



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**COMPARISON OF PRODUCTIVITY OF SMALL SCALE
INDUSTRY USING STOPWATCH TIME STUDY AND COST
BENEFIT ANALYSIS OF PRODUCTIVITY IMPROVEMENT
PROJECT**

This report submitted in accordance with requirement of the Universiti Teknikal
Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering
(Management) (Hons.)

by

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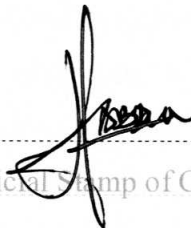
APPROVAL

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ABSTRAK

Produktiviti boleh diperkenalkan sebagai julat maklumat masuk terhadap maklumat keluar seperti beberapa elemen contohnya pekerja, mesin, bahan and perkara lain yang berkenaan dengan industri pembuatan dan perkhidmatan. Ia juga digunakan oleh pihak pengurusan tertinggi untuk mengenal pasti dan mengukur prestasi semasa operasi syarikat berbanding dengan syarikat pesaing. Di dalam tugas ini, pembelajaran produktiviti telah dijalankan di sebuah industri sederhana berdasarkan gerak kerja pemotongan getah dan kos operasi secara bulanan untuk menghasilkan produk “Firestop Collar”. Kaedah lama yang digunakan untuk kerja pemotongan telah dikenal pasti sebagai punca utama masalah di dalam operasi yang menghasilkan kecacatan pada produk dan pembaziran banyak kitaran masa operasi. Masalah ini juga menyebabkan penghantaran yang lambat kepada pelanggan dan turut member kesan kepada kos operasi bulanan syarikat. Untuk menyelesaikan masalah, urutan kerja secara lengkap telah dikenal pasti untuk memahami gerak kerja dan selain itu, maklumat seperti kitaran masa kerja dan kos operasi bulanan telah dikumpul berdasarkan penggunaan kaedah lama yang dipraktikkan. Secara purata, kaedah lama memerlukan kitaran masa selama 31:53 minit untuk kerja pemotongan lengkap dan boleh memperoleh sebanyak RM 115,934 dalam setahun operasi. Gerak kerja berulang dalam operasi tangan telah dikenal pasti sebagai punca utama masalah yang berlaku dalam kaedah lama. Setelah itu, cadangan penambah baik telah dibuat dengan menggunakan mesin pemotong automatik berbanding dengan menggunakan pemotongan secara tangan dalam kaedah lama. Berdasarkan analisis, perbezaan antara kaedah lama dengan kaedah penambah baik mempunyai potensi untuk meningkatkan kitaran masa sebanyak 80.2% dan meningkatkan pendapatan syarikat sebanyak 8.19% dalam bentuk tunai terkumpul.

ABSTRACT

Productivity can be defined as the ratio of input over output data of the several elements in the system such as labor, machine, material and others that relate with manufacturing or services industry. It's also used by top management level to identify and measure the current company performance of the operation among the competitors. In this project, the productivity was studied in a Semi Medium Industry that based on rubber cutting process and monthly operating cost to produce the product of Firestop collar. The conventional method of cutting process was identified as a major problem in the operation that produce the product defect and wasting a lot of operation cycle time. This problem led to the late part delivery to the customer and also affected the company's monthly operating cost. To overcome of the problem, the detail of process flow had been clarified to understanding the process and also data of process cycle time and monthly operating cost was collected based on the conventional method that's been practiced. As an average, the conventional method required by 31:53 minutes to complete the cutting process and able to gain RM 115,934 within a year of operation. The repeated steps of cutting process in manual operation defined as the root cause of the problem happen in the conventional method. After that, the suggested of improvement was made to implement the automated cutting machine rather than using manual cutting operation in the conventional method. Based on the analysis, the comparison between conventional and improvement method had the potential to increase the process cycle time from 80.2% and increase the company profit value of 8.19% in accumulated net cash.

DEDICATION

To my beloved parents, Baharom Bin Maarof and Sabariah Binti Zainal Abidin and by
brother, Mohd Nor Fadhli Bin Baharom

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Bismillahirrahmannirahim,

At the first moment, with the name of God, I'm very thankful with His bless and love that was being given during the whole journey during this Final Year Project (PSM 1 & 2). Then, I also appreciate my parents that were supported, pray and stay beside my side to still support what I'm doing in my life.

