UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SIX SIGMA (DMAIC) IMPLEMENTATION IN INDUSTRY

Report submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
Bachelor of Manufacturing Engineering (Manufacturing Management)

By

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I hereby, declare this report entitled "Six Sigma (DMAIC) Implementation In Industry is the result of my own research except as cited in the references.

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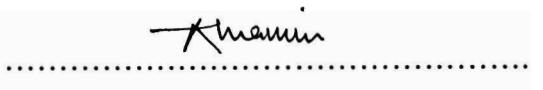
APPROVAL

This report submitted to the senate of UTeM and has been accepted as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management). The members of the supervisory committee are as follow:



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ABSTRACT

This project is providing to explain the Six-Sigma DMAIC (Define, Measure, Analyze, Improve, and Control) methodologies implementation in industry. The focused on DMAIC method were use as a guideline to design the Six-Sigma. The DMAIC methodologies were use to reduce scrap cost in one of the electronics company in Penang. The project were analyze by using Y= F (x) factor problem statement. This project covers the importance, benefits, limitations and any related issues that occurred in Six-Sigma, example; problem statements, objectives, scope of work, project outline, literature review of previous study and the methodologies and tools are using in this project. There are five factors were identified contributed to high scrap. The five factors are X1(Lacquer splashes), X2 (Glue A & B not mix properly), X3 (Fluxing), X4 (Machine set up for solder paste printing), X5 (Lacquer at the press fit hole). All the data was obtained from several techniques and methodologies. The Minitab 14 software use to provides the result whether it's significant or not significant after the project run and get the result in the analyze phase. In addition, based on result, several components of product was redesign to improve the product to be a quality and reduce higher scrap and wastage. This project was achieving the target to reduce scrap cost for 65% by using the method that mentioned above.

ABSTRAK

Projek ini disediakan bagi menerangkan perjalanan kajian terhadap projek yang berkaitan dengan pelaksanaan "Six-Sigma" menggunakan kaedah "DMAIC (Define, Meaure, Analyse, Improve,and Control)" dalam industri Tumpuan diberikan kepada penggunaan kaedah DMAIC sebagai garis panduan kajian berkenaan dengan "Six-Sigma". Kaedah DMAIC digunakan untuk mengurangkan kadar buangan yang disebabkan oleh beberapa faktor yang terjadi pada salah satu syarikat elektronik di Penang Projek ini dianalisa menggunakan formula Y=F(x). Kajian ini meliputi kepentingan, kebaikan, pembatasan dan berbagai lagi isu-isu yang berkaitan dengan kadar buangan seperti contoh adalah seperti; penyataan masalah, objektif, skop kerja, rumusan projek, dan cara kerja serta peralatan yang digunakan bagi projek ini. Terdapat lima faktor yang dikenalpasti menjadi penyebab kepada kadar buangan yang tinggi. Lima faktor tersebut adalah "X1(Lacquer splashes), X2 (Glue A & B not mix properly), X3 (Fluxing), X4 (Machine set up for solder paste printing), X5 (Lacquer at the press fit hole)". Data diperolehi daripada pelbagai teknik dan kaedah untuk projek ini. Penggunaan perisian Minitab 14 adalah untuk mendapatkan keputusan yang berkaiatan dengan data yang diperolehi sama ada penting atau tidak sesuatu faktor itu di kaji dengan lebih mendalam dalam fasa analisis. Daripada data yang diperolehi, sesetengah komponen yang digunakan juga akan dikaji untuk memperbaiki sesuatu produk tersebut supaya berkualiti dan mengurangkan kadar buangan yang tinggi. Projek ini telah berjaya mencapai objektif untuk mengurangkan kadar buangan sebanyak 65% dengan menggunakan kaedah yang telah disebut di atas.

