UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

PRODUCTIVITY IMPROVEMENT THROUGH WORK SYSTEM DESIGN METHOD FOR BETTER MAN POWER UTILIZATION AT ROBOT WELDING PROCESS

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Master of Manufacturing Engineering (Industrial Engineering)

2018

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A thesis submitted
in the fulfillment of the requirements for the degree of Master of Manufacturing Engineering (Industrial Engineering)

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2018

DECLARATION

I declare that this report entitled "Productivity Improvement through Work System Design Method for Better Man Power Utilization at Robot Welding Process" is the result of my own research except as cited in references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……………………

Name : CHUNG KAR YEE

Date : ……………………

APPROVAL

I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality as a partial fulfilment of Master of Manufacturing Engineering (Industrial Engineering).

Signature : ……………………

Name : ASSOC. PROF. DR. ZUHRIAH BINTI EBRAHIM

Date : ……………………

DEDICATION

Only

my beloved father,

my appreciated mother,

my adored sisters and brother,

for giving me moral support, money cooperation, encouragement and also understandings

Thank You So Much & Love You All Forever

ABSTRAK

Dalam pasaran hari ini, perniagaan memerlukan kepelbagaian dan keupayaan untuk berdaya saing dalam memenangi pasarannya. Untuk mempertahankan perniagaan di bawah persaingan yang sengit, sebuah syarikat perlu menghapuskan aktiviti yang tidak membawa nilai supaya prestasi yang cekap dan berkesan dapat diperolehi. Kajian ini membincangkan peningkatan produktiviti dengan penggunaan tenaga manusia yang efektif di dalam syarikat dengan kaedah "time study" dan "MOST" analisis. Tiga objektif telah ditetapkan iaitu; (i) untuk mengenal pasti aktiviti yang tidak membawa nilai dalam proses kimpalan robot; (ii) untuk menyediakan cara penyelesaian untuk mengurangkan aktiviti yang tidak membawa nilai dalam proses kimpalan; (iii) meningkatkan produktiviti penggunaan tenaga manusia sebanyak 30%. Pemerhatian langsung dilakukan untuk mengenal pasti aktiviti yang tidak membawa nilai dalam proses kimpalan robot. "Time study" digunakan untuk mengetahui masa sebenar yang telah digunakan oleh pekerja dalam operasi. Kemudian, "MOST" analisis digunakan untuk menganalisis operasi secara terperinci yang menumpukan kepada pergerakan objek. Perbandingan antara keputusan "time study" dan "MOST" analisis dilakukan untuk menyiasat operasi. Selepas itu, satu cara penyelesaian dicadangkan untuk mengurangkan aktiviti yang tidak membawa nilai dalam proses kimpalan robot. Akhir sekali, "time study" dijalankan untuk mengesahkan cara penyelesaian yang dicadangkan. Keputusan projek menunjukkan bahawa; (i) aktiviti yang tidak membawa nilai dalam proses kimpalan robot telah dikenalpasti; (ii) susunatur kerja yang baru dicadangkan untuk mengurangkan masa menunggu setiap pekerja (operator 1); (iii) penggunaan tenaga manusia meningkat sebanyak 26.44% dan produktiviti pekerja meningkat sebanyak 66.67%. Oleh itu, kajian ini menyimpulkan bahawa penggunaan tenaga manusia yang efektif boleh meningkatkan produktiviti pekerja.

ABSTRACT

In today's marketplace, business has become more diversified and competitive in securing its market share. In order to sustain in business under the fierce competition, a company needs to eliminate the non-value added activities of the operation so that efficient and effective performance can be obtained. This study focuses on the improvement of productivity through effective utilization of manpower in the production line by using time study approach and MOST analysis. Three objectives have been set; (i) to identify the non-value added activities at the robot welding production line; (ii) to provide solution to reduce the non-value added activities at the welding production line; (iii) to increase the manpower utilization by 30%. Direct observation is conducted to determine the non-value added activities at the robot welding production line. Time study approach is applied to determine the actual cycle time of operator work content. MOST analysis was then presented to analyze the operation in a detail way which focused on the movement of object. Comparison between time study result and MOST analysis was conducted to investigate the operation. After that, a solution is provided to reduce the non-value added activities at the robot welding production line. Lastly, time study is carried out to validate the proposed solution. Results of the project show that; (i) non-value added activities at the robot welding production line are identified (i.e. list of the non-value added activities); (ii) a new work sequence layout has been proposed to reduce the operator waiting time; (iii) the manpower utilization has increased by 26.44% as well as the labor productivity has been improved by 66.67%. Thus, this study concludes that effective utilization of manpower can improve the labor productivity.