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TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of content	v
List of Tables	viii
List of Figure	ix
List of Abbreviations, Symbols and Nomenclatures	x
CHAPTER 1: INTRODUCTION	1
1.1 Problem statement	1
1.2 Scope of work study	1
1.3 Objective	2
1.4 Interest area of work study	2
1.5 Research question	3
1.6 Importance area of work study	3
CHAPTER 2: LITERATURE REVIEW	4
2.1 Stopwatch time study	4
2.1.1 Equipment	6
2.1.2 Making the time study	7
2.1.3 Rating factor	8
2.1.4 Allowance and time standard	8
2.2 Cost benefit analysis	10
2.2.1 Cost and benefit categories	12
2.2.2 Selection evaluation method	14

2.2.3	Ethics of analysis	16
2.2.4	Accuracy problem in cost benefit analysis	16
2.2.5	Weight-scale approach to decision making	17
2.2.6	Strength and limitation	18
2.3	Productivity	19
2.3.1	Productivity model	19
2.3.2	Importance of productivity	20
2.3.3	Workplace productivity	21
2.3.4	Productivity improvement tool	22
2.3.5	Improve productivity in manufacturing industry	23
2.3.6	Calculate productivity in manufacturing	25
CHAPTER 3: METHODOLOGY		27
3.1	Methodology approach	27
3.2	Extended methodology of data collection	28
3.3	Extended methodology of data analysis	29
3.4	Extended methodology of project discussion	30
3.5	Extended methodology of project recommendation	31
3.6	Flow chart process of project	32
CHAPTER 4: RESULT & ANALYSIS		33
4.1	Collection of rubber cutter process data for stage 1	33
4.2	Collection of rubber cutter process data for stage 2	37
4.3	Collection of cost benefit analysis data	41
4.4	Analysis of data based on conventional methods of rubber cutting processing	44
4.1.1	Analysis of rubber cutter process data for stage 1	45
4.1.2	Analysis of rubber cutter process data for stage 2	46
4.1.3	Analysis of cost benefit data	47

CHAPTER 5: DISCUSSION & CONCLUSION	51
5.1 Improvement of rubber process	51
5.1.1 Lean manufacturing – Production waste	55
5.1.2 Six sigma approach – Measure stage	56
5.1.3 Six sigma approach – Analysis stage	57
5.1.4 Six sigma approach – Improve	60
5.1.5 Six sigma approach - Control	62
5.2 Analysis of suggested improvement	64
5.2.1 Cycle time process of rubber cutting	64
5.2.2 Cost benefit analysis of improvement method	66
5.3 Conclusion	68
RECOMMENDATION	69
REFERENCES	70
APPENDICES	

LIST OF TABLES

4.1	Cycle time data of rubber cutter process for stage 1 for data samples no.1 until 10	34
4.2	Cycle time data of rubber cutter process for stage 1 for data samples no.11 until 20	35
4.3	Cycle time data of rubber cutter process for stage 1 for data samples no.21 until 30	36
4.4	Cycle time data of rubber cutter process for stage 2 for data samples no.1 until 10	38
4.5	Cycle time data of rubber cutter process for stage 2 for data samples no.11 until 20	39
4.6	Cycle time data of rubber cutter process for stage 2 for data samples no.21 until 30	40
4.7	The division of estimation monthly operation cost of SMI Company	41
4.8	Monthly operation cost of SMI Company for Jul until Dec 2012	42
4.9	Forecasted monthly operation cost of SMI Company for Jan until Jun 2013	43
4.10	Analysis of rubber cutter process data for stage 1	45
4.11	Analysis of rubber cutter process data for stage 2	46
4.12	Analysis of cost benefit analysis data for Jun until Dec 2012	48
4.13	Forecasted analysis of cost benefits analysis data for Jan until Jun 2013	49
5.1	The potential waste in conventional method of rubber cutting process	55
5.2	Control phase action	63
5.3	Analysis data of suggested improvement in rubber cutting process	64
5.4	Analysis of comparison methods	65
5.5	Estimation improvement data of cost benefit analysis for Jun until Dec 2013	67

