UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT AND EVALUATION OF INTERACTIVE SPC SOFTWARE

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

By

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I hereby declare that this report entitled **"DEVELOPMENT AND EVALUATION OF INTERACTIVE SPC SOFTWARE"** is the result of my own research except as cited in the references.

Signature :

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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 Management). The members of the supervisory committee are as follow:

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ABSTRACT

The title of this project is “Development and evaluation of Interactive SPC Software”. The project discuss about the software that will be develop in order to enhance quality control in the manufacturing company. The software was develop based on using Microsoft Excel to control the rejection part that have increasing every day in the company. The data was collected thought factory visits, interviews and observation in order to understand the quality control that involved in the company. The software that will develop is equipped with the control charts and the yield of the production to maintain and control the reject part. In addition, the software must be user friendly to the engineer and the operator to operate the software; also it must easy to understand by them for using it.

ABSTRAK

Tajuk projek ini ialah "Pembangunan dan evaluasi Perisian Interaktif SPC ". Projek ini membincangkan mengenai perisian yang akan dibangunkan dalam rangka untuk meningkatkan kawalan kualiti dalam industri pembuatan. Perisian ini dibangunkan berdasarkan pada penggunaan Microsoft Excel untuk mengawal penaghasilan bahagian rosak yang mengalami kenaikan setiap hari di dalam syarikat. Pengumpulan data didapati daripada lawatan industri, wawancara dan pemerhatian untuk memahami proses kawalan kualiti yang terlibat dalam syarikat. Perisian yang akan dibangunkan adalah dilengkapi dengan graf kawalan dan hasil pengeluaran untuk mengekalkan dan mengendalikan bahagian komponen yang rosak. Selain itu, perisian juga harus senang dikendalikan dan mudah difahami oleh jurutera dan operator.

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SPC	-	Statistical Process Control
US	-	United States
CMM	-	Capability Maturity Model
SMI	-	Small Medium Industries
Cp	-	Capability Index
USL	-	Upper Specification Limit
LSL	-	Lower specification Limit
DOE	-	Design of Experiment
FMEA	-	Failed Mode Effect Analysis
QFD	-	Quality Function Deployment
UK	-	United Kingdom
SMED	-	Single Minute Exchange of Die
TPM	-	Total Productive Maintenance
SQC	-	Statistic Quality Control
QC	-	Quality Control
TQM	-	Total Quality Management
ISO	-	International Organization of Standardization
CCP	-	Control Charts Pattern
UCL	-	Upper Control Limit
LCL	-	Lower Control Limit
CUSUM	-	Cumulative Chart
EWMA	-	Exponentially Weighted Moving Average

CHAPTER 1
INTRODUCTION

Chapter one will discuss about the brief overview of the project, starting with the background of the project title "Development and evaluation of interactive SPC software". After that, there are brief explanation about SPC and its history. Then, there is also some brief information about the small medium industries and the story about the company involve in this project. Lastly, the objectives and problem statement of the project will be list and also the scope and scope limitation of this project will be discussing briefly.

1.1 Background

Statistical Process Control was invented by Walter Andrew Shewhart in the early 1920s. W. Edwards Deming later applied SPC methods in the United States during 1950's, and then he continues applying this method and successfully improving quality in the manufacturing field and other strategically important products. Deming was also the person who responsible to introduce the SPC method into Japan manufacturing era during world war II.

Shewhart created the fundamental for the control chart and the concept of a state of statistical control by carefully designed experiments. At the first stage, Dr. Shewhart had created the theory of SPC by using the pure mathematical method. From that, he understood that data from physical processes not always produces normal distribution curve

In 1989, a technological institute located in the US had discovered that SPC can be usefully applied to non-manufacturing processes, such as software engineering processes, in the capability maturity model (CMM). This is shown that SPC is a very

useful and powerful method to be implementing especially in the manufacturing engineering field in today's era because it can help the industry to gain more profit of course and also to make some process to be easier and more efficient.

