QUALITY IMPROVEMENT FOR MANUFACTURING PROCESS BY USING 7 QC TOOLS IN SME

MUHAMMAD HAMIZAN BIN KHALID

Report submitted in partial fulfilment of the requirements for the Bachelor of Mechanical Engineering

Faculty of Mechanical Engineering

UNIVERSITI MALAYSIA PAHANG

JUNE 2013

ABSTRACT

The aim of this project is studying the quality improvement after implementation of 7 QC tools in a manufacturing process in selected Small Medium Enterprise (SME) company. It is to detect the defects that occurred in the manufacturing process and analyzed using 7 QC tools. Besides that, the new design has been proposed for defect reduction and improving the production line. The chosen company was Kilang Keropok MakTeh and product that being analyzed is keropok sira. The main scope of this project is the implementation of 7 QC tools. Observation throughout the production line is done. There are ten main processes which are mincing, mixing, shaping, boiling, drying, freezing, slicing, frying, flavouring, and packaging. By using a check sheet, defects that occur throughout the production line are collected in 30 days. The data are then arranged back using Pareto Chart according to the frequency of the defects. The data are arranged from the highest defect to the lowest defect. The highest defect detected was under cook problem. Brainstorming session is done with the workers and also the manager to create the cause and effect diagram to details the problem. All possible causes are categorise under 4M which are Manpower, Machines, Materials, and Methods. Based on the cause and effect diagram, the improvement is generated. The improvement is to fabricate separators inside the boiler. Current boiler has problems such as low heating temperature and uneven temperature. Referring to Heat Transfer theory, small area needs only need small value of heat to raise the temperature to the desire temperature. Reducing the area of heating inside the boiler by inserting the separators, temperature inside the boiler is increased and the temperature became more stable. All data is tabulated in form of graphs and tables. Percentage of defects reduce is also calculated.

ABSTRAK

Tujuan projek ini dijalankan adalah untuk mengkaji tentang peningkatan kualiti selepas mengaplikasikan 7 alat pengawal kualiti di dalam syarikat kecil sederhana (IKS) yang terpilih. Pengaplikasian ini bertujuan untuk mengesan kecacatan yang berlaku di dalam proses pembuatan di syarikat tersebut dan menganalisanya menggunakan 7 alat pengawal kualiti. Selain itu, idea dan kaedah yang baru telah dicadangkan kepada pihak syarikat untuk menambah baik kaedah yang lama. Kilang yang terpilih adalah Kilang Keropok Mak Teh dan produk yang dianalisa ialah keropok sira. Pemerhatian dilakukan sepanjang proses pembuatan berlaku. Terdapat 10 proses utama yang dilakukan iaitu mencincang, mengadun, membentuk, merebus, mengering, membeku, memotong, menggoreng, menyira, dan membungkus. Dengan menggunakan jadual pemeriksaan, kecacatan yang berlaku dicatatkan selama 30 hari. Data tersebut kemudiannya disusun semula di dalam carta Pareto mengikut kuantiti kecacatan tersebut. Data disusun dari kecacatan tertinggi kepada kecacatan terendah. Perbingcangan telah dilakukan bersama majikan dan pekerja untuk mengenal pasti punca kecacatan berlaku dan ianya dicatatkan di dalam rajah tulang ikan. Kesemua sebab yang berkaitan diletakkan dibawah 4 kategori iaitu cara, pekerja, mesin, dan bahan. Bedasarkan rajah tulang ikan tersebut, idea pembaharuan telah dicipta. Pembaharuannya adalah untuk mereka pembahagi didalam mesin rebus. Mesin rebus yang sedia ada mempunyai masalah seperti pemanasan tidak sekata dan suhu pemanasan yang rendah. Merujuk kepada teori Pengaliran Haba, kawasan yang kecil hanya memerlukan haba yang sedikit untuk dipanaskan. Pengurangan kawasan pemanasan dengan menggunakan pembahagi didalam mesin rebus telah meningkatkan suhu didalamnya dan suhu lebih sekata. Kesemua data telah direkodkan dalam graf dan juga jadual.