LIST OF FIGURES

2.1	Example of Digital stopwatch	5
2.2	Example of Video recorder to record motion picture	5
2.3	Example of break even analysis of project return	15
3.1	The flow chart of project	32
4.1	Segmented blade cutter and Jig & fixture of rubber cutter in stage 1	33
4.2	One of fire stop collar that consist of small rubber sheets	37
4.3	Segmented blade cutter and Jig and fixture of rubber cutter in stage 2	37
4.4	Transition of rubber sheets by several processes	44
4.5	The diagram of SME Company cost benefit analysis	50
5.1	The process step for rubber cutting stage 1	53
5.2	The process step for rubber cutting stage 2	54
5.3	Pareto Diagram of the 7 waste classifications	56
5.4	Root cause analysis of repeated step in a rubber cutting process	58
5.5	Why – why diagram for problem of repeated step in a rubber cutting process	59
5.6	The finding of the best solution by using PDSA cycle	61

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

SMI	-	Semi Medium Industry
CBA	-	Cost Benefit Analysis
PV	-	Present Value
i	-	Rate of interest
n	-	Time
NPA	-	Net Present Value
CFROI	-	Cash Flow Return on Investment
PDCA	-	Plan-Do-Check-Act
SPC	-	Statistical Process Control
ISO	-	International Standard Organization
GMP	-	Good Manufacturing Process
No.	-	Number
Sec	-	Second
+/-	-	Plus, Minus
%	-	Percentage
PDSA	-	Plan-Do-Study-Act
RM	-	Ringgit Malaysia
Admin	-	Administration
ROR	-	Rate of return

CHAPTER 1

INTRODUCTION

The first chapter of this final year project report was described about the overall project approached such as the problem statement, scope and objective. It was provided readers with a clear view of the direction of the project with the support of area of work study, research question and the importance of study in the learning overview.

1.1 Problem statement

The Semi Medium Industry (SMI) company industry produced the component of Firestop Collar that one's of the sub-parts assemble was included the three sheets of rubber with different specification of each. The current practice of rubber cutter process was identified as one major problem that produce defect of the sheet of rubber with improper standard specification. The new rubber cutter machine was suggested for this process and required the study of productivity of cutting process between conventional and new suggested method.

1.2 Scope of work study

This project study was specifically based on the operation in the selected SMI industry of metal stamping as main company operation. The rubber cutter process was the main purpose of this study that was analyzed and counter measured by using the stopwatch time study and cost benefit analysis.

1.3 Objective

The objective of this project as follows:

1. To identify the conventional flow process of manufacturing the rubber sheet part.
2. To identify the problem and weakness in the conventional manufacturing process of rubber sheet part.
3. To suggest the improvement of conventional method in rubber cutting process
4. To measure the cycle time of manufacturing process between conventional and suggested improvement using stopwatch time study.
5. To analysis the expected result of current and suggested improvement to find its significant effect to process cycle time productivity and cost saving using cost benefit analysis.

1.4 Interest area of work study

Interest area of work study for this project was to apply the study approach that can be classified into three main categories. The first area of study in this project was in the Stopwatch Time Study. This stopwatch time study will be used to identify the cycle time of manufacturing process that had been studied. Basically, from the study of process cycle time, the waste and improper task can be identified, analyzed and suggest to be improved for the improvement purpose.

Second interest area of study is Cost Benefit Analysis. This analysis will be used to identify the relation of the overall cost that has been used in the manufacturing process. It includes the cost of material, equipment and machining, labor and overhead that been used while producing the product or component before it could be delivered to the customer.

The productivity of study will be the third area of interest of study in this project. Based on this study, the productivity will be used to measure the performance of a worker or employee while doing the specific task. For example, the performance level could be measured as the ratio between the quantities of product produced and cycle time of manufacturing process.

1.5 Research question

The research questions that want to be forwarded in this project are:

1. Was there any increase or decrease of productivity after suggesting improvement of manufacturing process or equipment implemented?
2. Was there any relation could be identified between the manufacturing process and productivity?
3. What was the effect of suggested improvement to the cost of operation and investment in manufacturing?