ACKNOWLEDGEMENT

First, I would like to express my gratitude to my respected academic supervisor, Dr Zuhriah Binti Ebrahim, industrial supervisor, Mr. Fazriani Bin Amran and industrial engineer, Ms. Nor Fazilah Binti Amran for the great mentoring that was given to me throughout the project. Besides, I would like to express my gratitude to the examiners for their kind advice and guidance.

Last but not least, I would like to give a special thanks to my best friends who gave me much motivation and cooperation mentally in completing this report. They had given their critical suggestion and comments throughout the project. Thanks for the great friendship.

Finally, I would like to thank to everybody who was important to this master project, as well as expressing my apology that I could not mention personally each one of you.

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BSI	-	British Standard Institution
CM	-	Cross-member
GDP	-	Gross domestic product
ILO	-	International Labor Organization
MATRADE	-	Malaysia External Trade Development Corporation
MIDA	-	Malaysian Investment Development Authority
MOST	-	Maynard Operation Sequence Technique
MODAPTS	-	Modular Arrangement of Predetermined Time Standards
MTM	-	Methods Time Measurement
MP	-	Master Project
NVA	-	Non-value Added
OP	-	Operator
PFD	-	Personal, fatigue and delay
PMTS	-	Predetermined Motion Time System
R	-	Robot
SIMO	-	Simultaneous-Motion cycle
SOP	-	Standard Operating Procedure
SWAG	-	Sophisticated Wild Ass Guess
TMU	-	Time Measurement Units
VA	-	Value added
W/S	-	Workstation

CHAPTER 1

INTRODUCTION

1.1 Project Background

Manufacturing is defined as the making of finished products from raw materials, components or parts using various processes, equipment, operations and manpower according to a detailed plan (Scallan, 2003). In an interview, Dato' Azman Mahmud, CEO of the Malaysian Investment Development Authority (MIDA), has stated that manufacturing sector is the backbone of Malaysia in which it contributes to the Malaysia's economy. This statement is supported by Nathan (2018), where in 2017, the manufacturing sector contributed 23% to gross domestic product (GDP), while the production grew by 6.1% and sales value increase 13.7% to RM 765.8 billion. Besides, according to the Malaysia External Trade Development Corporation (MATRADE), in 2016, manufacturing accounted for more than 80% of total Malaysia's total export.

Today, in the modern competitive world, manufacturers are unlikely to survive in the present form whereby they need to be expanded and secure their maket share by improving competitiveness (Khaleel *et al.,* 2011; Salehi *et al.,* 2013). Competitiveness mean the ability of an organization to take the most advantageous position in a rapidly changing market environment, which based on quality, speed, technical superiority and product differentiation (Mwanza and Mbohwa, 2016). According to the Salehi *et al.,* (2013), productivity is one of the key determinants of competitiveness.

Generally, productivity is defined as the ratio of an extent of output to the unit of all of the resources used to produce the output (Duran *et al.,* 2015). In other words, productivity is the efficient use of resources such as labor, capital, materials and etc. to produce various products and services (Joseph, 1987). Thus, the level of resource allocation and labor utilization will be largely affect the overall productivity. In addition, Tuan *et al.,* (2014) pointed out that the non-optimal resource allocation and utilization is directly or indirectly affect the profitability of a business as more wages for extra labor which need to paid by the manufacturer. Therefore, measure has to be taken in order to stay competitive in the marketplace, yet achieve a higher profit based on enhancement of productivity.

In this competitive manufacturing arena, the lean manufacturing philosophy is widely implemented due to that it helps to fulfill the customer demand on time by allocating the resources as well as maximizing their utilization. However, it is not an easy task to establish a lean manufacturing environment as industries need to identify and eliminate all the possible wastes throughout the production lines (Tuan *et al.,* 2014). As a part of the way of implementing lean manufacturing philosophy, work study is useful for the manufacturers in investigating, reducing and subsequently eliminating non-value added activities as well as ineffective time. This technique leads to a reduction of work content and eventually achieve an efficient production system. According to Zandin (2002), since a production system comprises of individual operations, it is necessary to optimize its individual operations in order to produce an efficient production system.