DEDICATION

Specially dedicated to my beloved mother, Sahir Banun Binti Anor Kassim, my late father, Ahmad Bin Othman, my fiance Muhamad Jamil Bin Mashdar and who are very concerns, understanding patient and supporting. Also thank you to my supervisors, Mr. Nor Akramin Bin Mohamad, my brothers, sister and all of my friends. Thanks a lot for all who was support me in this project and this project will never been achieved without all of you all.

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Lastly, I want send my thankful to all UTeM staff, my friend and all the people that involved in my thesis and project. Thank you to all for the help and support.

Asleeda Binti Ahmad

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

FYP	-	Final Year Project.
PSM	-	Projek Sarjana Muda
DMAIC	-	Define, Measure, Analyze, Improve, Control.
DMADV	-	Define, Measure, Analyze, Design, Verify.
SE	-	Statistical Engineering.
COPQ	-	Cost of Poor Quality.
DPMO	-	Defect per Million Opportunities.
DFSS	-	Design For ix-Sigma.
ANOVA	-	Analysis of Variance.
FMEA	-	Failure Modes Effect Analysis.
DOE	-	Design on Experiments.

CHAPTER 1
INTRODUCTION

1.0 Introduction

Six-Sigma is a philosophy, a measure and a metrology that provides business with the perspective and tools to achieve new levels of performance both in services and products. In Six-Sigma, the focus is on process improvement to increase capability and reduce variation. The Six-Sigma methodology aims to reduce the number of mistakes/defects in a manufacturing process and hence the manufacturing costs. Sigma is a letter in the Greek alphabet used to denote the standard deviation of a process. Standard deviation measures the variation or amount of spread about the process aver-age. Six-Sigma is the ultimate measure of quality (Tom Pyzdek, 1999). As firms improve their processes, and move towards the exclusive Six-Sigma, they often need to re-design the products, process and services to "design-out defects and design-in quality". In its broadest sense six sigma is a methodology that firms can use to improve the output quality of a process. Six-Sigma has its roots in the repetitive processes of manufacturing; however, the same tools can be used in any business process from hiring new people to effective product design and marketing plans. The foundation of the Six-Sigma programs is statistics; Sigma stands for standard deviations from the mean of a data set in other words a measure of variation, while six sigma stands for six standard deviations from the mean. When a process reaches the six sigma level that process will be running close to perfection, producing a mere 3.4 defects per million. By using statistical and analytical tools

firms can reduce the amount of variation in a process by removing the causes of variation therefore increasing the output quality of the process.

Six-Sigma is a part of proactive business strategy that is planned, executive, monitored, steered towards success, and nurtured by the executive management of the deployment organization and also provides companies with a series of interventions and statistical tools that can lead to breakthrough profitability and quantum gains in quality, whether the products of a company are durable goods or services. There has been a tremendous amount of discussion around defining Six-Sigma in terms people within your business or organization can understand.

Six-Sigma should not be viewed as a way to achieve one very successful project. Six-Sigma should become a company wide mantra and be implemented as a core part of the companies culture and strategy with training from top to bottom in order to see the fullness of its benefits. Some examples of companies that have successfully implemented a six sigma program are (Adam and Gupta, 2002):-

i. GE boasts gains of $2 billion to the bottom line in 1999 and $2.4 billion in 2001 because of Six-Sigma.
ii. Motorola saved $15 billion in the first 10 years of Six-Sigma implementation.
iii. DuPont realized more than $1.6 billion in cost savings the first four years of Six-Sigma.
iv. Many other companies and even municipalities have had similar success by implementing Six-Sigma.

