IMPROVEMENT OF QUALITY PERFORMANCE IN SME'S MANUFACTURING INDUSTRIES USING STATISTICAL PROCESS CONTROL (SPC)

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ABSTRACT

This project presented information on Statistical Process Control (SPC) control chart on quality improvement tools in automotive industries.By the recent knowledge, control chart is using the statistical approach to detect the occurrence of assignable causes so that necessary corrective action can be taken before a large quality of the reject product is manufactured which will negatively impacts quality and customer perception. Improvement in Quality Performance in SMEs Manufacturing Industries using Statistical Process Control (SPC), Burnmark Industries (M) SdnBhd(Burnmark) has been selected to be improved. The objective of this project is improving the quality performance of product and process using the SPC control chart in the Burnmark. This project focuses on applying the graphical method to improve the quality performance in this company.The project is started by selecting the product which is Bracket IP CTR Mounting from Quality Control department in Burnmark, continued by data collection for data analysis and proceeds to applying Minitab 16 for analysis step. From the result, creating $\bar{X}$ chart and R charts can clearly monitoring and controlling all the process in producing Bracket IP CTR mounting by reduce the dimensional range from 1.0 to 0.6 and the causes of the problem can be easily identify by monitoring the pattern of control chart and it bring the tolerances of dimension for Bracket IP CTR more close to center limit. As the conclusion, by creating the $\bar{X}$ chart and R chart, the performance of the product can be clearly identified by taking control of upper control limit and lower control limit. Corrective action can be taken instantly if the data beyond the upper and lower control limit.

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LIST OF SYMBOLS

$\bar{x}$	Mean
Σ	Sum or total Value
σ	Sigma
A_2 A3	Constants used to determining limits for average charts
B_3 B_4	Constants used to determining limits for standard deviation charts
R	Range
$\overline{R}$	Average range
n	Number of Observations

LIST OF ABBREVIATIONS

Burmmark	BurnmarkIndusties (M) SdnBhd
SME	Small and Medium Enterprises
QC	Quality Control
SPC	Statistical Process Control
LCL	Lower Control Limit
UCL	Upper Control Limit
WECO	Western Electric Company Rule
UNDP	United Nation Development Programme
MRS	Manufacturing-Related Services
CUSUM	Cumulative Summation Chart

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Statistical process control (SPC) is a technique of monitoring, measuring and controlling the performance of a process using chart and graph. SPC has become one of the most popular and widespread organizational interventions in the name of quality improvement (Sultana et al, 2009). SPC is a set of problem solving tools that can apply in any process and control chart is a powerful tool of SPC (Darestani et al, 2010). Control chart are using statistical approach for assisting operators, supervisor and managers to manage quality and to eliminate special causes of variability in process (*Judi et al,*2010). Furthermore, the use of SPC methods can help to identify instances of process variation that may signal a problem in the process and can help the managers to make corrections before the process variation negatively impacts quality and customer perceptions (Wisner, 2007).

In manufacturing industries, SPC is the one of the techniques used in quality assurance program and total quality management for controlling, monitoring and managing a process. The effective implementation of SPC can be achieved if organization/company has a good understanding of such strategy or method that will make the application successful (Sultana.et al, 2009). The used of SPC tools for quality improvement of production volume as well as quality will lead to manufacturing excellence. The company will make a huge profit by achieving the customer stratification (Darestani.et al, 2010). Implementation of SPC tools in manufacturing can

be used as quality control tools and it will contribute to increase the total volume of production and production manager can easily identify the causes responsible for poor product quality (Lyu and Chen, 2008).

However, in Malaysia, development of SPC in small and medium-sized enterprises (SME) is found lacking due to some companies still keeping the "waste" money concept in their minds. The development of statistical process control within production environments would improve quality, productivity and costs (Rungtusanatham, 2001). His statement been agreed by the Srinivasu.*et al* (2011), state that: "The goal of the statistical process control is to maintain and improve the capability and the quality of the manufactured product. Statistical process control aims to produce the products in the most economic and useful way by using statistical principle and techniques at every stage of the production".

