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A SIMULATION OF
SELECTED STATISTICAL PROCESS CONTROL METHODS

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ABSTRACT

A simulation program, SQC, was developed at the Production Technology Department, Massey University. The program was written in Vax Basic 3.0 which is structured programming language and is run on the Vax computer under the VAX/VMS operating system 4.5. SQC is a menu-driven program which was designed to simulate data from a variety of production processes subject to inherent random variation and predetermined changes; sample selection for statistical quality purposes. Such decisions were made via the available feature to allow for user interactive control of the process parameters and sample selection methods while the chart of selected method was plotted on the terminal screen as well as optionally on the printer.

The exercise has been done to test and to observe how the program performed and produced the output on the screen and terminal-format files. Moreover, the program evaluation was carried out by comparing with a published article, which is satisfactorily acceptable.

The SQC can be utilized as a teaching tool for students in practising how each statistical process control method performs and how to make a right decision at a right time and as a research tool to observe and use the simulated results to predict and to improve the production process in the future.

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CHAPTER 1

INTRODUCTION

Blum and Bingham (1979) said that computer simulation is the method used to determine 'what would happen if' in the system. By the definition, 'simulation is the process of designing a computerized model of a system (or process) and conducting experiments with this model for the purpose either of understanding the behaviour of the system or of evaluating various strategies for the operation of the system' (Shannon, 1975). It is an appropriate method of system study where an analytical approach is not practical. Nowadays, computer simulation is widely used in many applications, because computers provide the capability of testing the model repeatedly with a variety of different conditions suitable to the questions to be answered (Blum and Bingham, 1979). The results from the simulation enable the researchers to understand the performance of the present system and predict the performance in the future under various conditions.

The use of simulation applied to industrial area has been increasing rapidly in recent years. It has become an effective tool in problem solving and decision making for management because it can help imitate the production operation by varying the physical conditions to see what would happen under many different management strategies (Rao and Smith, 1974). Cousins et al. (1975) also described how simulation can be applied in quality control with a case study in manufacturing. They concluded that simulation offers an excellent method for decision making without interfering with day-to-day operations.

There are many statistical quality control researches that have been done by using simulation approach both on quality control techniques and management as Hahn (1985) suggested that statistics can help improve the quality of manufactured product. The quality simulation can clarify the techniques used to achieve a given quality goal in

advance in various stages of product development (Osamu,1983).

However, sometimes, statistics is hard to understand by supervisors or operators without being trained. Therefore, education and training are an essential part of quality improvement (Juran, 1979). Gupta et al. (1987) said that education and training of entire workforce become a top priority in statistical process control scheme.

Computer laboratory in quality control using simulation method can be a good tool in training with many benefits (Bommer and Frazer, 1976).

- o It provides decision making experience in constructing and applying decision rules to actual data.
- o The experience provides the trainee with opportunity to experiment with alternative decision strategies.
- o The process identifies faulty decision strategy allowing the trainee to analyze and benefit from errors.
- o The trainee's confidence in utilizing quality control concepts is reinforced when he succeeds in developing an effective decision strategy.

Furthermore, Juran (1979) added that although the preparation of the simulation program for training is costly because of requiring considerable time by skilled analysts and programmers, once it is prepared it permits a good deal of flexibility in training and helps minimize total costs since it does not disturb the actual operation. Also the program provides the capability of testing and demonstrating the trials repeatedly with various questioned conditions.

The objectives of the study

1. To build a programming package that adequately simulates :-
 - data from a variety of production processes subject to inherent random variation and predetermined or random parameter changes.
 - sample selection for SQC purposes
2. To compare the performance of each control methods resulted from the simulation.
3. To utilize the package as a study tool both in research and laboratory practice for statistical quality control students.

Chapter 2 describes the statistical process control method only those provided in the established program and discussed the advantages and disadvantages of each control method.

Chapter 3 explains the design and description of the program which is called SQC while Appendix 2 and 3 provide the diagram of program structure input specifications.

Chapter 4 provides the guidelines of how to run SQC and also demonstrated some examples to help users understand the use of SQC with both arbitrary data and data taken from some previous researches. In addition, Appendix 1, and 4 to 8 provide some useful informations of program maintenance for those users who are interested in program modification and development (see DEC, 1986a, 1986b and 1986c for more detail informations).

Chapter 5 concludes with the results of the study and suggests some interesting ideas for further study and program development.