1.6 Importance area of work study

The important area of work study in this project was based on the interest area of work study and the expected outcome of research question. The importance area of this project was as follows:

1. To do counter measured and differentiated the work study before and after suggesting improvement of manufacturing process and equipment.
2. To identify and clarify the waste and improper manufacturing process in selected industrial been studied that could be improved.
3. To measure the investment cost involved before and after suggesting improvement process implemented.

CHAPTER 2

LITERATURE REVIEW

The second chapter was the reference that could be used by reader to understand the theory and detail about the scope of work area that being used in this project. It was based on the research and the declaration by the other writer about the selected literature component in actually what it's all about. All relate material has been reviewed in the proper manner for easy and fast revision.

2.1 Stopwatch time study

This stopwatch time study is from now on referred as time study. It could identify as the most versatile and widely used to measure work operation in industry. This method was effective method for obtaining data and information about process work of operator and machine for determining the time standard. It includes the study area in the way to measure and determine the operation time that being used by the qualified and workday operator to work at the normal operation of specific task given. Although the time study method is used in connection with wage incentive, it also could be used for other purpose (Ralph M. Barnes, 1990) such as:

1. Determine schedules and planning work.
2. Determining standard costs and as an aid in preparing budgets.
3. Estimate the cost of manufacturing a product before producing it.

4. Determine the machine effectiveness, number of machines that could be operated by a single operator and line balancing of assembling line.
5. Determine the basic payment or labor cost of wage incentive based on time standard.

To perform the standard time study, it's required the average worker that works on the normal condition and have an experience for the selected job to be investigated. The average worker need not be the best or the worst worker to perform the job. It represents the normal performance of the job time requirement that suit to any worker that will perform the same job in the future. Refer to Lawrence S. Aft (2000), he mentions that the normal of time study could be defined in four it is; at first, evaluating job needs to be consistent to all other jobs. The second is, should be neither too fast or too slow that it able to worker to work entire day without undue physical strain. Third, the normal pace need to reflect to the thing should be performed, not being performed. And for the fourth, there no changes or adjusted level had been made to provide the constant of the data approach of the study.

Making the time study was come with several steps of the process. At first, it required of selected job to be studied. This selection will give the direction in how of timing data will be collected. The measurement process was only required to record the time at the beginning or start of the process until the end based on the process sequence that's been defined in earlier steps.

2.1.1 Equipment

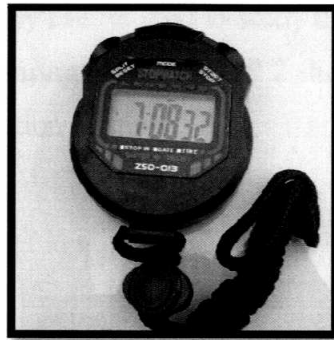


Figure 2.1: Example of Digital Stopwatch (Source: < <http://www.ebay.com/itm/Digital-Sport-stopwatch-Timer-Stopwatch-Counter-New-/280855506831>> 30 Oct 2012)

The basic type of equipment that required while doing the time study work include; timing device and data collection form. In timing device, items like a stopwatch and video recorder will be used to gain the time study data of time measurement and motion movement of working operation that will be done by the operator. Figure 2.1 of a stopwatch or other electronic timer could be used to record the duration of activity or process that be done by operator step by step in more accurate measurement.



Figure 2.2: Example of motion pictures to record motion picture (Source: <http://www.pma-show.com/0095/sony/camcorder/sony_dcrsr200_camcorder/> 30 Oct 2012)

Besides that, the motion pictures of operator's activity will be obtained by using a motion picture camera and video recorder. Usually, the video will record the exact speed of actual movement that not only can be used to study the operation movement, but also can be used to collect the measuring time. Figure 2.2 shows a simple video recorder that will be used to record the operation of study.

2.1.2 Making time study

There is no exact step or procedure in doing the time study measurement. It depends on how type of application and data obtained from operation study. However, the eight common steps that proposed by (Ralph M. Barnes, 1990) is:

1. Secure and record information about the operation and operator being studied.
2. Divide the operation into element and record a complete description of the method.
3. Observe and record the time taken by the operator.
4. Determine the number of cycles to be timed.
5. Rate the operator performance.
6. Check to make certain that a sufficient number of cycles have been timed.
7. Determine the allowance
8. Determine the time standard for the operation.