1.1 Problem Statements

Six-Sigma process improvement methodologies have been accepted as the pioneering process improvement framework. Industry leaders like Raytheon, Motorola, GE and Honeywell (formerly, Allied Signal) have laid out specific blue prints for process improvement using this framework. The original Define, Measure, Analyze, Improvement, and Control (DMAIC) scheme has undergone a critical

review by the practitioners and implementers. Every corporation looks at any possible issue of cost cutting and wise deployment of scarcely available funds. So it is worthwhile to deliberate on quality improvement example like Six-Sigma, TQM, Statistical Engineering (SE) and the others. Miss-implementing Six-Sigma can be extremely damaging to a business because the Six-Sigma often leads to an entire overhaul of every single process and function within a business, its implementation impacts all levels and employees. When done it properly, this means that every employee and process will be used to its fullest potential, creating the highest level of quality, and leading to the most successful bottom line.

One of the electronic company in Penang facing high scrap problem cost of an average RM29, 670.22 per month. The focus of this research is on Manufacturing Cost Effective is one of the main factors for one of the company in Malaysia. Base on scrap data, overall Body Controller wastage and scrap was RM326, 372.47 from the period of October '05 to August '06.

1.2 Project Objectives

The objectives of this project are follows:

i. To design a proper method of Six-Sigma (DMAIC) implementation in industry.
ii. To analyze the problem statements using Y=F(x) factor.
iii. To solve the possible issue of higher cost because of waste.
iv. To reduce scrap cost for body controller division.

1.3 Scope of Project

Six-Sigma are one of the quality improvement methodologies to reduce wastage or cost. This project is to analyze the problem statement using DMAIC methodologies to solve the problem. According to the DMAIC methodologies, it will only focus on factors F (x) that had higher scrap wastage. The possible factor that cause the high scrap will be identified in DMAIC methodologies and these projects only focus on significant factors.

1.4 Outline of Project

The rest of the project's chapters are organized are as follows (summary in figure 1.0):

Chapter 2: Literature Review
Reviews the basic of Six-Sigma implementation in industry theory according to the journal, books and other resources about the method, barriers, and implementation in industry.

Chapter 3: Methodology
Review the method of Six-Sigma methodology of DMAIC (Define Phase, Measure Phase, Analyze Phase, Improve phase and Control Phase).

Chapter 4: Result and Discussion
This chapter will done the data collection, result and discussion of Six Sigma project to Reduce Scrap Cost for Body Controller Division implementation in electronic industry in Penang using Y=F(x) factor.

Chapter 5: Conclusion and Recommendation
In this chapter will conclude the project and give some recommendation.

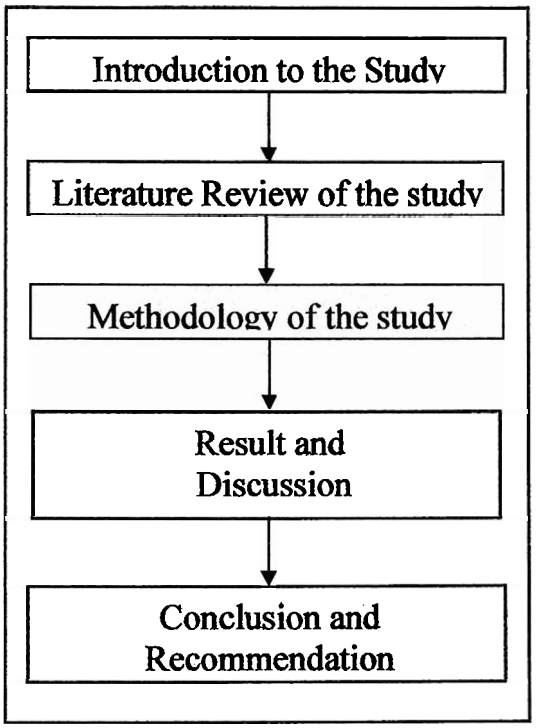

Figure 1.0: Outline of the Project

CHAPTER 2
LITERATURE REVIEW

This chapter provides a review of the concept of Six-Sigma implementation in industry. There are two methods that can apply in Six-Sigma are DMAIC (Define, Measure, Analyze, Improve and Control) and DMADV (Define, Measure, Analyze, Design and Verify). This method will also briefly explain in sub topic in this chapter. Six-Sigma gives us a statistical scale to measure our progress and benchmark others companies, processes or products. The defect per million opportunities measurement scale ranges from 0 to 6. The research methodologies of quality improvement from the previous study also will explain in this chapter.

