UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MEASUREMENT ERROR AND UNCERTAINTY ANALYSIS BY EXCEL

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

By

MARLIANA BINTI MD TAIB

FACULTY OF MANUFACTURING ENGINEERING

2010

UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Measurement Error and Uncertainty Analysis By Excel**

SESI PENGAJIAN: **2009/2010 Semester 2**

Saya **MARLIANA BINTI MD TAIB**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan Penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	TIDAK TERHAD	

Disahkan oleh:

(TANDATANGAN PENULIS) (TANDATANGAN PENYELIA)

Alamat Tetap:

G17-G-2 DESA MURNI,
KOMPLEKS PENJARA SG BULOH,
47000 SG BULOH,
SELANGOR DARUL EHSAN.

Tarikh:____________________

Cop Rasmi:

Tarikh:____________________

** Jika laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled “Measurement Error and Uncertainty By Excel” is the results of my own research except as cited in the references.

Signature : …………………………………
Author’s Name : …………………………………
Date : …………………………………

APPROVAL

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

…………………………………………………

Project Supervisor

(Official Stamp & Date)

ACKNOWLEDGEMENT

First and foremost, thanks to ALLAH S.W.T for His blessings and strengths, I had finished this project. Next, I would like to place my gratitude to the ones that contributed to the success of this project. I wish to acknowledge and express my gratitude and appreciation to my supervisor, Dr Mohd Rizal Salleh for his supervision, encouragement, suggestion and assistance through the research.

Valuable suggestions, criticisms and comments have been made by numerous individuals. I greatly appreciate the time and effort the following people gave in order to complete my final year project and I really appreciate them for their help in improving the quality of this final year project:

Last but not least, million thanks to all friends who's guide me to complete this research. I could offer here only an inadequate gesture of my appreciation and all of your good deeds will always be in my mind.

DEDICATION

Specially dedicated to my beloved father, mother, family, and friends who provide a loving, caring, encouraging and supportive atmosphere. These are characteristic that contribute to the environment that is always needed to achieve the goals ahead.

ABSTRACT

This thesis has focused on the measurement error and uncertainty analysis by excel conducted in the ABC Company Sdn Bhd. The objective of this study was to investigate the methods applies in error determination and measurement uncertainty. In order to analyze the data some of Statistical Process Control (SPC) tools were used such as histogram, cause and effect diagram and control chart. The result that gained is achieved to develop software to measure error and uncertainty. The errors in the production line are determined and proper tool is used to analyze the quality problem. Major defects were highlighted and analyzed. Root causes for the problems were determined and suggestions for improvement were suggested. After the improvement stage, suggestions for control the quality also were suggested.

ABSTRAK

Laporan ini bertujuan untuk mencipta perisian melalui Microsoft Excel bagi kesalahan dan ketidakpastian pengukuran di syarikat ABC company Sdn Bhd. Objektif kajian ini adalah untuk mengkaji kaedah kaedah yang digunakan dalam penentuan dan pengukuran kesalahan ketidakpastian Untuk menganalisis data, beberapa alat “Statistical Process Control” (SPC) digunakan seperti histogram, diagram sebab dan akibat dan carta kawalan. Keputusan yang diperolehi adalah dapat mencipta perisian untuk mengukur kesalahan dan ketidakpastian. Kesalahan didalam pengukuran pengeluaran dan alat sesuai yang digunakan untuk menganalisis masalah kualiti. Kecacatan utama dianalisis. Masalah utama dinyatakan dan saranan untuk pembaikan dicadangkan. Selepas peringkat pembaikan, saranan kawalan quality juga dicadangkan.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

ABBREVIATION

MT	-	Must Trial
SPC	-	Statistical Control Chart
UCL		Upper Control Limit
LCL		Lower Control Limit
CL		Center Line

CHAPTER 1

INTRODUCTION

1.1 Background of Project

Measurements are made so that the resulting data may be used for decision making. In fact, the most fundamental definition of 'good' data is data that are applicable or useful for drawing conclusion or making decision. Because of this no test or evaluation data should be presented or used without including its measurement uncertainty. It is properly evaluated measurement uncertainty that provides the information needed to properly assess the usefulness of data. For data to be useful, it is necessary that their measurement errors be small in comparison to the changes or effect under evaluation. The actual measurement error is unknown and unknowable. Measurement uncertainty estimates its limit with some confidence.

Therefore measurement uncertainty may be defined as the limit to which a specific error or system error may extend with some confidence. The most commonly used confidence in uncertainty analysis is 95% but other confidences may be employed where appropriate. Error is most often defined as the difference between the measured values of one data point and the true value of the measured.

