UNIVERSITI TEKNIKAL MALAYSIA MELAKA

QUALITY OPTIMIZATION IN THE MANUFACTURING INDUSTRY: AN APPLICATION CASE

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

by

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2010

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Quality Optimization in the Manufacturing Industry: An Application Case

SESI PENGAJIAN: 2009/10 Semester 2

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) with Honours. The member of the supervisory committee is as follow:

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(Ms. Muzalna bt. Mohd Jusoh)

(Main Supervisor)

ABSTRACT

This report presents a research on quality optimization in the manufacturing industry. Nowadays, quality plays an important role in controlling the properties of a product. By providing optimal quality, the cost for rework or defect could be reduced. This research mainly focuses on the defects problem in one of the company in the manufacturing industry, namely ACME Ferrite Products Sdn. Bhd. The objectives of this research were to identify, analyze and recommend a solution for the defects problem in the manufacturing industry. The Six Sigma methodology was used in conducting this research. It is a step-by-step methodology that is consists of 5 important stages, such as define, measure, analyze, improve and control. As for the data analysis, some of the quality control tools such as cause and effect diagram, pareto chart, flow chart, histogram, and control chart were used. The main type of defect, which is dimension defect, was identified and proper tools will be used to analyze the quality problem. Next, the major defect was highlighted and analyzed. The root causes of the defects were investigated in this research and recommendations for improvement were proposed, such as job rotation, investigation of the significant response in sintering and barreling process by using Taguchi Method and etc. After improvement is done, some control steps, such as x bar chart were suggested in order to maintain the outcome of this research.

ABSTRAK

Laporan ini mempersembahkan satu penyelidikan yang melibatkan peningkatan qualiti dalam industri pembuatan. Pada masa kini, qualiti memainkan satu peranan yang penting dalam kawalan properti untuk sesebuah produk. Dengan adanya qualiti yang optima, kos untuk "rework" atau "defect" boleh dikurangkan. Penyelidikan ini mengfokus kepada masalah "defect" dalam sesebuah kilang industri pembuatan. Objektif penyelidikan ini adalah untuk mengenalpasti, menganalisa dan mencadangkan penyelesaian untuk masalah "defect" dalam industri pembuatan. Methodologi "Six-Sigma" digunakan untuk menjalankan penyelikan ini. Ini merupakan satu methodologi yang mempunyai 5 peringkat yang penting, seperti nyata, ukur, analisa, tingkat dan kawal. Dalam proses analisa, beberapa alat kawalan qualiti seperti gambah rajah sebab dan implikasi, carta pareto, carta aliran, histogram dan carta kawalan akan digunakan. Jenis utama "defect" dikenalpastikan dan alat yang sesuai digunakan untuk menganalisakan masalah qualiti. Seterusnya, "defect" utama diperhatikan dan kemudian dianalisakan. Faktor-faktor utama masalah "defect" disiasat dan cadangan untuk peningkatan quality, seperti putaran tugasan, penggunaan kaedah Taguchi dalam siasatan tanggapan penting dalam process sintering dan barelling telah diberikan dalam penyelidikan ini. Selepas peningkatan qualiti dibuat, beberapa langkah kawalan sepert chart x bar juga dicadangkan supaya pencapaian penyelidikan ini dapat dikekalkan.

DEDICATION

This research is dedicated to my family members and my friends, who express their love, care, encourage and support to me.

ACKNOWLEDGEMENT

First of all, I would like to thank my supervisor Ms. Muzalna bt. Mohd Jusoh for her grateful guidance during the course of the final year's project. Her valuable advice and guidance help me a lot and play a very important role in completing this report successfully.

Next, I would also like to express my appreciation to my fellow friends for their support and help in this report; especially my roommates Lee Chee Yoong from Robotic and Automation Course, Soo Sze Wei, and Kwong Soon Yuen from Manufacturing Management course.

Meanwhile, a special thanks to my lovely family for their understanding and caring delivered throughout the duration of this project.

Also, I would like to extend my gratitude to Mr Teng Khoon Wai (Senior Process Engineering Assistant in ACME) for giving me the valuable guidance while doing my research.

Last but not least, I also want to express my gratitude to UTeM for giving a chance to me to take part in this final year project and providing some awesome facilities and services, such as library and online journal database.

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LIST OF ABBREVIATIONS

AHP	-	Analytic Hierarchy Process
AIAG	-	Automotive Industry Action Group
ANOVA	-	Analysis of Variance
CTQ	-	Critical to Quality
DAM	-	Defect Analysis Matrix
DPMO	-	Defect per Million Opportunities
FMEA	-	Failure Mode and Effect Analysis
HPAC	-	Process Attribute Chart
LDA	-	Linear Discriminant Analysis
ODC	-	Orthogonal Defect Classification
PCA	-	Principal Component Analysis
PDPC	-	Process Decision Program Chart
PPM	-	Parts per Million
QA	-	Quality Assurance
QC	-	Quality Control
SPC	-	Statistical Process Control
TQM	-	Total Quality Management

CHAPTER 1
INTRODUCTION

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

1.1 Project Background

Generally, quality is defined as the measure of excellence or state of being free from defects, deficiencies, and significant variations. ISO 8402-1986 standard defines quality as "the totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs." Schneider (2009) said that quality is one of the most important properties of a product. By providing the optimal quality, the costs for rework, scrap, recall or even legal actions could be reduced while satisfying customers demand for reliability. Nowadays, most of the industrial process and products are evaluated by more than one quality characteristics, such as effectiveness, productivity, safety and satisfaction.

Quality is actually a system, which, when implemented, yields increased market share and reduced scrap and rework. Quality is the umbrella if a plethora of process improvement techniques and theories that starts with a company's vendors and extends beyond the sales of that company's products and services to the customer. It is a system that is built on these provable process improvement techniques, which serve as components under the umbrella. (Fryman, 2002)

Meanwhile, quality is a critical success factor to achieve competitiveness in today's markets. Quality system is designed to set clear view to organization to follow enabling understanding and involvement of employees proceeding toward common goals. As the competition increases and consumer demand of high quality of product or services at reasonable price. A better understanding of the quality is the needs to every company in order to maintain their competitiveness. There is a increasing of focus on quality throughout the world. With increased of the competition, companies have recognize about the important of the quality system to effectively maintain their business. Effective quality management decreases production costs because the sooner an error is found and corrected, the less costly it will be.

According to Melissa (2002), quality improvement is necessary for providing a systematic approach to continuous quality improvement. Continuous improvement requires the use of cost of quality as a management tool to help gauge the effectiveness of the quality improvement process. Next, the use of statistical method is vital in identifying, understanding and continually improves process capability.

Today's global business environment calls for organization to develop, implement and maintain effective quality management system. In recent years, statistical method have also been explored by banks, insurance companies, government agencies and health care organizations interested in improving the quality of their services to customers. More organizations have adopted the use of quality control tools as a mean for obtaining higher product quality. Although quality control tools are only an element of total quality management (TQM), it is nevertheless a major one. Quality control is the use of statistical-based methods to evaluate and monitor process or its input in order to achieve or maintain a state of control.

In the meanwhile, quality improvement tools are numeric and graphic devices used to help individuals and teams work with, understand, and improve processes. These tools were further expanded to become the following seven (old) basic quality control tools

such as cause-and-effect diagram, run chart, scatter diagram, flow chart, pareto chart, histogram and control chart. In 1976, the Japanese Society for Quality Control Technique Development proposed the seven new tools for quality improvement, for example, relations diagram, affinity diagram, systematic diagram, matrix diagram, matrix data analysis, process decision program chart (PDPC) and arrow diagram. These are the useful tools in conducting this research towards the goals for quality optimization in the manufacturing industries. (Bauer, 2002)

To achieve product quality improvement, a system which having at least the following functions such as to predict product quality from operating conditions; to derive better operating conditions that can improve the product quality; and to detect faults or malfunctions for preventing undesirable operation has to be developed. (Kano *et al.*, 2007).

This paper will give an overview of quality improvement by using Six Sigma Methodology. It will concern about the problem of defects produced in the manufacturing industry.

1.2 Problem statement

Currently, the ACME Company receives lots of complaint from the customer that they found that there were large amount of defects detected, especially the dimension of the cores, lots of cores were out of range of the specification. As a consequence, large batches of the cores were return back to the company. This may affect the profit of the company and could receive negative perspective in the point of view of customer. In this study, the author will practice the six sigma methodology in the company to optimize the defects problem encountered.

1.3 Objective

The main objectives of this research are:

a) to identify the defects problem in the manufacturing industry.
b) to analyze the factors that contributing to defects problem.
c) to recommend a solution for the defects problem of the company

1.4 Scope of Study

The scope of the study focuses on one particular product, namely Baluns Cores (RID). This study includes identification of the defects problem of the product, quality analysis for the product, root cause of the defect problem, process capability of the product and suggestion for improvement will be made. Minitab 14 software was used to conduct the analysis.

CHAPTER 2
LITERATURE REVIEW

This chapter will focus on the study and research of the published materials such as case study, thesis, journal and some online database. Some related quality topic such as Six Sigma methodology, quality improvement process, quality tools and etc.