1.1.1 Definition of Statistical Process Control

Statistical Process Control is a tool for measuring and controlling quality during the manufacturing process. The data that come in the form of Product or Process measurements are obtained in process during manufacturing. The data after that will be scattered as a graph and then will be analyze by the person in charge. The control limits then will be analyzed within the range given by the standard specification and the limits will follow according to the customer specification.

The data that located between the ranges of control limits shown that everything is operating as expected. If data falls outside of the control limits, this is show that there are problems occurred which is likely happen at the source of the product variation. The solution of the problem must be determine and after that the process should be changed or improved in order to fix the problem before error occur while the process started to execute. Once the problem had been encountered, the process then can be run smoothly according to the time scheduled thus will help the company maintain their production rate or maybe increase the rate into higher level.

By using SPC, we can:

- Reduce variability and scrap
- Improve productivity
- Reduce costs
- Uncover hidden process personalities
- Instant reaction to process changes
- Make real-time decisions on the shop floor

1.1.2 Small Medium Industries (SMI) in Malaysia

SMI in Malaysia was being announced effectively in January 1998. Before this, many manufacturing companies in Malaysia had falls into the SMI category because they did not had chance to introduce their product in wide range so that the development of their industry difficult to rise. To define SMI, there are many criteria that have been used such as paid-up capital, shareholders' funds, turnover and number of employees or a combination of these.

In Malaysia the official definition of SMI since September 1986:

1. A small scale firm "with less than 50 full-time employees, and with an annual turnover of not more than RM10 million" or
2. A medium scale company "with between 51 and 150 employees, and with annual turnover of between RM10 million and RM25 million".

The problem faced by these industries also crucial and need to be taken action seriously to avoid it market growth slower such as the financial problem that had relation with capital fund, marketing problem which is more on the marketing strategy problem and lastly the problem related to this project which is regarding the production. In Malaysia, the SMI manufacturer tend to have problem in production that related to the labor intensive, have relatively low labor productivity and also low capital productivity. Their management tends to concentrate on problems encountered in the day-to-day implementation of manufacturing processes to the neglect of planning, development and improvement of operational systems. The weakness in SMI in manufacturing company are due to shortage of skilled personnel, poor linkage development, lack of market access, inadequate finance, unintended impact of policy instruments, competitions from foreign SMIs and technological constraints. To encounter this entire problem, industry need to apply continues improvement on each problem especially in quality control at the production line in order to maintain and increase the quality of their product.

1.2 Problem Statement

Most of the SMI's implement SPC manually and as a result of this conventional practice, they had encountered many problems such as:

1. Involving too many staff for the quality control process. This will make the process become messy and wasting the labor cost.
2. Time consuming. This will result time delay in setting and finish up the daily quality report.
3. Using many document in some simple process. This will cause the company incurred unnecessary administration cost such as paper work and traceability work.
4. Delay in getting quality control status by top management.

Basically, this project will develop new SPC software and then evaluate the effectiveness of it so that it can enhance the quality of the product produce from the production line into higher level.

1.3 Objectives

Based on the title "Development and evaluation of Interactive SPC Software" The objectives that can be stated regarding to this thesis topic is:

1. To study and evaluate current practical quality control method use in selected SMI Company.
2. To develop new interactive excel based SPC software for controlling the reject rate and production quality in industry.
3. To evaluate the effectiveness of the software hence subsequently proposes the feature provided in the software so that the optimum performance can be achieve.

1.4 Scope and Limitation

This project is basically intend to maintain production rate at the production line with less reject rate thus high quality product can be produce. The software that already use in the manufacturing company now will be upgrade and there are some new feature will be added so that the quality control for every production line in the company is under control and as an early detection for the product that fail to carry out the specification of good product.