Most of the manufacturing in Malaysia facing a bottle necks in implementation of quality improvement using SPC tools due to the:

a. Not yet being aware of the possibilities of SPC
b. Not having enough time
c. A low degree of motivation and involvement in general
d. Lack of assurance
e. Lack of cooperation between team member

Benefits of implementation of Statistical Process Control (SPC) in manufacturing industries are:

a. Reduction of waste: From the financial point of view, implementations SPC are profitable even it take many hours in return for implementation.
b. Predicable process: SPC tools enable the management to analyze the date and provide a picture of the performance of the process to decision making.
c. Better harmony in customer/ supplier relations: SPC enable processes to be run more consistently and increase the percentage of the product that meets customer stratifications.

d. Insight into process performance: Differentiate between variation owed to special causes and variation owed to common causes will first need to make. Examination of specification action will be point to the weak spots.
e. Clarity in process workmanship: SPC approach is train the employees and install them with skill of problem solving and knowledge for structural improvements.

1.2 BACKGROUND OF THE STUDY

In recent years, most of the manufacturing companies have focused on the manufacture of higher value added products with low production costs. Therefore, quality has become an important success criterion for the manufacturing process. Quality control for an inspection procedure will enable companies to produce high quality product which fulfil the customers' requirements and stratification from market (Basu and Wright 2003).

Quality control charts are widely used to improve the quality of a manufacturing process. It is often the case that some aspects of the quality of the output of a process cab be described in terms of one or more parameters of the distribution of a quality measurement. The control chart s is a graphical tool that aids in the discovery of assignable causes of variability in there quality measurements. It is used to monitor a process for the purpose of detecting special causes of process variation that may result in lower-quality process output (Juran 1986).

Shewhart type control charts are the most commonly used method to test whether or not a process is in-control. The basic idea is that given a quality measurement, a Shewhart chart with 3-sigma control limits. By analysis the data values with respect to upper and lower control limits together with their location in the zones, assignable cause are detected. The measurement can be performed by means or either variables or attributes. Variable is measure of a product that can have any value between the limits of the measurement while attributes is count of things which may or not be present in the product (Juran and De Feo, 2010).

1.3 PROBLEM STATEMENT

According to CEO of large American automotive manufacturer, one-third cost for produce a vehicle are the cost of waste (F.M.Gryna.et.al, 2007). In Malaysia, the automotive company was struggling to reduce vehicle recall costs and its warranty and policy spend. The costs associated with waste (cost, quality, time related) are due to sudden change in the status quo and long-standing adverse situation, which remedy by changing the status quo.

The automotive industry of Burnmark Industries (M) SdnBhd is selected after some inspection is due to the unsatisfactory of the quality performance of the product and process that causes the customer complaints and quality issues. Therefore, analysis and improvement for the quality improvement will be done in this project in order to enhance the quality performance of the industry.

The quality control method applied in Burnmark Industries (M) SdnBhd is using the histogram. Histogram is assuming all the parts produce from the machine are exactly alike as it hit the target specification. The purpose of a Histogram is to take the data that is collected from a process and then display it graphically to view how the distribution of the data, centers itself on the mean or main specification.

In this study, I will using the SPC Control Chart as the quality control tools to replace the Histogram as the main tools that using by the Burnmark. Control Charts can clearly display the performance in the natural to the process and generally attributed to machines, material and time which Histogram will cannot perform it. Control Chart will also take a minor adjustment to the process to make the correction and return the process to a normal output so that the process was performing or behaving as expected and the process of constructing the Control Chart is simple. While Histogram will manipulated to show different result and too many or few bars are used which can obscure the time differences among data sets.

Today, there is plenty of software such as Matlab, Microsoft Excel, SSPS and etc were developed to allow users to analysis the quality performance. By applying Minitab 16 as tools of quality improvement, the actual quality performance can be identifiedand the further quality control action can be taken to decrease the lost.

These studies will analysis the quality performance in Burnmark Industries (M) SdnBhd and suggest the alternative ways to increase the quality performance of the product and process for Bracket IP CTR Mounting.

1.4 OBJECTIVE

The objective of this study is to improve the quality and process of product specification via SPC control chart supplier in automotive industries in Malaysia.

1.5 SCOPE OF STUDY

This study will analyze an industry specific problem of quality product of Bracket IP CTR Mounting in order to increase the quality performance and solve it through statistical approach.

i. This study is conducted at Burnmark Industries (M) SdnBhd which located at No 6, JlnPiandang 24/34, Seksyen 24, 40000 Shah Alam, Selangor.
ii. Product Bracket IP CTR Mounting is selected for collecting the data.
iii. Data analyze will be done using the Minitab 16.
iv. This study evaluates monthly quality performance of the Bracket IP CTR Mounting and $\bar{X}$ and R chart will be used as tools for data analysis.