TABLE OF CONTENTS

1.6 Project Scope   6

CHAPTER 2   LITERATURE REVIEW

2.1 Total Quality Management (TQM)   7

2.2 7 Quality Control Tools (7QC)   8

     2.2.1 Check Sheet   9

     2.2.2 Histogram   10

     2.2.3 Pareto Chart   12

     2.2.4 Cause and Effect Diagram   13

     2.2.5 Stratification Chart   14

     2.2.6 Scatter Diagram   15

     2.2.7 Control Chart   16

CHAPTER 3   METHODOLOGY

3.1 Introduction   18

3.2 Flow Chart   20

     3.2.1 Company Selection   21

     3.2.2 Data Collection   21

     3.2.3 Manufacturing Process Flow Chart   23

     3.2.4 Data Analyzing 7QC Tools   25

            3.2.4.1 Pareto Chart   26

            3.2.4.2 Fish Bone Diagram   26

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

7 QC	Seven Quality Control
DAQ	Data Acquisition
FYP	Final Year Project
ISO	International Standard Organisation
RM	Ringgit Malaysia
SME	Small Medium Enterprise
SPC	Statistical Process Control
SS 304	Stainless Steel 304
TQM	Total Quality Management

LIST OF SYMBOLS

Cp	Specific Heat at Constant Pressure
K	Thermal Conductivity
$\dot{Q}$	Rate of Heat Transfer
Kg	Kilogram
KJ	Kilo Joule
$°C$	Degree Celcius
Δ	Differences
ρ	Density

LIST OF APPENDIXES

CHAPTER 1

INTRODUCTION

1.1   INTRODUCTION AND GENERAL INFORMATION

Quality improvement has long been analyzed and been remarked as the most important parameters that need to be monitored time to time. Many companies believe that as long their products shows high quality they can still become the competitors in the market. Having good quality control can increase the performance of the company by reducing defective parts and increase the production rate. In order to implement total quality control, the application of right element or selecting the right quality tools must be chosen correctly so that we could get the best quality (Shamsuddin Ahmed, Masjuki Hassan, 2003).

The purpose of this paper is to present the quality improvement by using 7 QC tools at selected SME. The studies also focusing on manufacturing processes that apply the quality counter measure. Overviews of quality control and SME definition were included in this paper that gives the general views on the topic. This is followed by the explanation of problem statement and also the main objective of these studies. The application of the 7QC tools in the manufacturing process is explained in detail in chapter of analysis. Finally the discussion and conclusions are discussed comprehensively in chapter of conclusion.

1.2   SME Profile

First of all, Small Medium Enterprise (SME) gives us several definitions according to the level of business. SME's in Malaysia are divided into two wide categories which for the manufacturing, manufacturing related services and agro-based industries, it may have less than 150 full time workers or an annual sales turnover of less than RM25 million. For the second categories, an enterprise that goes into services, primary agriculture and information and communication technology (ICT), the full time workers was less than 50 and an annual sales turnover was less than RM5 million.

Table 1.1: Definitions of SME's in Malaysia

	Category	Micro-enterprise	Small enterprise	Medium enterprise
1	Manufacturing, manufacturing related services and agro-based industries	Sales turnover of less Than RM250, 000 or Fewer than five full-time Employees.	Sales turnover Between RM250, 000 and RM10 million or Between five and 50 Full-time employees.	Sales turnover Between RM10 Million and RM25 Million or between 51 and 150 full-time Employees.
2	Services, primary agriculture and information and communication technology (ICT)	Sales turnover of less Than RM200, 000 or Fewer than five full-time Employees.	Sales turnover Between RM200, 000 and RM1 million or Between five and 19 Full-time employees.	Sales turnover Between RM1 Million and RM5 Million or between 20 and 50 full-time Employees.

Source SMIDEC

According to SMIDEC (2002), in the manufacturing sector SME's companies were about 93.8 per cent. They generate 27.3 percent of total manufacturing output, 25.8 per cent of value-added production, own 27.6 per cent of fixed assets, and employ 38.9 per cent of the country's workforce. By 2020, value added products for SMEs are expected to be worth RM120 billion or 50 per cent of total production.

1.3   SME's Problems and Challenges

Despite all those statistics, they were still having issues in term of management and also production. Management skill was the priority that needs to be developed by our SMEs so that they can still become the competitor in the local market or became a new rival in the global market. Not only have that, according to APEC surveyed (1994), SMEs in Malaysia having several problems which can be short listed below:

- Agencies use inconsistent definitions to categorize SMEs at the operational level
- There is inadequate data and information on the development of Malaysian SMEs.
- There are difficulties in accessing loan and other forms of financial assistance.
- Many SMEs in Malaysia still occupy lands or sites that not approved to be used for industrial purposes.
- There is a lack of a comprehensive framework in term of policies towards SMEs development.
- There are too many agencies or channels for SMEs at the operational level.
- There is an inability to be in the mainstream of industrial development.
- There is an under utilization of technical assistance, advisory services and other incentives made available by the government and its agencies.
- There is a lack of skilled and talented workers, which affects the quality of production as well as efficiency and productivity.