In making the time study, there will be some phases that need to be carried out and described for the performance of the operation. At first, obtaining and recording information with relation to an activity and process involved, dividing of activity into a subdivision or element, listing the prepared element into real process sequence, measurement of time recording and reading, repeat the measurement of time recording and reading. Finally, clarify the operator tempo and performance level while doing the appropriate task given.

2.1.3 Rating factor

Rating in the time study approach was used to compare the performance (either speed or tempo) of the operator while doing the task that base on observation of the observer's own concept of performance level. This because, as Ralph M. Barnes (1990) said; there was wide different of working performance among different people that work in the same activity. For that, the rating factor could be used to classify the operator performance work naturally in the way to establish the time standard of operation that being studied.

There was a system in the rating the operator performance. There were top six systems have been used and they are like; skill and effort rating that was introduced by Charles E. Bedaux to control the wage payment and labor. Westinghouse system rating (divide by four factors; skill, effort, condition and consistency). Moreover, the other system like synthetic rating (that predetermine speed based on time value), objective rating (operator speed rate against an independent of job difficulty), physiological evaluation of performance level (measure the heart beat rate and oxygen consumption) and last but not least, the performance rating (rating a single factor – operator speed, pace or tempo that present in percentage). Base on this rating, the capabilities of the operator could clusters and categorize.

2.1.4 Allowance and time standard

The normal time data for measuring operation is not including any allowance. Allowance in time study was defined as an activity that interrupts or include in the operation when it involve the task by human. Which means, qualified operator need to doing the task in normal tempo without concern about the personal need, for rest and other activity the beyond of his or her control which it impossible. Refer to Ralph M. Barnes (1990); there was three classification of allowance that interrupts production such as:

1. Personal allowance
2. Fatigue allowance
3. Delay allowance

Compare to standard time, all elements of allowance must be including that state as the standard time is the normal time plus allowance. At first, the personal allowance basically identifies as personal needs. Based on research by Ralph M. Barnes (1990); in every 8 hours of the working day, it's about 2 to 5 percent (10 to 24 minutes) was required by a worker for their personal need. It also needs to consider the condition and the type of work for example the worker with the heavy task operation need some time to comfortable themselves.

Second allowance, the fatigue allowance is the high concern by modern managed plant of new step implementation to eliminate it. This because, the high numbers of fatigue operation for the operator or worker not only reduce the productivity of production line but also affect the health and safety level in the company operation. The modern of machine, handling equipment, fixture and others with the proper design and been improve could help worker work in an easy manner and increase the physical comfort than formerly. (Ralph M. Barnes, 1990)

In delay allowance, it is categories as the allowance that can be avoided and unavoidable. This allowance will not be considered in time standard because it might occur only in certain time that currently caused by the machine, operator or some outside effect. If it's happening on the work operation day, the operator was usually paid for waiting time at standard hourly rate of labor cost intensive. Each unavoidable delay may be that happen in ought to be identified and directly eliminate to avoiding it to enter into time standard data. (Ralph M. Barnes, 1990)

2.2 Cost benefit analysis

Cost benefit analysis that will be referred as (CBA), is the systematic process for calculating and comparing benefits and costs of a project or decision making. It also could be used to evaluate a planned action by determining what net value will have for the company. CBA has two purposes which are:

1. To determine if it is a sound of an investment or decision making,
2. To provide a basis for comparing projects. It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.

In CBA, benefits and costs are expressed in economic terms, and adjust for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "*net present value*". Silva (1996) stated that cost benefit analysis tests the economic viability of an existing or proposed activity, and compares two or more ways of doing something. For prevailing social and economic structures, the standard of measure generally used is money.

In a natural resource management context, cost benefit analysis involves subtracting the economic costs of a development of all the benefits generated by the same development to obtain a net economic benefit or cost for the proposed activity. Usually, the method with the highest economic benefit is selected by decision makers. (Silva, 1996)

Basically, a cost-benefit analysis finds, quantifies, and adds the entire positive and negative factors of the cost involve. The difference between the two indicates whether the planned action is desirable. The real key in doing a successful cost-benefit analysis is to make sure to include all the costs and all the benefits in the proper measurement. It is the fundamental assessment in every business decision, due to the simple fact that