STATISTICAL PROCESS CONTROL

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ABSTRACT

The quality development concepts have seen a great growth over the entire 20th century. To help an organization to survive in the world class market, Total Quality Management technique was introduced. TQM is a continuous development process developed to satisfy the customers by meeting their expectations. Statistical Process Control is one of the TQM methods that improves quality and reduces variation. The seven basic Quality Control tools help to eliminate the randomness in a process, to develop an effective method to analyze and a systematic way of thinking and problem solving. The present paper illuminates the concepts of the seven basic quality control tools - pareto diagram, process flow chart, cause and effect diagram, check sheet, histogram, scatter diagram and control chart. This paper covers the need of each tool, steps to construct them, their use and advantages.

KEYWORDS
Seven Quality Control Tools, Statistical Process Control, Total Quality management.

INTRODUCTION

Total Quality Management is a customer oriented philosophy which is centered on quality to result in customer delight. The TQM philosophy was evolved in Japan when they concentrated on customer satisfaction and were working to meet their needs. The need for TQM was felt due to the unprecedented need for goods. Quality plays an important role. The definition of quality as defined by ISO 9000 is "The totality of features and characteristics of a product or service, that bear on its ability to satisfy a given or implied need". The quality has many dimensions which are the various features of a product or service".

The process employed to develop a process plays a crucial role in determining the quality of the product or service. For best quality, every organization should nurture a standard, organized procedure (Ref 4). The best proposed tool for better quality product is Statistical Process Control (SPC). SPC tools are required to control and improve the process. SPC is useful in identifying the reasons for quality problems and reducing variability in product output, in making delivery, in maintenance, in equipment use etc. (Ref 1). According to H.G.Wells, "Statistical thinking will one day be as necessary for effective citizenship as the ability to read and write". The goals of SPC are collection of data, finding out variations, analyzing through brainstorming, finding out the causes and effects, continuous improvement (Ref 4).These quality control techniques were first introduced to the workers in Japan by Dr. Kaoru Ishikawa in 1968. He has mentioned the benefits of these techniques in his book "Guide to Quality Control" published in 1971(Ref 1).There are seven tools which controls and improves the process. These tools can be classified into three categories as follows:

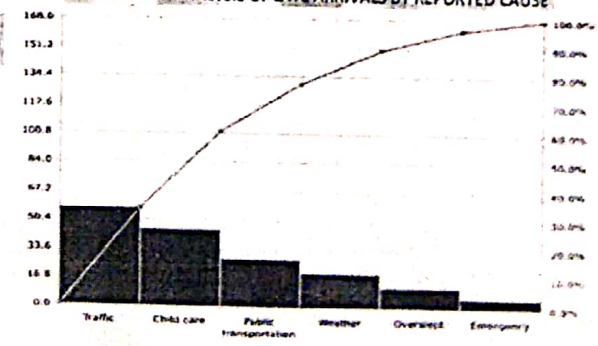
IDENTIFYING TOOLS: Flow chart and Check sheet are used to identify and quantify the problems existed.
PRIORITIZING TOOLS: Histogram and Pareto charts are used to organize, understand, interpret and present the collected data
ANALYSING TOOLS: Cause and effect diagram, Scatter diagram and Control charts are used to examine the causes for problems and suggests corrective actions.

PARETO DIAGRAM

To sort out the unequal distribution of wealth in Europe, Alfredo Pareto invented this chart. He has discovered the universal law called "80-20 law" which states that 80 percent of anything is attributed to 20 percent of its causes (Ref 1). The pareto diagram is chart that ranks data classification in descending order from left to right.The steps involve in its construction are as follows :

1. Specify the goals and collect the required data.
2. Calculate the frequency distribution.
3. Rank the categories and calculate the cumulative distribution.
4. Draw the bars and cumulative curve.

FIG1. PARETO ANALYSIS OF LATE ARRIVALS BY REPORTED CAUSE



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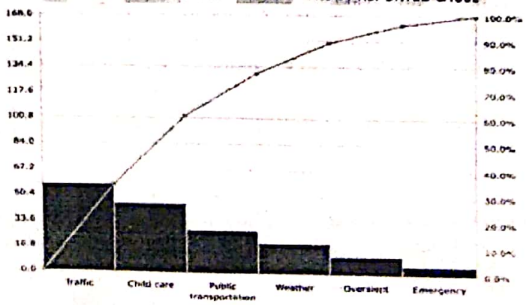


