



UNIVERSITI TEKNIKAL MALAYSIA, MELAKA

**QUALITY IMPROVEMENT BY USING SIX SIGMA IN
MANUFACTURING INDUSTRY**

This report submitted in accordance with requirement of the Universiti Teknikal
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(Manufacturing Management) with Honours.

by

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I hereby, declared this report entitled “Quality Improvement by Using Six Sigma in Manufacturing Industry” is the results of my own research expect as cited in references.

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ABSTRACT

The good quality of product or service performance is important to reach customer's expectation. This project was aimed to analyze the product quality problem faced by Maruwa (Malaysia) Sdn. Bhd. which the defect products are frequently received from customer claim. To improve the problem, Six-Sigma DMAIC methodology has been implemented. In order to analyze the data, the Statistical Quality Control (SQC) tools were used such as pareto chart, histogram and cause and effect diagram. Pareto analysis was turn down the scope of study by identified the highest rejection rate of model, the most common defects and also determining the particular process that cause the defects product was got by customers. Cause-and-effect diagram had been used to lists out all possible causes that could bring the problem and identified the main factor of problem. Through analysis, crack problem was the major defect of customer claim while visual inspection is the process of crack inspection. Suggestions for improvements such as the job rotation and machine adjustment had been suggested. Control of the product quality after the improvement also suggested.

ABSTRAK

Kualiti produk dan servis yang baik adalah penting untuk menjangkau jangkauan pelanggan. Projek ini bertujuan untuk menganalisa tentang masalah kualiti produk yang dihadapi oleh Maruwa (Malaysia) Sdn. Bhd. dimana produk yang mempunyai kecacatan seringkali diterima oleh para pelanggan. Bagi mengatasi masalah tersebut, metodologi enam sigma (DMAIC) telah digunakan. Untuk menganalisa data, kawalan kualiti secara statistik (SQC) seperti rajah pareto, histogram dan rajah sebab dan akibat telah digunakan. Analisis pareto telah mengecilkan skop kajian dengan mengenalpasti model yang mempunyai kadar penolakan paling tinggi, jenis kecacatan yang sering dihadapi dan juga menentukan proses yang telah menyebabkan produk cacat diterima oleh pelanggan. Rajah sebab dan akibat digunakan untuk menyenaraikan semua sebab yang mungkin membawa kepada masalah dan menentukan faktor utama masalah tersebut. Melalui analisis, masalah retak merupakan kecacatan utama yang sering diadu oleh pelanggan manakala pemeriksaan secara visual merupakan proses pemeriksaan retak. Pembedulan seperti kerja bergilir-gilir dan penyelarasan mesin telah dicadangkan. Pengawasan kualiti produk selepas pembedulan juga di cadangkan.

DEDICATION

With lots of love and special dedicated to.....

My beloved mom Pn.Ruziah Binti Mohd Raus ...

My beloved sisters and brother Riny Sarah, Raidah Syazana, Raihana Salihah and

Mohd Syauqi Ruzaini...

All my friends that are always support me...

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LIST OF ABBREVIATIONS

ANOVA	-	Analysis of Variance
CEO	-	Chief Executive Organisation
Cpk	-	Process Capability Analysis
CTQ	-	Critical to Quality
DMAIC	-	Define, Measure, Analyze, Improve, Control
DPMO	-	Defect per Million Opportunities
FMEA	-	Failure Mode and Effect Analysis
GE	-	General Electric
GR&R	-	Gauge Repeatability & Reproducibility
ISO	-	International Organisation for Standardization
ITT	-	International Telephone and Telegraph
JIT	-	Just In Time
KE	-	Kinpo Electronics
KPIV	-	Key Process Input Variables
KPOV	-	Key Process Output Variables
MBO	-	Management by Objectives
PCA	-	Philip Crosby Associates, Inc.
PDCA	-	Plan, Do, Check, Act
PSM	-	Projek Sarjana Muda
QA	-	Quality Assurance
SIPOC	-	Supplier, Inputs, Process, Outputs, Customers
SPC	-	Statistical Process Control
SPI	-	Substrate Product Inspection
SQC	-	Statistical Quality Control
TQM	-	Total Quality Management
UTeM	-	Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

This report described a project on improving quality in a manufacturing industry. This chapter explained about the background of project, problem statement, objectives, scope, and report outline.

1.1 Background of Project

Nowadays, excellence in quality product or service strongly influences the competitiveness of organizations. It plays an important role in assuring the safety of consumer and to exceed customer's expectation on product or service performance. Other than that, it is also important to manage quality improvement to bring the company into globalization field, process orientation, high quality and productivity.

Long term profitability was the aim of the business. A company may outsource a portion of its operation to achieve lower cost with higher productivity and have better quality. In order to prepare for employment in the current environment and to prepare for increasing responsibilities within modern business, governmental, and service organizations, knowledge of quality principles is becoming increasingly important.