In this context, Maynard Operation Sequence Technique (MOST) is a breakthrough work measurement technique that measures the both repetitive and non-repetitive work easily and accurately (Chaudhary *et al.,* 2008). Through MOST, the waste and unproductive methods can be exposed quickly, which also means that the ineffective time can be defined and separated from the effective time (Chaudhary *et al.,* 2008; Kanda *et al.,* 2013). Elimination of waste is emphasized to reduce the production time, increase the value-added content and consequently improve productivity (Moktadir *et al.,* 2017).

This project has been undertaken to investigate the scope of making possible improvement in labor utilization as well as productivity of the operation in production line. Firstly, the current utilization of labor is determined in such a way that direct observation is carried out to obtain the real time data. Then, MOST is implemented to analyze the elemental activities of the operation in which that the value added and non-value added activities can be shown up within the operation. As a result, improvement can be made by eliminating the non-value added activities and then improving overall productivity of the company.

1.2 Problem Statement

In today's highly competitive marketplace, business has become more diversified and competitive in securing its market share. Besides, with the introduction of alternative product by competitors, it has become much challenging to satisfy customer requirement since they have choices to purchase product from different company (Tuan *et al.,* 2014). In order to sustain in business under the fierce competition, a company needs to investigate and optimize its operation by eliminating the non-value added activities of the operation so that efficient and effective performance can be obtained. In short, productivity is the main concern in the manufacturing industry where it is considered to be a profit growth of a company (Kumar *et al.,* 2013; Vergeer and Kleinknecht, 2014).

This project focuses on the improvement of productivity by effective utilization of manpower in the company. In the company under study, it was found that the manpower is not fully utilized. The work content of the operators is to load the parts to the jig and unload the assembly parts from the jig after the welding operation done by robots. During the operation of assembly welding, the operators are only waiting aside without assign to other job. The time required for them to perform the task is taken. Based on Figure 1.1, it shows that all operators are underutilized as their productive time is less than 50% compare to the takt time.

Furthermore, based on Figure 1.2 to Figure 1.6, the result of stopwatch reading shows that there is a variance of time when the operators performed their tasks at their workplaces. This indicates that the time required for the operators to complete their tasks is not consistent due to lack of standardization in performing the tasks.