The new invented software will be using the statistical process control formula to process the data and sources but only focusing on attribute elements. This new software will only use control chart for attribute as its primary objective. This will give more opportunities to the company for checking their product quality control not basis on the number of the product but also from the degree of conformity and non-conformity to the particular specification for the quality characteristics of the product. Instead of using the normal distribution, this software will use both the normal and binomial distribution for their chart depends on the type of process being chosen.

This software will undergo the evaluation process by doing some survey with questionnaire where it effectiveness and reliability to be use will be evaluate by selected respondents. This software hopefully can help the operator who's in charge the quality control at the production line to save more time, energy and also can detect the go and no-go product easier.

CHAPTER 2
LITERATURE REVIEW

This chapter will focus more on the theory of six sigma, lean manufacturing, and quality system as a whole and also about SPC tools that is widely used in manufacturing industries. This chapter also will discuss all the theory involving quality tools that will be more focus in SPC and both the control chart for variable and attribute. That is also including the theory of cp and cpk for the control charts. Lastly, this topic will discuss about the Microsoft Excel 2007 which is the platform to invent this new upgraded software.

2.1 Six Sigma

Six Sigma is a well-established approach that seeks to identify and eliminate defects, mistakes or failures in business processes or systems by focusing on those process performance characteristics that are of critical importance to customers. According to some experts, Six Sigma is a business strategy that seeks to identify and eliminate causes of errors or defects or failures in business processes by focusing on outputs that are critical to customers (Snee, 1999). It is also a measure of quality that strives for near elimination of defects using the application of statistical methods. A defect is defined as something which could lead to customer dissatisfaction in term of the product produced. The fundamental objective of the six sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction.

2.1.1 The history of Six Sigma

In as early as 1987, Motorola initiated the Six Sigma program with a focus on the design of products and processes so that defects would almost never occur. It was conceived by Bill Smith, a senior engineer and scientist at that time. He had introduced the six sigma concept to achieved 100 times improvement in quality. Technically, the sigma number is an indication of the amount of process variation. Than until early 1990, they had introduced quality management in six sigma into manufacturing and engineering in US based companies. After that, six sigma had been successfully being implemented by many manufacturing company in US that lead them to be introduced to other international companies and from that time it had been improved to give more efficiency in manufacturing process from time to time. Representing product quality by the sigma numbers indicates that the ultimate quality of a product depends not only on a clever design but also on the capabilities of the manufacturing processes.

2.1.2 Process Capability

By definition, process capability is simply the full range of normal process variation measured for a chosen characteristic. We can use μ (mean) to represent the average of all values in a population and σ (sigma) to represent the standard deviation that measures the distance away from the population mean value. The maximum range of variation that will still allow the manufactured object to work in the product determines the design tolerance on the desired mean value (nominal value). Defects occur when the process capability is greater than the specified upper and lower tolerance limits (SU and SL respectively). The relationship of specified tolerance to process capability is called design margin, or the capability index (Cp).

$$C_p = \frac{Design\ Tolerance\ (or\ Specification\ Width)}{Process\ Capability\ (or\ Total\ Process\ Variation)} = \frac{S_U - S_L}{6\sigma}$$

In some

cases, even the process capabilities is within the specified tolerance (Cp > 1.0),

defects will still occur because process mean shifts away from nominal target. In this type of cases, we can use Cpk to capture this important measurement.

$$C_{pk} = \min\{\frac{\mu - S_L}{3\sigma}, \frac{S_U - \mu}{3\sigma}$$

Sigma levels can be measured in terms of the process capability indices Cp and Cpk. In order to design the products and processes so that defects virtually never occur, the specification width (or design tolerance) should be twice as large as the true process capability. This means that a Six Sigma capability is equivalent to Cp >= 2.0 and Cpk>=1.5 (Fieler and Loverro, 1991).