Total Quality Management (TQM) is one of the most common quality management practices in today's industrial environment. TQM refer to the broad set of management and control processes designed to focus an entire organization and all of its employees on providing products or services that do the best possible job of

satisfying the customer. TQM means that the organization's culture is defined by, supports, the constant attainment of customer satisfaction through an integrated system of tools, techniques, and training. This involves the continuous improvement of organizational process, resulting in high quality products and services.

Besides TQM there are other quality system used to improve quality such as Lean and Six Sigma. These two are related, but distinct. Lean is about controlling the resources in accordance with the customers' needs and to reduce unnecessary waste including the waste of time. But, most recent quality philosophy to be adopted by businesses around the world is known as "Six Sigma."

Six Sigma has become a proven methodology and strategic initiative that corporation are deploying to realize dramatic benefits. It is the fastest growing business management system in industry today. It has been credited with saving billions of dollars for companies since the early 1990s. World-class organizations such as Motorola, GE Corporation and CitiGroup have achieved great performance in customer satisfaction by using Six Sigma method (Hoerl *et al.*, 2004).

Six Sigma has been considered as a philosophy that employs a well-structured continuous improvement methodology to reduce process variability and drive out waste within the business processes using statistical tools and techniques (Banuēlas and Anthony, 2002). The Six Sigma strategy involves the use of statistical tools within a structured methodology for gaining knowledge needed to achieve better, faster and less expensive products and services than the competition.

This report mainly focused on Six Sigma quality philosophy and other related philosophy that would be implemented in these studies in order to identify the current problem or rejection criteria facing by the company. In order to enhance more knowledge on the related study field, related literature reviews was carried.

1.2 Problem Statement

In order for companies to survive and grow, the quality of their goods is very important to exceed customer's expectation on the product or service performance. So, the quality problem must be solved before the products are being send to the customers.

Maruwa (Malaysia) Sdn. Bhd. which producing ceramic electronic components have undergone many types of quality problems. The crack rejections of ceramic substrate product are one of the defects that were frequently produced by the product during its manufacturing process. This type of problem also frequently getting from customer complaint that caused some amount of the product is returned back. This problem occurred because of negligence of operators during visual inspection that causes the rejection products are escape to customers. It is may affect the production cost and also could receive negative perspective of the customer point of view. It is important for the company to ensure that product's inspection is effectives before send the product to customers so that the rejects product does not escape to customers.

The aim of this project is to apply the quality improvement method by using Six Sigma tools and technique in order to study the problem occurred.

1.3 Objectives

The project is a two semester of quality improvement effort in Maruwa (Malaysia) Sdn. Bhd. It is aimed of applying the Six Sigma method to optimize crack rejection of ceramic substrate product are escape to the customers. In order to fulfill the project aim, the following objectives are proposed:

- (a) To analyze the rejects crack reject due to ceramic substrate problem during visual inspection process.
- (b) To solve the reject problems which frequently escape to customers by using Six Sigma concepts.

- (c) To recommend actions to improve the quality and productivity of the production process.

1.4 Scope of Project

This project will be conducted at Maruwa (Malaysia) Sdn. Bhd. which the substrate department and quality assurance (QA) department will be focus on the study. The analysis is focused on the crack rejection and visual inspection process only. YA0255 products were chosen for this study. Six Sigma DMAIC methodologies will be used where DMA is applied and IC will be suggested to the company.

1.5 Report outline

This report contains 6 chapters which are:

Chapter 1 is the introduction to the entire project, which are states clearly the objectives, scope, and background of the project. In this chapter, it is also describes the background of quality problem as the case study of Company.

Chapter 2 presents the literature review with describe the concept of TQM and Six Sigma Quality approach that used in this project. All the concept and techniques which were used in this project are also mention in this chapter.

Chapter 3 describes about the methodology of this project, company background, flowchart and Gantt chart of the project, and also other techniques that were used during the study.

Chapter 4 is about the company profile and background, the process chosen and also about the defects that was produced during the manufacturing process.

Chapter 5 presents the data analysis using Six-Sigma methodology. In this chapter the data collected was analyzed stage by stage, starts with Define stage, continued with Measurement stage, then followed by Analyze stage. After analyze the problem based on the data collected, we go to the Improve stage and the last is Control stage.

Chapter 6 presents the conclusions of the project and suggestions for future work.

CHAPTER 2

LITERATURE REVIEW

Literature review was includes of published materials on study and research such as journals, case studies, books, technical documents and internet sources that has been selected relevant to this project. This chapter will describe mainly about Six Sigma methodology since the study conducted in a Six Sigma manner. Others relevant topics are the concept of quality, Quality Management Philosophies, Total Quality Management (TQM), quality tools and also others topic related to this project.