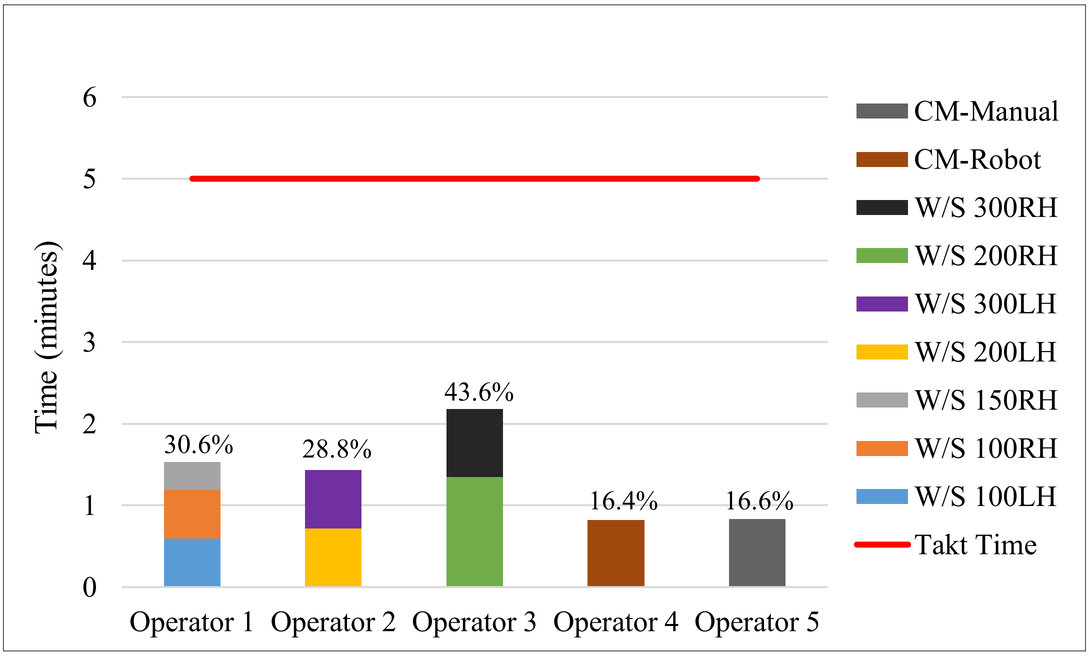

Figure 1.1: Comparison of manual work content with takt time

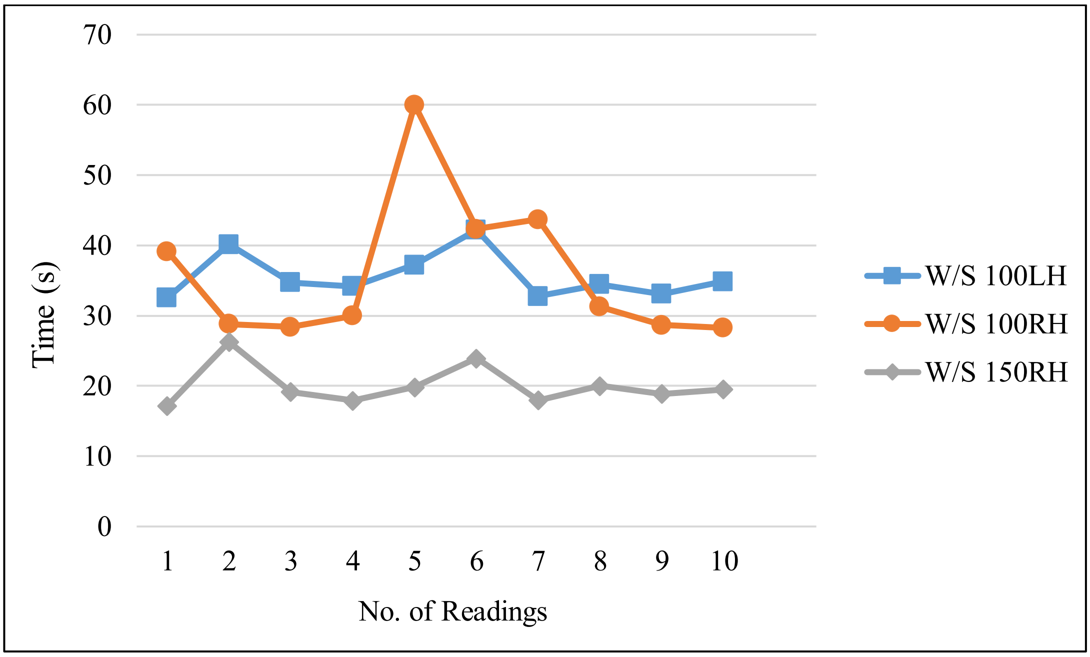

Figure 1.2: Inconsistent processing time at W/S 100LH, 100RH and 150RH (operator 1)

