The International Journal's
Research Journal of Science & IT Management
ISSN:2251-1563

Statistical Quality Control Techniques Used in the Manufacturing Industry

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Abstract

The way in which businesses compete is rapidly changing. Businesses must constantly strive to offer "better" products and services than their competitors. Most of the Indian Companies on the whole need to improve the quality of their products in order to be a player in the global market. Managers must decide how to overcome the many problems that prevent quality products and services. One of the aims of this study is to know and also to establish whether managers in the Manufacturing industries are aware of the uses of statistics in decision making. In this study, it was found that most of the quality managers either do not use statistical quality control techniques or use them hardly ever. It was established that the majority of the respondents do not use statistical quality control charts. The above facts indicate the need for the awareness of the uses of statistical quality control techniques and charts to improve the quality of products and services.

Keywords: Decision, Statistics quality control charts, services.

1. STATISTICAL QUALITY CONTROL:

Statistical Quality Control (SQC) is a scientific method to analyze manufacturing data. Based on this analysis, measures are taken to maintain the quality of the manufactured product. A control chart is the tool used to monitor the variation in a process and ensure that the process is in a state of control. This allows the operator to monitor the trends occurring in the process. The control chart reflects the specification limits, namely, the Upper Specification Limit (USL) and the Lower Specification Limit (LSL). In addition, it has upper and lower control limits that lie within the specification limits. The Upper Control Limit (UCL) and the Lower Control Limit (LCL) are determined by evaluating the dispersion (variability) in process, see Fig. 1. In a well-controlled process, these limits can be chosen to be equal to $\mu \pm 3\sigma$ respectively, where σ is the process standard deviation and μ is the process mean. These statistical limits are normally called the .3 sigma control limits.. In a normal (Gaussian) distribution, 99.73% of the values measured lie in interval of width 6σ.

2. QUALITY CONTROL TOOLS:

Statistical process control aims to produce the products in the most economic and useful way by using statistical principles and techniques at every stage of the production. In this manner, statistical process control aims faithfulness to the standards, provides the fitness of the specifications that have been determined earlier. It is used to reduce the defected products as much as possible. Statistical process control is powerful collection of problem-solving tools useful in achieving process stability and improving capability through the reduction of variability. The company had used some of the "seven basic quality control tools" in their problem solving technique. The seven quality tools are (Ishikawa, K. 1985). These tools, often called magnificent seven are;

• Check Sheet • Pareto Chart • Histogram • Scatter Diagram • Process Flow Chart
• Cause and Effect Diagram or Fish Bone Diagram • Control Chart

The control chart is perhaps the most widely used of the "seven basic quality control tools". It is the key tools in statistical quality control (SQC) because it displays process behavior graphically and it is used to monitor and control processes within the specified control limits. There are two basic types of

control chart, depending on the type of data collected; namely variable control chart and attribute control chart. Variable control chart are designed to control product characteristics and process parameters which are measured in continuous scale. The primary variable control chart used are the X-bar and R chart and moving range chart, while the other two, rarely used charts include X-bar and s chart and median chart.

Attribute control charts are designed to control the process. Measurements used are in terms of good or bad, accept or reject, go/no-go, or pass or fail criteria (e.g. conforming or nonconforming) The distinction between nonconforming or defective unit and nonconformities or defects is very important in attribute control chart because t will determine the selection in the type of attribute control chart used. A nonconforming or defective unit, however, may fail to meet the assessment criteria because of one or more nonconformities or defects exist. For attribute data, there are: p chart, np chart, c chart and u chart. The p and np charts are the most widely used. They are primarily used to monitor the fraction of nonconforming unit, while, the c and u charts are used to monitor the number of nonconformities or defects.

3. Research Methodology:

The aims of the study" Do Managers Make Decisions using Statistics?" are to determine:

- In the manufacturing industry aware of the uses of statistics in decision making?
- What are the common statistical process control techniques and charts used by managers in the Manufacturing industry

Is there a need for statistical consultants in the manufacturing industry A questionnaire was designed by the researcher to meet the aims of the study. The target population was quality managers in the Manufacturing Industry. There were more than 25 company names on these lists from this in nearly about Ninety questionnaires were sent out, of which, 41 (55% response rate) were returned. The questionnaire was constructed using Likert Scales and the data was captured on Excel 5.0 and processed using SPSS.

4. Some Results are Drawn Based on Study:

Because the method of Likert Scale was used in the design of the questionnaires in this study, indicated that:

- Only 63% of the quality managers made decisions using statistical techniques.
- Only 32% of the respondents use statistical process control charts .

  This indicates that very few quality control managers use statistical process control techniques to control the variability of their products. As statistical process control techniques are used to improve the quality of products, it is essential that many more quality managers are aware of the uses of statistical process control techniques. Quality managers need to be made aware of the fact, that by using information based on statistical process control, companies are able to reduce or eliminate nonconforming products, and this leads to reduced manufacturing costs, increased customer satisfaction, tighter specification limits and hence, improved product claims.

Statistical quality Control Technique	Percentage (%)
Check Sheets	50.5
Sampling Techniques	48.2
Statistical quality Control Charts	32.1
Capability Analysis	10.7

Surprisingly, only (9.3%) use Shewhart Control Charts or Process Behavior Charts yet, this chart is known to be the easiest and most widely used chart. This could mean that very few quality managers are aware of these charts, yet, the charts control the variability of a product, and thus help to improve the quality of the product

Statistical Quality Control Technique	Percentage (%)
Cumulative sum control (CUSUM) Chart	32.5
Process Behavior Chart (Shewhart control Chart)	15.3
Exponentially weighted Moving average(EMWA)	5.0
Nonparametric Control Chart	0.2

- The correlation coefficient (0.926) for the level of statistical knowledge and frequency of using statistical process control techniques indicates that the higher the level of statistical knowledge, the more frequently statistical process control techniques were used. Hence, if it is desired that quality managers use statistical process control techniques more often, then there is a need to increase their level of statistical knowledge.
- The correlation coefficient of 0.59 indicates that the higher the respondents statistical knowledge, the higher the rating on "statistical quality is important for producing a quality product". Hence, there is again an indication that, the belief that "statistical quality is important for producing a quality product" depends on the level of the statistical knowledge of the quality manager. There seems to be a need to increase the level of statistical knowledge of quality managers so that their belief that "statistical quality is important for producing a quality product" is increased.
- A significant correlation exists between the use of statistics for decision-making and the frequency of using statistical process control techniques. In fact, a correlation coefficient of 0.987, indicates that there is a strong relationship between the use of statistics for decision making and the frequency of using statistical process control techniques. