CHAPTER 4

RESEARCH METHODOLOGY

This chapter deals with the methodology adopted for the study and aims to explain appropriate methodology for achieving the research study aims and objectives. The main purpose of this research study was to examine the feasibility of applying statistical quality control techniques in paper industry through control charts. Based on the published literature review and conceptual models, several control chart techniques were deployed to assess the manufacturing process of paper. This chapter outlines the data collection and statistical analyses methods that was used in this research study.

This researcher employed a quantitative data collection method using the on-the-spot data collection approach to collect data concerning the measurement of various characteristics of paper. Data analysis was performed by Control chart techniques using the Minitab software. The primary intent of this statistical approach is that it allows a researcher to assess as to whether the production process in under statistical control.

4.1 DESIGN OF THE STUDY

The research design phase deals with the detailing of procedures that will be adopted to carry out the research study. The kind of research that is carried out, whether the study is carried out in the field or in the laboratory, are decided. The details of data collection procedures and the schedule of analytical procedures to be used in order to accomplish the research
objectives are also dealt with in research design. The basic research design issue involved in determining the kind of research strategy is whether the study is a field study or a laboratory study. The data pertaining to the present study is concentrated on the measurements on the characteristics of paper, and the data were gathered on the basis of time as independent variable and measurements on various characteristics as dependent variables, empirical research study was carried out. The basic empirical design deals with considering the effect of independent variable (time, taken as sample numbers in the study) on the dependent variables (measurements on various characteristics of paper). Figure 4.1 depicts research design.

![Research Design Diagram](image)

**Figure 4.1 Research design**

In this study, the researcher employed a quantitative data collection method to obtain data concerning the measurements on various characteristics of paper, *viz.*, substance, caliper, and bulk density at the time of production
process. A time-bound study employing a time interval of one hour between measurements was carried out for collecting the data.

4.2 SAMPLING STRATEGY

4.2.1 Population

The population is all elements that meet certain criteria for inclusion in the study. The population for the study is all the units of the finished product – ‘paper’ of variety ‘SPRINT-75’ and SWIFT-70, coming out of paper machine in SPB Ltd. and HMC-80 and RDP-56, coming out of paper machine in TNPL.

4.2.2 Sampling

The population selected for the study is two varieties of paper each from SPB and TNPL, coming out of respective paper machines in these companies. The measurements on Substance, Caliper and Bulk Density of paper were taken for study. These measurements were collected for sample size of 20 to 25 samples at different time periods during the manufacturing process with sample subgroup size of minimum 5. The Simple Random Sampling was applied to select the subgroup size of minimum 5.

4.2.3 Sampling Technique

Simple random sampling is used to gather samples from the manufacturing process with sample subgroup size of minimum 5. This subgroup size was further considered beyond 5 to check with the variability of the process.
4.2.4 Data Collection Method

Primary data were collected for this study. Primary data are gathered and assembled specifically for the first time for the research project and gives the first-hand information. Data were collected during the manufacturing process of the finished product ‘paper’ at the two companies SPB and TNPL.

4.3 DATA ANALYSIS

According to Coorley (1978), the main goal of “the statistical techniques are to assist in establishing the plausibility of the theoretical model and to estimate the extent to which the various explanatory factors seem to be influencing the dependent variable” (p.13). The primary purpose of this research study was to see the feasibility of applying statistical quality control techniques in paper industry. In order to achieve this objective, this thesis used two different statistical software tools, Minitab v.17 and Statistical Package for Social Sciences (SPSS v.22) for analysing the data. These softwares are widely accepted and used by researchers in different disciplines. The MS-Excel 2007 was also used to make manual calculations and draw control charts.

4.3.1 Tools Used

Statistical Quality Control is the use of statistical techniques to analyze a process in order to monitor, control, and improve it. The objective is to have a stable, consistent process that produces the fewest defects possible. This is achieved through the use of Control charts and Capability analysis. Control charts track process statistics over time to detect the presence of special causes variation; Capability analysis determine if the
process is capable; that is, meeting specification limits and producing good parts.

The central idea of statistical process control is to control variation so as to avoid product defects. There are two kinds of variation in any process: common causes and special causes. Common causes refer to occurrences that contribute to the natural variation in any process. Special causes are unusual occurrences that are not normally (or intentionally) part of the process. While some degree of common cause variation will naturally occur in any process, it's important to identify and attempt to eliminate special causes of variation. Control charts are capable of bringing out the presence of special (assignable) causes of variation. Several basic control chart techniques like X-Bar, R and S charts are deployed along with cumulative sum charts (Cusum), exponential moving average charts (EMWA) and Multivariate charts are used to assess the paper manufacturing process is in control.

4.4 CONCLUSION

The aim of this chapter was to discuss and choose the appropriate methodology and to discuss statistical techniques used in this study. This study adopted the empirical approach, as it was consistent with the topic. In addition, time-based quantitative measurement approach was employed to collect the data. This thesis used two different statistical software tools, Minitab v.17 and Statistical Package for Social Sciences (SPSS v.22) was used for analyzing the data. These software are widely accepted and used by researchers in different disciplines.