Other problems that could discuss such that how far the concern of Malaysian SMEs about green tech or green environment. This could be a big issue if they not concerned it now because the rapid growth of SME development in Malaysia. Some of the investment would be costly and for the SME level the entrepreneur did not want to take risk spending for the green tech rather than spending for the production unit that would be double their findings.

For the solutions, they must ready to go green and implement it throughout their company (Lewis and Gretsakis, 2001); (Sarkis, 1995); (Sarkis and Coidero, 2001). The company will grow up into the next level if they can manage to bring the environmental items into their company. The opportunity and competition will become different in such a new way for their business (Hanssman and Claudia, 2001). Getting certification like ISO14000 would be a new objective for them. According to Handfield *et al.* (2005), the ISO 14000 will guide them to implement an EMS to improve environmental performance only within the firm's operation's boundary and not the supply chain. Therefore we can say that the ISO 14000 is just the beginning of being green and there are still mountains to climb to achieve the environmental company.

Not enough with the problem that they are facing now, SMEs in Malaysia are now must encounter the new challenge that came from domestic and also global. According to the SMIDP's 2001–2005 study report (SMIDEC, 2002), these challenges are:

- Intensified global competition
- Competition from other producers (for example, China and India)
- A limited capability to meet the challenges of market liberalization and globalization
- Limited capacity for technology management and knowledge acquisition
- Low productivity and quality output
- A shortage of skills for the new business environment
- Limited access to finance and capital, and the infancy of venture funds in initial or mezzanine
- Financing
- The high cost of infrastructure
- A general lack of knowledge and information.

1.4   Problem Statement

SME is one of the industries that which very quickly develop in our country. Most of them are a local company which is growing from a small company. The challenge faced by SME is to survive in the competition of the global market. Due to certain reasons they might face certain problems which are related to quality management. The problems that might be faced by SME are as stated below:

i) There is inadequate data and information on the development in the manufacturing process of Malaysian SMEs.
ii) There is an underutilization of technical assistance, advisory services and other quality management tools.
iii) There is a lack of skilled and trained workers in quality management field who could help improving the quality of production as well as efficiency and productivity.

This project will thoroughly analyze the probable problems as stated above and defining objectives for this project. Finally, at the end of this project, we can come out with effective solution that really could help SMEs.

1.5   Objectives

The objectives of this project are:
1. To analyze the manufacturing process by using 7 QC tools
2. To improve production performance by eliminating production waste at the selected production line.
3. To propose a new method or design for improving production performance.

1.6   Project Scope

The scope of this project is focusing on the implementation of 7 QC tools in the selected SME company especially in the manufacturing process in order to eliminate production waste and increasing production performance.

CHAPTER 2

LITERATURE REVIEW

2.1 Total Quality Management (TQM)

There is an old saying: "the only constant is change". If change is part of our daily life, how can we drive it under our control rather than being driven off with it? Change in an organization would, in the long run, lead to changes in the organizational culture. The old culture that leads to deficit and loss should be leaving. We must dare to take challenge try a brand new idea that possible to generate profit. The process of change depends on how we manage it. Are we on the right track by using the right tools?

Since the beginning, quality management has become a successful method in order for us is a competent person in the world (Prajogo&Sohal, 2003). Total Quality Management (TQM) proved that it will help the firm gaining development limited to how much it have been implemented (Punnakitikashem et al. , 2010). Variation of problem need a right method to be solved and by using quality tools and technique it will help a lot in term of managing that organization(Arash Shahin 2010).

With the help of relevant tools and techniques, a systematic structured Quality Management must be in sequence in order for us to get the continuous improvement. For service quality method, SPC can be suggested application in any company that want improvement in term of quality. Different from the top management of an organization, the use of hard data is a matter of exception, what Taylor phrases "theory of exception" (Shamsuddin, Masjuki, 2003).

The purposed of approaching TQM in a company is to educate about an awareness of quality control in all over the aspect (Siddiqui, Haleem, &Wadhwa, 2009). Definition of TQM given by the Deming prize Committee of the Union of Japanese Scientist and Engineers (JUSE, 2010) as: "a set of systematic activities carried out by the entire organization to effectively and efficiently achieve the organization's objectives so as to provide products and services with a level of quality that satisfies customers, at the appropriate time and price".

Variation of concept in managing quality lead to several problems that only can be solved by referring back to the correct way on how to handle or implementing quality control in our organization or company. Sometimes misunderstood about certain concept can create a various problem that needs to be solved directly. In TQM, it has many tools that can help us to drive our organization to achieve our mission especially gaining a profit.