Error analysis is the study and evaluation of uncertainty in measurement. In science the word "error" does not carry the usual connotations of "mistake". "Error" in a scientific measurement means the inevitable uncertainty that attends all measurements. As such, errors are not mistakes, cannot avoid them by being very careful. Errors in experimental measurements can be divided into two classes, (a) systematic errors and (b) random errors. It is possible to correct for errors of the first type if the source of the error is known. Random error typically arises from unpredictable variations of influence quantities. These random effects give rise to variations in repeated observations of the measured. The random error of an analytical result cannot be compensated by correction but it can usually be reduced by increasing the number of observations. Random error indicated by fluctuation in successive measurements and lead to imprecise measurements. Systematic errors are reproduced in successive measurements, made under the same conditions. It is defined as a component of error which, in the course of a number of analyses of the same measured remains constant or varies in a predictable way. It is independent of the number of measurements made and cannot therefore be reduced by increasing the number of analyses under constant measurement conditions.

Uncertainty, on the other hand, takes the form of a range, and, if estimated for an analytical procedure and defined sample type, may apply to all determinations so described. In general, the value of the uncertainty cannot be used to correct a measurement result. The definition of the term uncertainty (of measurement) used in this protocol and taken from the current version adopted for the International Vocabulary of Basic and General Terms in Metrology is "A parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measured". The definition of uncertainty given above focuses on the range of values that the analyst believes could reasonably be attributed to the measured. In general use, the word *uncertainty* relates to the general concept of *doubt*. In this guide, the word *uncertainty*, without adjectives, refers either to a parameter associated with the definition above, or to the limited knowledge about a particular value. *Uncertainty of measurement* does not imply doubt about the validity of a measurement; on the contrary, knowledge of the uncertainty implies increased confidence in the validity of a measurement result.

In practice the uncertainty on the result may arise from many possible sources, including examples such as incomplete definition, sampling, matrix effects and interferences, environmental conditions, uncertainties of weights and volumetric equipment, reference values, approximations and assumptions incorporated in the measurement method and procedure, and random variation.

In estimating the overall uncertainty, it may be necessary to take each source of uncertainty and treat it separately to obtain the contribution from that source. Each of the separate contributions to uncertainty is referred to as an uncertainty component. When expressed as a standard deviation, an uncertainty component is known as a standard uncertainty. If there is correlation between any components then this has to be taken into account by determining the covariance. However, it is often possible to evaluate the combined effect of several components. This may reduce the overall effort involved and, where components whose contribution is evaluated together are correlated; there may be no additional need to take account of the correlation

1.2 Definition of problem

Nowadays, the Must Trial processes (MT) were done by engineer at Production Engineering Department which the disk must be checking and setting the parameter first before the actual process running. Disk defects are checking and data were keyed- in at the forms that are given before calculated manually. Usually the problems were arising during calculation of defect and more error will detect. Besides that, time is important because they can take the longer time to do the calculation.

1.3 Objective

a) To investigate the methods applies in error determination and measurement uncertainty

b) To develop a tool for computing the measurement error and uncertainty using Excel.

1.4 Scope of Work

This research project will focus to Lens Engineering Department at ABC COMPANY which the disk defect were measured and calculated by manually during Must Trial (MT) process test occurred. The tool of Statically Process Control (SPC) are use to solve the problem during measurement. The user can use the tool to optimize the error calculation at shorten duration small error. The flow charts below show the rough research progress by follow the sequence.

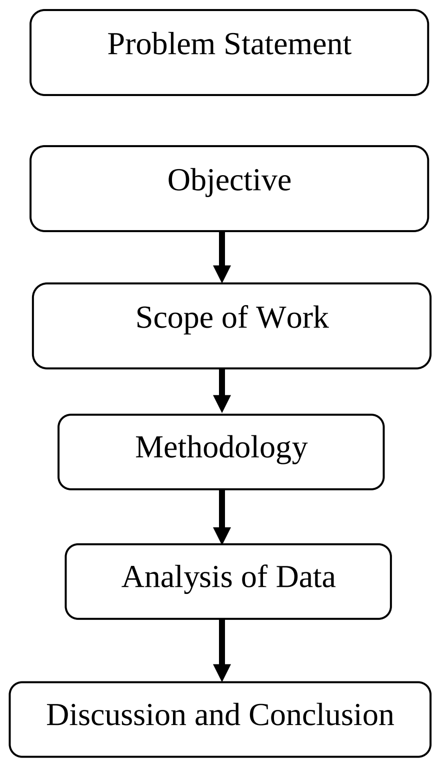

Figure 1.1: Rough Research of Flow Chart

CHAPTER 2

LITERATURE REVIEW

2.1 Error In Measurement

2.1.1 Introduction

Error analysis is the study and evaluation of uncertainty in measurement. In science, the word 'error' does not carry the usual connotations of mistake. Error in a scientific measurement means the inevitable uncertainty that attends all measurement. As such, errors are not mistakes cannot avoid by being very careful. The best is to ensure that errors are as small as reasonably possible and to have some reliable estimates of how large errors are.

There is no perfect measure. Error is inherent in any measurement strategy. Measurement error is the difference between what exist in reality and what is measured by a research instrument. Measurement errors exist in both direct and indirect measures and can be random or systematic. Direct measures which are considered to be highly accurate are subject to error. For example the scale may not be accurate the machine may be precisely calibrated but it may change with use or the tape measure may not be held at exactly the same tightness.

There is also error in indirect measures. Efforts to measure concepts usually result in measuring only part of the concept but also contain other elements that are not part of the concept. Figure 2.1 shows a Venn diagram of the concept A measured by instrument A-1. As can be seen, A-1 does not measure all of A. In addition some of what A-1 measures is outside the concept of A. Both these situation are examples of error in measurement.

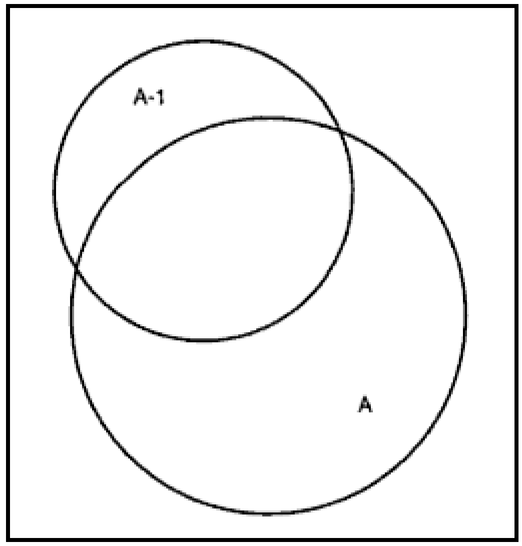

Figure 2.1: Measurement error when measuring a concept

Errors in experimental measurement can be divided into two classes, systematic errors and random errors. It is possible to correct for errors of the first type if the source of the error is known. Random errors are indicated by fluctuation in successive measurement and lead to imprecise measurement made under the same condition (George J.Klir, 2006).

2.1.2 Types of Measurement error.

Two types of errors are concern in measurement random error and systematic error. To understand these types of errors, we must first understand the element of a score on an instrument or an observation. According to measurement theory, there are three components to a measurement score, the true score (T), the observed score (O) and the error score (E). The true score is what would be obtained if there were no error in measurement. Because there is always some measurement error, the true score is never known. The observed score is the measure obtained. The error score is the amount of random error in the measurement process. The theoretical equation of these three measures is as follow:

$$O = T + E \tag{2.1}$$

This equation is a means of conceptualizing random error and not a basis for calculating it. Because the true score is never known the random error is never known only estimated. Theoretical the smaller the error score the more closely the observed score reflects the true score. Therefore using measurement strategies that reduce the error score improves the accuracy of the measurement.

A number of factors can occur during the measurement process that can increase random error. They are (1) transient personal factors, such as fatigue, hunger, attention span, health, mood, mental set and motivation;(2) situational factor such as a hot stuffy room, distraction, the presence of significant others, rapport with the researcher and the playfulness or seriousness of the situation; (3) variations in the administration of the measurement procedure such as interviews in which wrong or sequence of questions varied, questions are are added or deleted or different coders code responses differently ; and (4) processing of data such as errors in coding accidental marking of the wrong column, punching of the wrong key when the data are entered into the computer or incorrect totaling of instrument scores (Howard C, 2001).

2.1.3 Systematic error

Systematic error is a wrong due to bias sources of variation that distort the study findings in one direction. The only way to improve the accuracy of the estimate is to design the study in a way that either reduces the size of the various biases or gives some information about them.

Many systematic can be eliminated by the application of familiar corrections. For example in the determination atmospheric pressure using a mercury barometer, correction must be applied to allow for the difference between the thermal expansion of mercury column and scale are at a temperature of 0 ºC. In very precise work it is necessary, in addition to correct for the capillary depression of the mercury and for the difference between the acceleration of gravity where the barometer is being used and the reference point.

Systematic errors may not manifest themselves by fluctuation in measurement and cannot be eliminated by merely repeating the measurement. These errors are therefore especially serious and insidious and can be avoided only by careful calibration and consideration of all possible correction. Sometimes systematic errors are indicated by the change in the measured value resulting from a change of experimental technique or when different values are obtained on different days.

Systematic error (or bias) occurs in epidemiology when result differs in a systematic manner from the true values. A study with small systematic error is said to have a high accuracy. Accuracy is not affected by sample size. The possible sources of systematic error in epidemiology are many and varied over 30 specific types of bias have been identified. The principal biases are selection bias and measurement bias (N.C Barford, 1967).

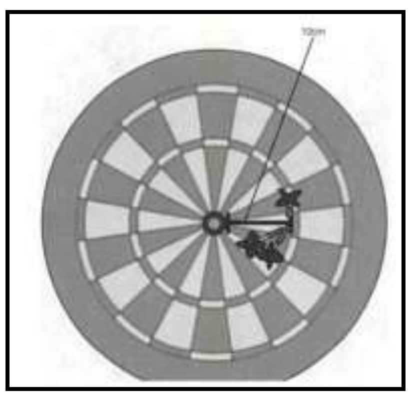

Figure 2.2: To compensate for the systematic error in my dart throwing ability, will need to throw 10 cm lower to bit the target