2.1 Research Areas in Methods of Quality Improvement

For this project research there are three methods of quality improvement are done for comparison.

2.1.1 Taguchi's methods

A Taguchi's method was introduced by the Japanese engineer name Genichi Taguchi. He had been working on his quality improvement ideas since the 1950s; his methods were virtually unknown outside of Japan until the 1980s. His techniques and vocabulary are heavily based on his engineering background, and they differ to

some extent from the statistical techniques and vocabulary that are used in traditional quality improvement.

Taguchi discerns between online and offline quality control. Offline quality control concerns the design (or re-design) of products and processes, and includes the stages system design, parameter design and tolerance design (Taguchi, 1986, pp. 75-79; see also Kackar, 1985). Restricted to operational production processes Taguchi's offline quality control conforms to my definition of quality improvement.

Taguchi invented and promoted various new concepts, such as a quadratic loss function (Taguchi, 1986). These concepts represent a view on quality in which variation plays a dominant role. This view on quality is generally accepted (Nair, 1992). Furthermore, Taguchi introduced an alternative experimentation methodology (using orthogonal arrays; see Ross, 1988). The adequacy of this methodology has been the subject of much debate among statisticians (Nair, 1992), though it is popular in engineering (Jugulum and Dichter, 2001). As an operationalization of Taguchi's methodologies and concepts consider a stepwise strategy described by Ross (1988). This approach is built around Taguchi's quantitative experimentation methodology.

Taguchi emphasizes the importance of variation reduction in quality improvement. Based on the results of an experiment, settings for the control variables are chosen such that the process is made robust against variation in the nuisance variables. Next, the process mean is brought on target by manipulation of control variables that affect the mean but not the variation. Finally, tolerance design is exploited if needed to accomplish a further reduction in variation.

2.1.2 Shainin System of Statistical Engineering

Dorian Shainin is the introducer for Shainin system. She was put several techniques both known and newly invented in a coherent stepwise strategy for problem solving in a manufacturing environment. This strategy is called the Shainin system, or

statistical engineering. The system is described in various papers (Shainin, P., 1993; Shainin, R., 1993). Part of the strategy is promoted by Bhote (1991). Starting from a problem in the output of a process, the objective of the strategy is to select the one, two or three dominant causes of variation (called the Red X, Pink X and Pale Pink X, respectively) from all possible causes. This is achieved by a "homing in" method; using statistical analysis tools, the classes of causes in which the important causes are likely to be found are selected, thus zooming in on the Red X. Once the Red X is identified, either an irreversible corrective action is taken, or the tolerances on the Red X are tightened and controlled.

The Shainin system is built around a set of tools that are plainly understood and easily applied, hereby refraining from more advanced techniques. The theory is clarified using a clear vocabulary (featuring concepts as "Red X" and "homing in strategy") because of its simplicity and the integration of tools the system appeals to persons with a technical background and limited knowledge of statistics.

2.1.3 TQM and its implementation steps

According to Juran and Grayna (1993), emphasis on customer satisfaction, broad application of quality concepts, and participation of all employees has given rise to a new title TQM. TQM is an approach to improving the competitiveness, effectiveness and flexibility of a whole organization. It is essentially a way of planning, organizing and understanding each activity. The philosophy of TQM, in the words of Bates (1993), recognizes that customer satisfaction; business objective, safety and environmental considerations are mutually dependent and applicable in any organization. According to Barclay (1993), the impact of TQM on any organization is, first, to ensure that the management adopts a strategic view of quality.

Eight points that guide implementation of TQM are:

1. The organization needs long-term commitment to constant improvement

   (Dean and Evans, 1994).