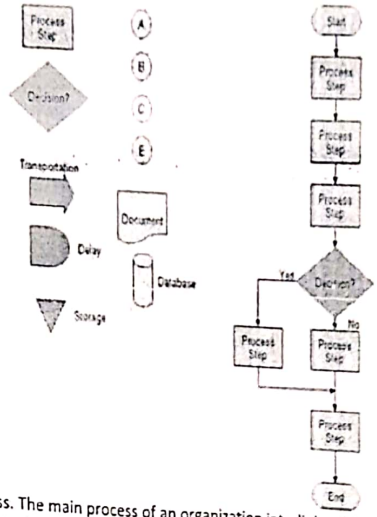
in X-axis, we plot the different categories of defects and in their Y-axis, the percentage of their total (Ref 4) The data classification can be field failures, problems, causes and non-conformities. The aim of this diagram is to highlight the problem which should be examined first. The use of pareto analysis is a endless process since it is used to measure the progress of corrective action (Ref 2).It also helps to improve the safety, reduce wastage, preserve energy, reduce cost etc by analyzing problems by different groupings of data and by analyzing before and after impact of changes(Ref 1)

PROCESS FLOW CHART

A process chart records the sequence of operations connected with the process graphically or diagrammatically. As a prerequisite for ISO 9000 certification, process flow charts are insisted upon and the organisations are asked to document the process. The changes should be regularly updated and the chart should made available in the shop floor. This is mainly done to let the employees know the complete process which will ensure increased productivity (Ref 1). The steps involved in forming this chart are as follows:

1. Define the process.
2. List the steps involved.
3. Draw the steps with different shapes and arrows.
4. Analyse the chart.

FIG2. OUTLINE OF A PROCESS FLOW CHART



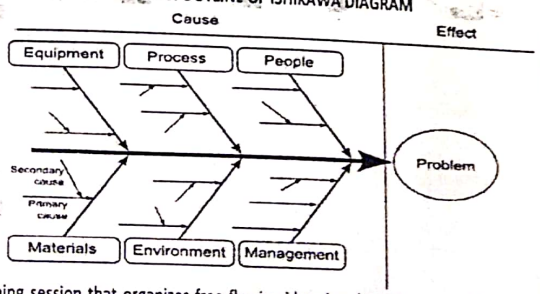
The chart helps in easy understanding of the process. The main process of an organization interlinks all the sub process being carried out. This helps not only the employees but also the quality system auditors (Ref 4).The undesirable expenses like backtracking, traffic congestion can be minimized by this recording technique. This is the simplest of all the available tools (Ref 2).It helps to identify quality problem as well as productivity improvement. This improves the communication between departments. It motivates the employees and helps to develop the internal supplier-customer relationship.

CAUSE AND EFFECT DIAGRAM

The "Ishikawa or Fishbone diagram" is a systematic way of listing down all the possible causes of a quality effect. It assists the generation of ideas for problem caused and serves as a basis for solution finding. The effect is represented in a box with a horizontal line. The main causes are presented by slanting arrows towards the horizontal line and the sub causes are represents by horizontal lines touching the relevant main cause arrow (Ref 3). The steps for constructing this diagram are:

1. Specify the effect and list the causes.
2. Construct the diagram frame work.
3. Write the principle and sub causes.

FIG3. OUTLINE OF ISHIKAWA DIAGRAM



This diagram is a picture of brain storming session that organizes free flowing ideas in a logical manner. It is used analyse any quality problem (Ref 2).It can eliminate undesirable conditions in a process and standardizes the existing operations. It is also useful to educate and train the personnel in right way (Ref 5).

CHECK SHEET

Check sheets are systematic way of collecting data. It helps in getting quick review of the process (Ref 4). It gives the user a place to start and provides the steps to be followed in collecting the data. The form of check sheet is individual for each situation and is designed by project team. Creativity plays a major role and should be user friendly and should include information on date and time (Ref 4). The construction of check sheets involves the following steps:

1. Identify the problem area and different types of defects.
2. Design the form and schedule for collecting data.

3. Collect and summarize the data
4. Analyse the check sheet.

FIG4. CHECK SHEET OF REWORKED JOBS

Dept	Weeks								
	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	Total
11		I		II		I			4
66	I		I		II		II	I	7
55	III	I	II	II	I	III	II	IIII	20
22	I	II		III	II		I	I	10
Others			I		I		II		4

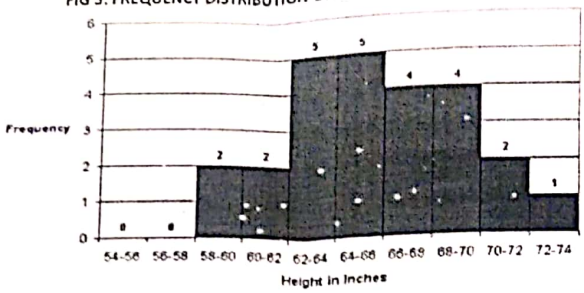
Check sheets can be formulated at all stages of production. This helps to collect data at all situations. They can be used to picture the location of product, frequency of defect occurrences, to find the cause of problem. This method gives visible results, immediate inference and corrective actions (Ref 4).