2.2   Seven Quality Control Tools (7QC)

Surprised with strong evidence and convincing by a report it has been suggested that implementing proper quality management and quality management tools can help in controlling the organization into fine improvement (Burnley and Dale, 1997). Seven basic quality tools and techniques is one of the quality tools and most of the company using these tools to make an improvement in term of quality in their company (Arash Shahin 2010).

7QC include check sheet, histogram, Pareto chart, Cause and effect chart or also known as Fishbone diagram, Stratification chart, scatter plot and control chart (Arash Shahin 2010). Ishikawa (1985) stated that by using 7QC tools, we can solve 95 percent of any problem that relate to quality. Even though some of the basic tools like Pareto diagrams, Fishbone diagram, check sheets, histograms and scatter diagrams are categorized in the basic SPC tools (Besterfiled*et al,*. 1999; Dale and Shaw, 1999), but there were also not be claimed as statistical and Dale and Shaw (1999) define them as 7QC tools.

7QC tools also sometime only can be used in certain areas only (Lam, 1996). Even though there are other quality tools that can be used such as QFD and DOE but 7QC tools still became the first choice in quality control tools (ArashShahin, 2010). A simple tool such as check sheet is found that regularly used by people compare to others that are more complex (Curry and Kadasah, 2002).

2.2.1   Check Sheet

A check sheet is any kind of form that is designed for recording data. Data collection can always become unmanageable and messy. Data collection is important because it is starting point for statistical analysis. In many cases, the recording is done so the patterns are easily seen while the data are being taken. Check sheets help analysts to find the facts or patterns that may aid subsequent analysis. Check sheets also help to organize data by category. They show the likelihood of the event and the most important the data is increasingly helpful as more data are collected.

Reason of Usage

- Check sheet is use of recording data in a period of time.
- To clearly identify what is being observed. The event should be labeled so that everyone will look at the same thing
- It is used to record data when it is necessary to investigate important products in a period of time.
- It is also used in order to be certain that the solution is effective.

When to use?

- When we need to observe an operation and record its data in a period of time.
- When we want to identify that which potential problems should be specified first.
- In a measurement phase of continuous improvement cycles or when we want to make a problem measurable.
- In a control phase of continuous improvement cycles for measuring performance changes.

Advantages of using a check sheet

- It is easy to use
- The root of the problem can be clearly identified
- Efficient way to show data
- Core of constructing other graphical data

Defect	Hour							
	1	2	3	4	5	6	7	8
A	///	/		/	/	/	///	/
B	//	/	/	/			//	///
C	/	//					//	////

Figure 2.1: Example of check sheet

2.2.2   Histogram

Even though the origin of the word histogram doesn't identify yet, but surely it has made a huge impact in the statistical field. Sometimes it said the word came from the Greek which is *histos* means anything set up right. It was firstly introduced by Karl Pearson.
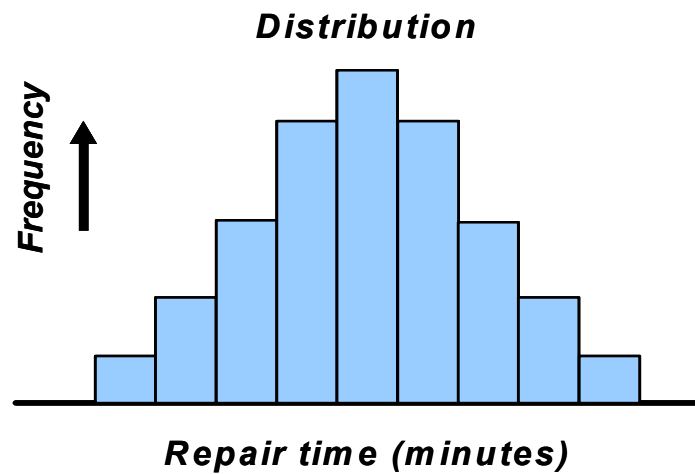
Histograms show the range of value of a measurement and the frequency with which each value occurs. They show the most frequently occurring readings as well as the variations in the measurements. Descriptive statistics, such as the average and the standard deviation, may be calculated to describe the distribution. However the data should always be plotted so the shape of the distribution can be seen. A visual presentation of the distribution may also provide insight into the cause of the variation.

Reason of Usage

- For perceiving and displaying the distribution of a set of data
- For specifying variables in a process

When to use?

- When we want to know the process is under control
- When we want to analyze the process
- When we want to approve changes is a process
- When we want to evaluate a process

Figure 2.2: Example of histogram