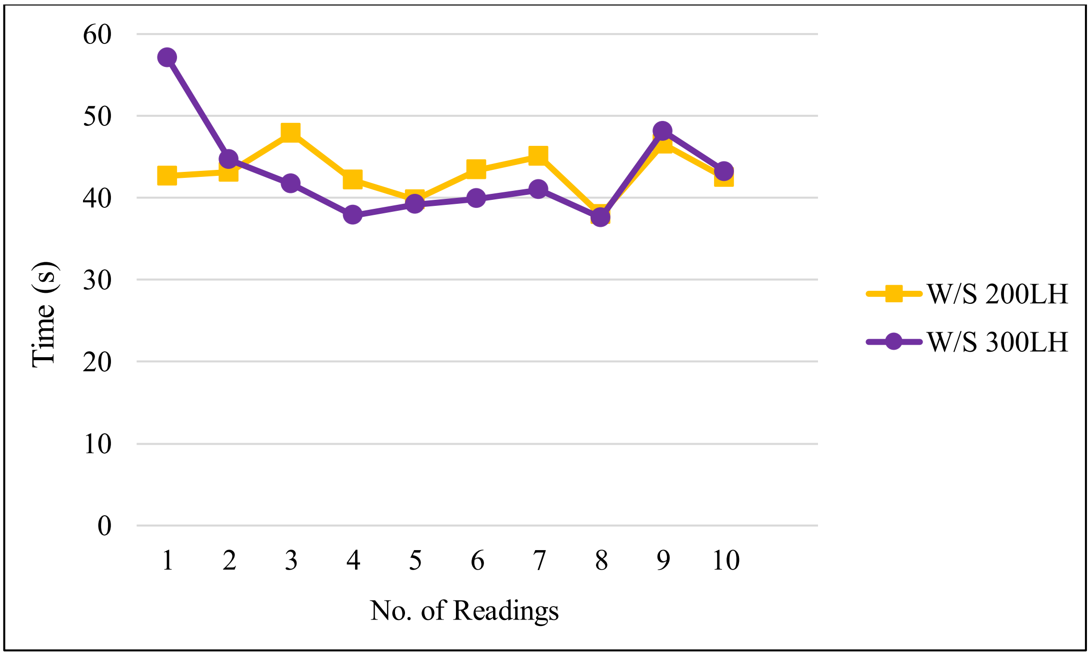

Figure 1.3: Inconsistent processing time at W/S 200LH and 300LH (operator 2)

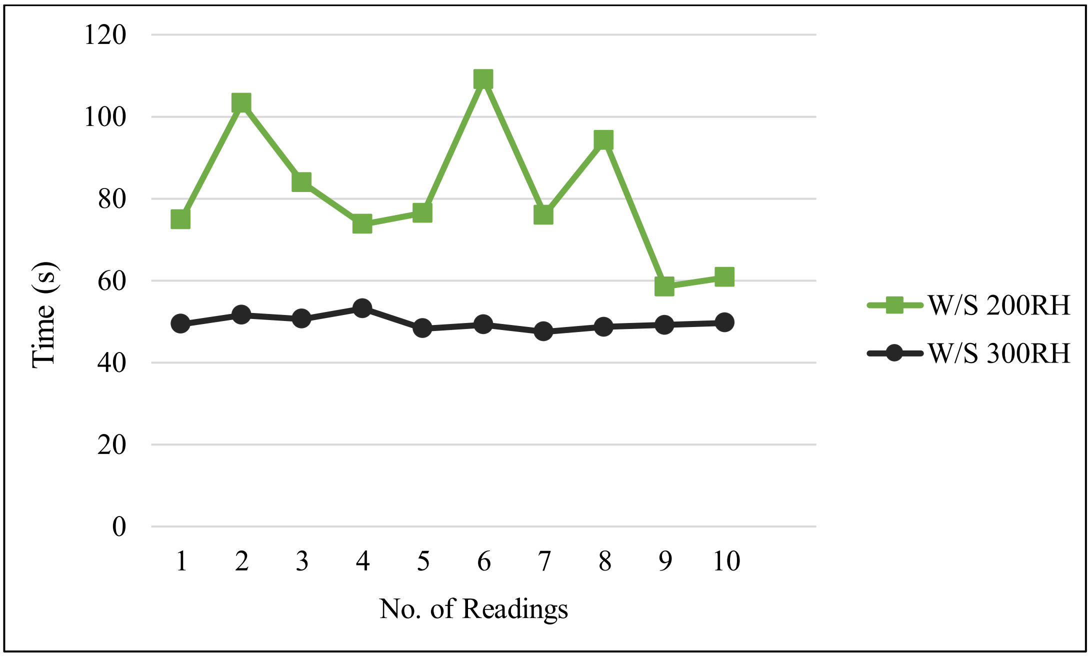

Figure 1.4: Inconsistent processing time at W/S 200RH and 300RH (operator 3)