HISTOGRAM

The first statistical SPC technique is the histogram, These are powerful tools that used for elementary analysis of data with variation (Ref 2). It is a bar graph with the range of resistance values measured to be plotted in X-axis and the frequency of occurrence of the range in Y-axis (Ref 4). The aim is to keep up a minimum variation with maximum net value and minimum tolerance limit. The construction of histogram is very easy but the interpretation is very difficult. The steps involved in construction of histogram include:

1. Measure and record data pertaining to a process.
2. Arrange the values in ascending order.
3. Divide the range into intervals.
4. Plot the X and Y axes and the column graph

FIG 5: FREQUENCY DISTRIBUTION OF HEIGHT OF 25 STUDENTS



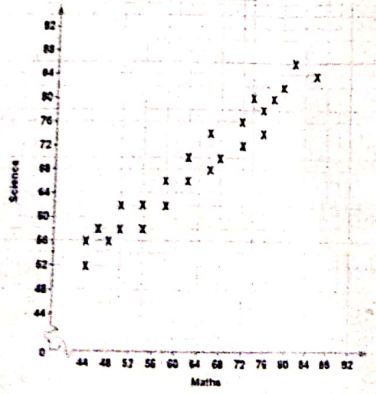
Histograms can give sufficient information about a quality problem to provide a basis for decision making without further analysis. They can determine the process capability, compare with specifications, suggest the shape of population and indicate gap in the data (Ref 5). Different shapes of histograms can be obtained which helps in determining the distribution of data observed (Ref 1).

SCATTER DIAGRAM

The scatter diagram helps to find out the relationship between two factors. With the help of independent variable, the dependent variables can be controlled. It is used in explaining the behavior of process and the means of controlling it (Ref 2). This basically shows the pattern of relationship between two variables. In X-axis, we plot the variable and in Y-axis, the effect of the variable. They can be used for real time applications. The steps to construct the scatter diagram involve:

1. Identify the dependent and independent variable.
2. Set up a appropriate recording sheet and collect the required data.
3. Plot the points on scatter diagram.

FIG6. SAMPLE SCATTER DIAGRAM



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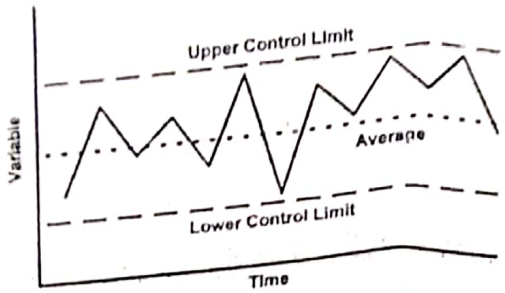
...to easily understand the results mathematically for any situation. It is useful to find relationship between data which cannot be represented in terms of ... Despite being a useful tool, it can be easily misrepresented (Ref 4) When all plotted points lie on a straight line, this gives a perfect correlation which rarely occur.

CONTROL CHARTS

The control chart is used to graphically compare the process performance data with control live limit. The control chart has three lines. The central line is the target line, while the other two lines represent the upper and the lower limits. The main purpose is to find out whether the plotted points are normal or abnormal. The control lines are not the specification limits but the previous stable performance of the process. The main objectives of control chart are:

1. to detect the marked causes for process shifts
2. to investigate the process being adopted for manufacturing.
3. to determine whether a process can meet certain specifications.
4. to reduce the inspection costs

FIG 7: SAMPLE CONTROL CHARTS



The process is monitored at regular intervals and the desired characteristics are measured and plotted in the graph. This chart increases the productivity, gives quality assurance, shows pattern variability, reduces rework, improves co-operation. They can only detect assignable causes and cannot judge random process variations.

With all these tools, the benefits will only come when it is used correctly and when the information it produces is acted upon. These seven techniques are mainly aimed to increase the quality along with productivity. They are applicable to any type of organization. These tools are mainly based on statistics which has been widely used by the Japanese quality gurus to run a qualified nation.

REFERENCES

1. Total Quality Management (for B.B.A, B.B.M, M.Com and M.B.A Courses) By Prof. P.Saravanavel and S.Balakumar
2. Total Quality Management By Prof S .Bhaskar, Asst. Professor, Department of Mechanical Engineering,Kumaraguru College Of Technology,Coimbatore.
3. Total Quality Management Practising Manager By Dr. Rajesh Kumar Shukla, Ex. Joint Manager, Council Member at Quality Circle Forum Of India.
4. Total Quality Management By Subburaj Ramasamy, Senior Director, Deparhnt of Information Technology, Chennai
5. Total Quality Management, Third edition, By Dale. H.Besterfield, Carol Besterfield-Michna, Glen H.Besterfield, Mary Besterfield

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