1.6 LIMITATION OF STUDY

One of the limitations of this study is the fact that there can be some confusion on choosing an Attribute control chart or variable control chart. In fact the data can be calculate using the attribute or variable control chart method because they got similarity in the way on collecting data but difference in the way of presenting results. The privacy of the company or organization also limited my research because not all the needed data from the company or organization can be collected due to it privacy and policy.

1.7 CONCLUSION

As a conclusion, the overview of this project is reviewed. It introduces a brief concept of the project by developing the idea of the problems facing by the manufacturing industries. The problem statements are identified after selecting the suitable researched company. The objectives and scopes of the project are stated to specify the boundary of the study to avoid any deviation from the title of the project. Lastly, the arrangement of report displayed the summary of each chapter discussed in this project.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discussed about literature review of the Statistical Process Control (SPC) of quality improvements. It began with the introduction of the small and medium enterprises (SME), philosophy of quality,variable control chart, recalculate of the control chart, Western Electric Company Rules (WECO) for Signaling "out of control", control chart interpretation and software used.

2.2SMALL AND MEDIUM ENTERPRISES (SMEs) IN MALAYSIA

Small and Medium Enterprises (SMEs) in play a vital role in the Malaysian economy and are considered to be the backbone of industrial development in the country. Malaysian Government's commitment to and concern for the development of SMEs has been clearly evident since the early 1970s and in the second Industrial Master Plan (IMP2) and Third Industrial Master Plan (IMP3) to coincide with the country's vision for 2020 (Saleh and Ndubisi, 2006).

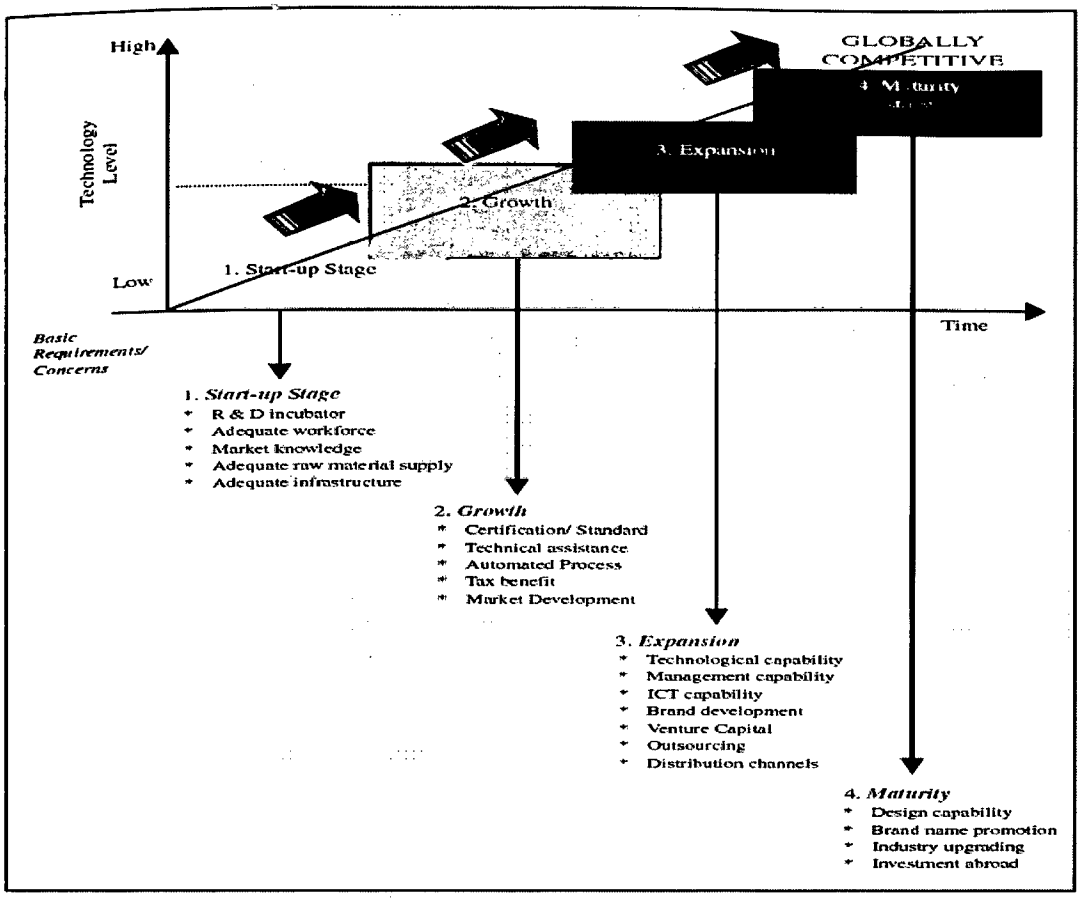

Figure 2.1: Phases of Enterprise Development (four stages)