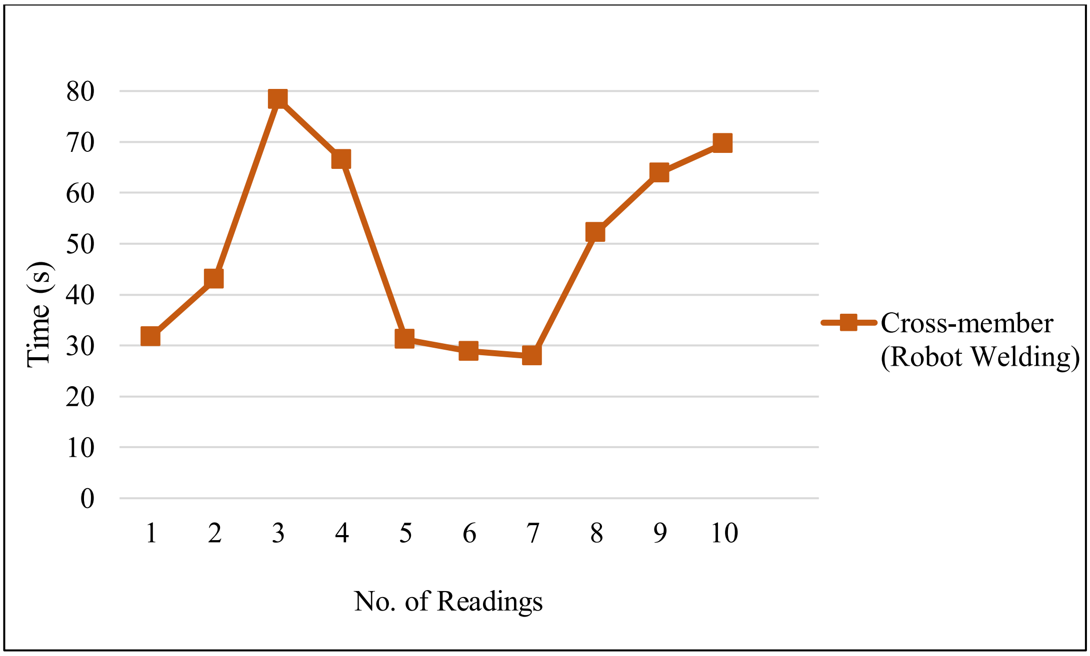

Figure 1.5: Inconsistent processing time at robot welding cross-member station (operator 4)

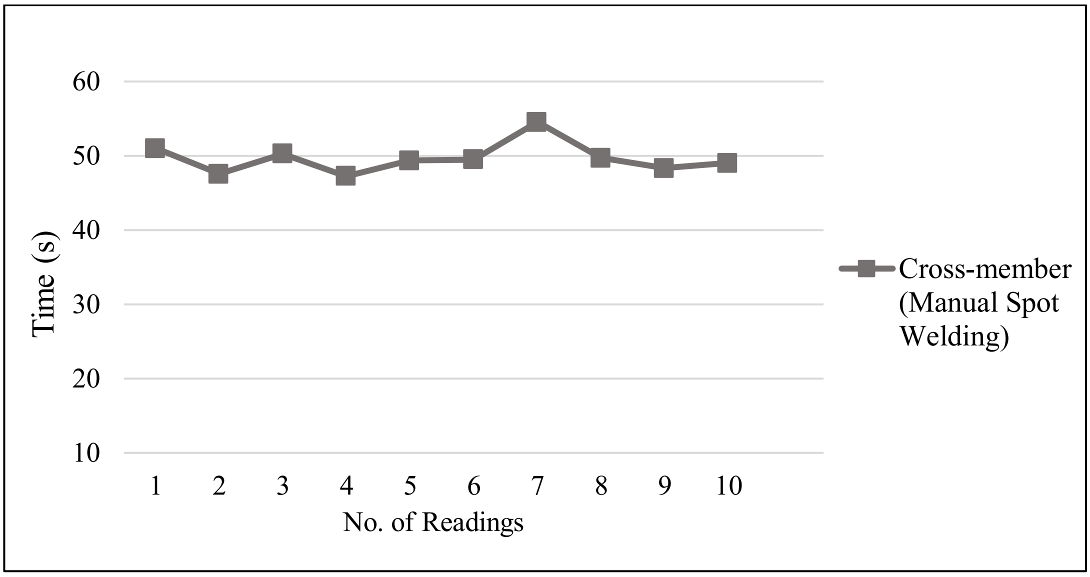

Figure 1.6: Inconsistent processing time at manual spot welding cross-member station (operator 5)

Therefore, the work and time measurement technique are used to help the manufacturer to increase productivity by defining the proper working method, standard time and the way of maximizing the resource utilizations (Tuan *et al.,* 2014). MOST is a work measurement technique which breaks down the tasks into elemental activites. In that, non-value added activities can be shown up and separated from the value-added activities within the operation. As a result of implementing MOST, the work is being standardized and the working practice becomes more productive. Eventually, the utilization of labor is optimized and then overall productivity of the company is improved.

1.3 Objectives

The objectives of this project are:

a) To identify the non-value added activities at the robot welding production line.

b) To provide solution for reducing the non-value added activities at the robot welding production line.

c) To increase the manpower utilization by 30%.