toward the company in managing their assembly line.
d. Hopefully from this research can inspire the small-medium enterprise that has the same cases to build their assembly line production.

1.6 Thesis Structure

The research outline will be arranged as the following:

CHAPTER I INTRODUCTION

This chapter contains the background of the problem, problem formulation, research objectives, problem limitation and significance of the research.

CHAPTER II LITERATURE REVIEW

This chapter will be elaborations of the literature studies which are in the form of inductive and deductive study. There will be also the general description of the company as well as the research framework. Inductive study is the previous studies which will be the basic of research. While deductive study is the theoretical basis for supporting the problem solving in the research. Inductive study was obtained from the journal and proceedings are published periodically. While deductive study was obtained from the study of textbooks related to the theory.

CHAPTER III RESEARCH METHODOLOGY

This chapter will describe the methodology which is applied in the study. It consists of several parts: the arrangement of research position and model development as an improvement.

CHAPTER IV DATA COLLECTING AND PROCESSING

This chapter will elaborate the collection of the data as well as the data processing. The data collection is divided into the primary as well as the secondary. Data accumulation is derived from interviewing and direct observation. The data processing will be developed based on the methodology which has been built in the previous chapter.

CHAPTER V DISCUSSION

This Chapter is going to discuss the results of data processing and the analysis. Discussion will be presented the result of assessment based on the parameters. It will also discuss the simulation result that has been generated.

CHAPTER VI CONCLUSION AND SUGGESTION

The final section will describe the overall conclusions from the results of the study and the suggestion for the future research.