Source: An Evaluation of SME Development in Malaysia(2006)

According to paper published by United Nations Development Programme (UNDP), Malaysia in year 2007, definition of SMEs are based on annual sales turnover and number employees of the SMEs. A broad definition of SMEs is provided along with specific definitions for micro, small and medium enterprises. In the paper issued by Secretariat to National SME Development council of Bank Negara, Malaysia in year 2005, SMEs in manufacturing industries which including agro-based and Manufacturing-Related Services (MRS) in generally defined as an enterprise with full-time employees not exceeding 150 people or with annual sales turnover not exceeding RM25 million. In specific definitions, a micro enterprise in manufacturing and MRS are an enterprise with full-time employees of less than 5 people with annual sales turnover of less than RM250,000; small enterprise are an enterprise with full-time employees of

between 5 to 50 people or with annual sales turnover of between RM 250,000 and less than RM 10 million; and medium enterprise is an enterprise with full-time employees of between 51 to 150 people or with annual turnover of between RM 10 million and RM 25million.

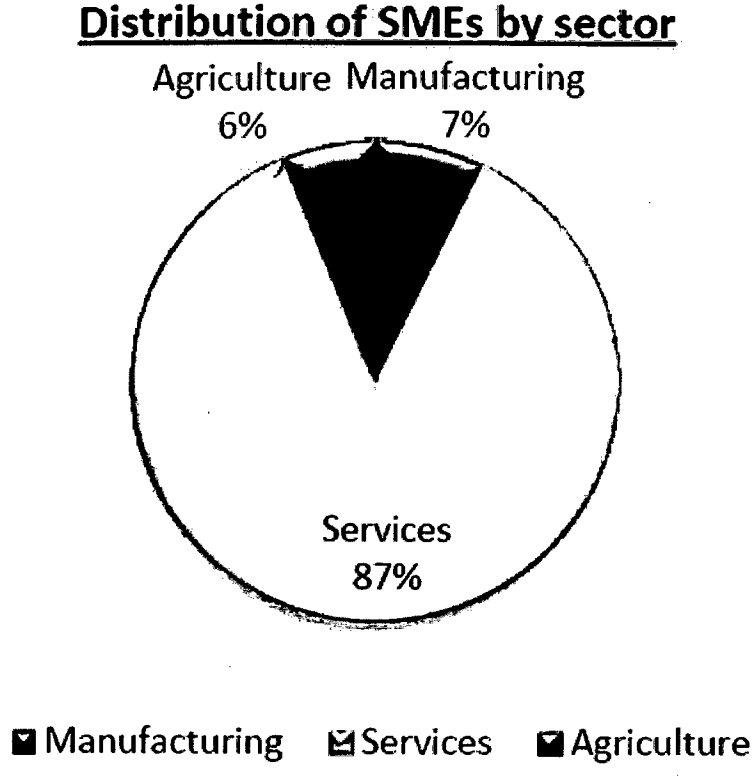

Figure 2.2: Percentage of SMEs in Agriculture, Manufacturing and the Service sector, Malaysia 2010.

Sources data: Department of Statistics (DOS) (2010)

The advantages of SMEs process relative to larger companies are:

a. Their flat structure and short decision making process allows shorter and faster information flow which can improve communication as well as easier to permeate new change initiatives.
b. Their flexible culture provides a good foundation for a change

c. People dominated together with organic behavior, rather than bureaucratic and system dominated and this will help in improve the chances of success for new initiates.
d. The high incidence of innovativeness can nurture a continuous improvement culture.

Meanwhile the disadvantage of SMEs as compared to larger companies is:

a. Lack of skills and knowledge which can affect staff development and training
b. Lack of financial resources which can affect investment in new products or process.
c. Improper and inadequate systems and procedures can affect efficiency and will result in dissatisfaction from employees.