2.1 Definitions of Quality

Quality is a much more complicated term than it appears. Quality is defined and measured in different ways by various quality experts and authors. They view quality from different perspectives and perceptions, and thus the definitions of quality are subjective, depending on individual viewpoint.

Shewhart (1931) mention that there are two common aspects of quality; one of these has to do with the consideration of the quality of a thing as an objective reality independent of the existing of man. The other has to do with what we think, feel or sense as a result of the objective reality.

Quality is fitness for use, (Juran, 1988). Quality is conformance to requirements (Crosby, 1986) and quality should be armed at the needs of the customer present and future (Deming, 1986).

According to Garvin (1988), quality has nine dimensions which are:

(a) *Performance*

Primary product characteristics, such as brightness of the picture.

(b) *Features*

Secondary characteristics, added features, such as remote control.

(c) *Conformance*

Meeting specifications or industry standards, quality of work.

(d) *Reliability*

Consistency of performance of time, average time for the unit to fail.

(e) *Durability*

Useful life, including repair.

(f) *Service*

Resolution of problems and complaints, ease of repair.

(g) *Response*

Human-to-human interface, such as the courtesy of the dealer.

(h) *Aesthetics*

Sensory characteristics, such as exterior finish.

(i) *Reputation*

Past performance and other intangibles, such as ranking first.

Based on all definitions, no one can be considered as a universal definition. This is because quality itself is a very subjective term. It has different meaning to the different responsible area. In every case, the requirements of the customers are always a consideration in a valid definition of quality (Bhote, 1991).

2.2 Quality Management Philosophies

More managers than ever before are focusing on quality as a way of increasing productivity, reducing costs, and meeting customer needs. They are beginning to understand the importance of continuously improving of quality services and products as a means of achieving these goals. Those who have made contributions to the many aspects of TQM, but none to the degree as W. Edwards Deming, Joseph M. Juran, and Philip B. Crosby. These three individuals have been regarded as true "quality gurus." Their contributions have had gave an impacts on companies and managers around the globe.

2.2.1 The Deming Philosophy

W. Edwards Deming was originally trained as a statistician, and much of his philosophy can be traced to these roots. He worked for Western Electric during its pioneering era of statistical quality control development in the 1920s and 1930s. During World War II, he taught quality control courses as part of the national defense effort. Deming began teaching statistical quality control in Japan shortly after World War II is credited with having been an important contributor to the Japanese quality improvement programs. In fact, the highest award for quality improvement in Japan is called the Deming Prize. While Japan embraced his methods for 30 years, he was virtually unknown in the United States until 1980.

Deming focuses on the improvement of product and service conformance to specifications by reducing uncertainty and variability in the design and manufacturing process. In Deming's view, variation is the chief culprit of poor quality. In mechanical assemblies, for example, variations from specifications for part dimensions lead to inconsistent performance and premature wear and failure. Likewise, inconsistencies in service frustrate customers and hurt the reputation of the company. To achieve reduction of variation refines a never-ending cycle of product design, manufacture, test, and sales, followed by market surveys, then redesign, and so forth. Deming claims that higher quality leads to higher productivity, which in

turn leads to long-term competitive advantage. The Deming "chain reaction" theory summarizes this view; the theory states that process improvements lead to lower costs due to less rework, fewer mistakes, delays and snags, and more efficient use of materials. Lower costs, in turn, lead to productivity improvements. With better quality and lower prices, the firm can achieve a greater or larger market share and remain competitive and provide more meaningful and rewarding jobs. Upper management needs to recognize the benefits of quality as a strategic factor and strive to create a culture that supports empowerment, continuous improvement and customer satisfactions. Deming stresses that top management has the overriding responsibility for quality improvement (Deming, 1986).

2.2.1.1 Deming's 14 Points for Management

- (a) Create and publish to all employees a statement of the aims and purposes of the company or other organization. Management must demonstrate constantly their commitment to this statement.
- (b) Learn the new philosophy throughout all areas everybody.
- (c) Understand the purpose of inspection. It should evaluate process improvements and cost reductions.
- (d) End the practice of awarding business on the basis of price alone.
- (e) Improve constantly and forever the system of production and service.
- (f) Institute training.
- (g) Teach and institute leadership.
- (h) Drive out fear. Create trust. Create a climate for innovation.
- (i) Optimize all efforts toward the aims and purposes of the company.
- (j) Eliminate exhortations for the work force
- (k) (i) Eliminate numerical quotas for production Instead learn and institute methods for improvement.
(ii) Eliminate management by objectives (MBO). Instead, learn the capabilities of processes, and how to improve them.
- (l) Remove barriers that rob people of pride of workmanship.
- (m) Encourage education and self-improvement for everyone.
- (n) Take action to accomplish the transformation.