2.1 Definition of Quality

Juran defined quality as fitness for use, Deming said that quality should be aimed at the needs of the customer, present and future, and the definition of Crosby is that quality is conformance to requirements (Kolarik, 1995). From these definitions, it is clearly shown that there is no single definition of quality exists, and it seems that, for a good definition, the customer, the manufacturer, the product, the technology as well as the processes should be considered. Whenever there is a need for improvement in the company, everybody and everything in that company should be involved.

2.2 Defects

Defect is defined as a deviation from specification or, or in other words, the performance gap between a desired result and an observed result (ISO 8402, 1986). Besides that, the defect was also defined as the nonfulfilment of intended usage requirements. From this definition, it should be noted that it covers the departure or absence of one or more

quality characteristics from intended usage requirements. The error is the source of a defect. However, the errors may or may not lead to defects. Such defects are nonconformities to stated requirements or to human expectations. Defects may or may not lead to failure when meeting the required specifications, as a defective item may pass all quality inspections and tests. This is evidence of the fact that not every error leads to a defect and not every defect results in a failure. Also, a failure may arise from a combination of defects.

2.2.1 Defect Life Cycle

A variety of defects could be generated by equipment malfunction, process variation, and an improper process operation (Koleske, 1995). Therefore, manufacturing system variables affecting product quality are related to operators' skills, capability of machines, human actions during the production process, and workplace environment (Kolarik, 1995). A standard process for the recording and analysis of defects should be developed. However, it is crucial to produce a model of the life history of a defect. The purpose is to provide manufacturers with a standard set of states through which a defect occurs. These states are intended to help standardize defect reporting. This life history illustrates the time order of the various states of a defect, moving from when a case is first reported to when it is resolved. The consideration of defects arising from machine faults, operators' errors and any other operational sources are included. If measures based on defect status are gathered, they may be used to learn from the defects and thus improve the performance of the production line. Figure 2.0 shows the sample of defect cycle. (Dhafr *et al.,* 2005)

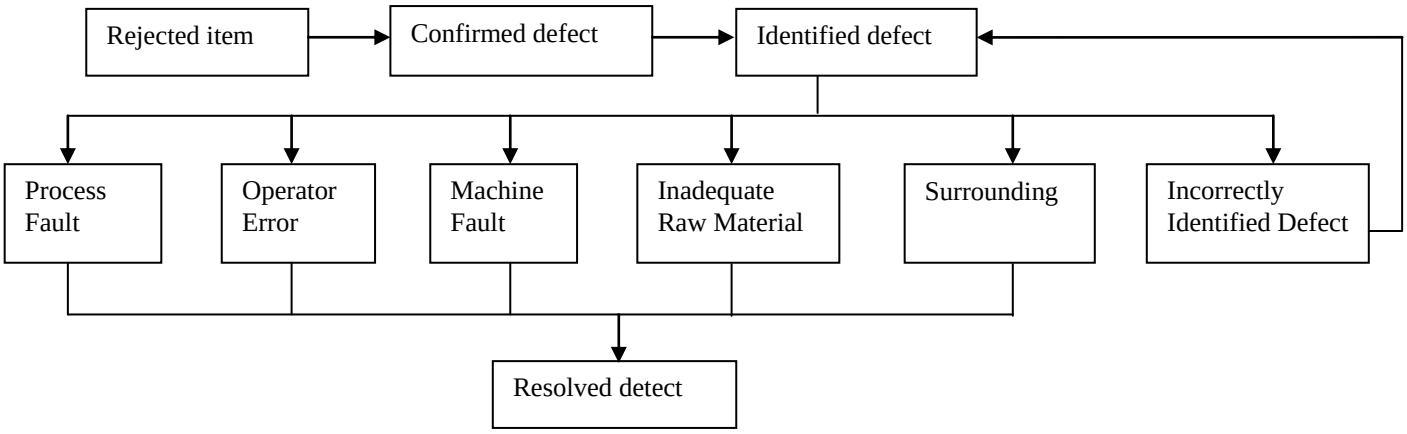

Figure 2.1: Defect Cycle (Dhafr *et al.,* 2005)

2.2.2 Critical Factors of Defects

An industrial case studies that related to the production of defects was carried out and the inspection of production items is carried out visually, through which defect types and its sources are identified (Dhafr *et al*. ,2005). An estimation of the probability for a defect to occur was used to quantify the effect. This is achieved by the use of real data from actual operations, which can then be used to count the frequency of an individual defect or total defects on a timely basis; then the probabilities can be calculated based on the collected data. Some probabilities were lead to the defects to be occurred such as operator, machine fault and supplier error. The probability of operator error was measured based on the training matrix with different levels of skill of the operator. For the machine fault, the probability was figured out by the collection of historical data. The probability of this type of defect can be measured by the performance of the supplier, using the 'parts per million (PPM)' data that is generated monthly. Next, the quantity of finished products that are returned to the supplier due to faulty material will increase the probability of the error.