2.3 PHILOSOPHY OF QUALITY

According to Deming's basic philosophy on quality, productivity improves as variability decreases due to vary causing a statistical method in quality control is needed. Statistical control does not imply the absence of defective item; rather it is a state of random variation which the ranges of variation are predictable. Deming determine the two type of variation which is chance and assignable. The cause of chance variation based on the Deming's view was a waste of time and money, but yet, still many companies attempt to solve the quality problem without using statistical method (Deming, 1986). According to Deming, good quality did not necessarily mean high quality but based on the degree of uniform and dependability at low cost that suits to the market (Speegle, 2010). He strongly believed that in quality improvement process, management needed to remove the barriers of lack of training and proper equipment that rob hourly workers of their right to do good jobs and guide employees to work smarter, not harder.(Thompson and Koronacki, 2002)

In view of Juran philosophy on quality, Juran believed there were two kinds of quality which is "fitness to use" and "conformance to specification but would not fit for

use". When Juran deals with the broad management in aspects of quality, he concluded that human element such as communication and coordination of function are the main problem in quality control (Speegle, 2010). According to Juran, an understanding of human situation associated with the job helps to solve technical problem which later he advocated three steps trilogy of management, for making progress with quality:

a. Financial planning: set business financial goals and develop the actions and resources needed to meet those goals.
b. Financial controls: Evaluate actual performance, compare to goals and take action on the differences.
c. Financial improvements: Do better than the past. Strive for cost reduction and raise productivity.

In Juran's view, the less than 20 percent quality problems are causes by the worker while 80 percent quality problem are causes by the management. So he believed all management needed some training in financials, quality to participate in quality improvement project. But Juran and Deming did not believe that motivation campaign is the ways to solve quality problem in organization. This statement been strongly rejected by Crosby because he believed strongly in motivation and personal behavior can solve quality problem (Gryna.et al, 2007)

According to Juran, in order to produce a good quality products, purchasing department playing an important role in choosing a greater precision from suppliers with the better communication with supplier such as in purchase the raw materials or components. This statement been agreed by Crosby which he state that "*purchaser caused at least half of the quality problems associated with purchased items by not clearly understand the requirement of items*". Juran believed improvement in quality is going to come by project by project and he suggested "Ten Steps to Quality Improvement" which are:

a. Build awareness of the need and opportunity for improvement
b. Set goals for improvement.

c. Organize to reach the goals (establish a quality council, identify problems, select projects, appoint teams, designate facilitators).
d. Provide training
e. Carry out projects to solve problems.
f. Report progress
g. Give recognition
h. Communication results
i. Keep score
j. Maintain momentum by making annual improvements part of the regular systems and processes of the company.

According to Crosby's Quality philosophy, he defined quality as conformance to requirements and it could only be measured by the cost of nonconformance. Crosby did not believe in high quality or poor quality but he believed in conformance and nonconformance which only standard of performance was zero defects. He believed that prevention was the only system could produce quality (Crosby, 1986). According to Crosby, quality improvement was a process not a program because nothing is permanent come from program. He state that quality was management's responsibility and management had to be concern about the quality as production, safety and profit (Speegle, 2010). Crosby created four principles that called the "Absolutes of Quality" for achieving quality which are:

a. Quality is defined as conformance to requirements.
b. The system that will make quality happen is prevention.
c. The performance standard is zero defects.
d. The cost of the quality is measured by price of nonconformance (PONC).

In order to achieving quality, Crosby develops 14 steps to quality improvement which are:

a. Make it clear that management is committed to quality.
b. Form quality improvement teams with representatives from each department.
c. Determine where current and potential quality problems lie.
d. Evaluate the cost of quality and explain its use as a management tool.
e. Raise the quality awareness and personal concern of all employees.
f. Take action to correct problems identified through previous steps.
g. Establish a committee for the zero defects program.
h. Train supervisors to actively carry out their part of the quality improvement program.
i. Hold a "zero defect day" to let all the employees realize that there has been a change.
j. Encourage employees to communicate to management the obstacles they face in attaining their improvement goal.
k. Recognize and appreciate those who participate.
l. Establish quality councils to communicate on a regular basis.
m. Do it all over again to emphasize the quality improvement program never ends.

2.4 VARIABLES CONTROL CHART

A quality characteristic that is measured on a numerical scale is called a variable; and includes dimensions such as length or width, temperature, time, and volume (can be measured in fraction or decimals). When dealing with a quality characteristic that is of variable type, it is usually preferable to monitor both the mean level of the quality characteristic and its variability. The variable quality control charts:

a. $\bar{x}$ chart
b. R chart
c. Individuals charts
d. Zone charts
e. CUSUM charts
f. EWMA charts