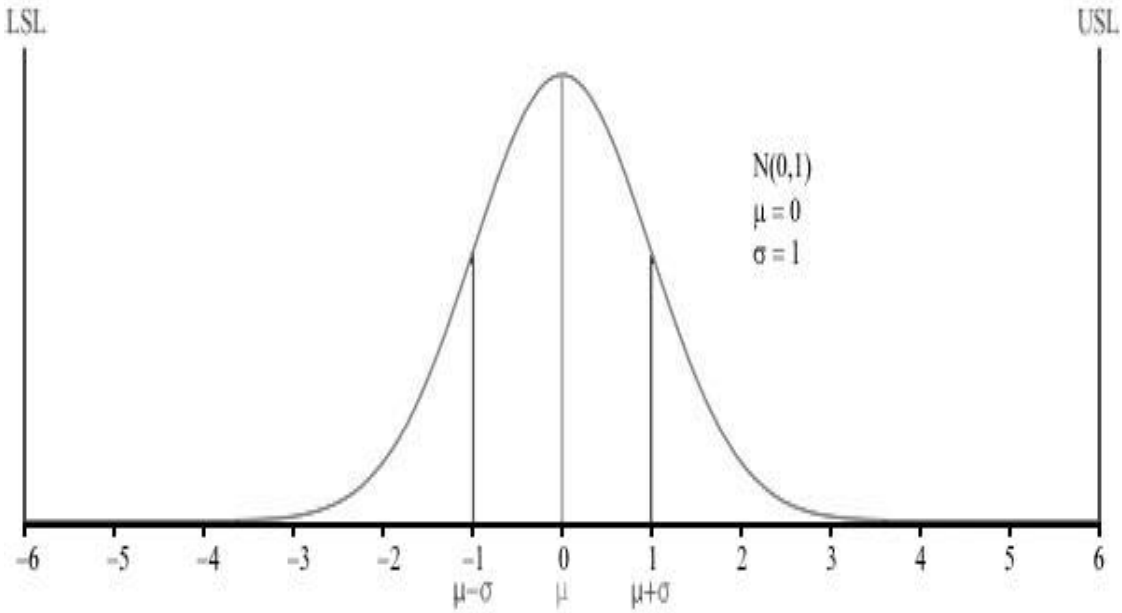

Figure 2.1: Graph of the normal distribution

Graph of the normal distribution, which underlies the statistical assumptions of the Six Sigma model. The Greek letter σ (sigma) marks the distance on the horizontal axis between the mean, μ, and the curve's inflection point. The greater this distance is, the greater is the spread of values encountered. For the curve shown above, μ = 0 and σ = 1. The upper and lower specification limits (USL, LSL) are at a distance of 6σ from the mean. Due to the properties of the normal distribution, values lying that far away from the mean are extremely unlikely. Even if the mean were to move right

or left by 1.5σ at some point in the future (1.5 sigma shift), there is still a good safety cushion. This is why Six Sigma aims to have processes where the mean is at least 6σ away from the nearest specification limit.

There are several key focus of six sigma that will lead company to strive excellent in their goal achievement. By applying the concept of low variation and high customer satisfaction, the key focuses are:

- Every human activity has variability
- Every process has variability
- Variation means that process does not produce consistent, predictable results over time
- Variation leads to defects, and defects lead to unhappy customers
- Minimizing variation is a key focus of Six Sigma

2.1.3 Six Sigma tools

There are many types of six sigma tool being used in any industries or manufacturing companies globally. Some of them are relevant with their manufacturing need while some of them are not. It is up to the company which of the tools is suitable with them. Several types of Six Sigma tools that always being used are:

- Brainstorming
- Cause and effect diagram (Ishikawa/fishbone)
- Control Charts
- Design of Experiments (DOE)
- Failed Mode Effect Analysis (FMEA) / Risk Assessment
- Histogram
- Pareto
- Poka Yoke (Mistake proofing)
- Quality Function Deployment (QFD) / House of quality

However, in this project the Six Sigma tools that will be implemented in the new developed software is control charts which is consists of control chart for attributes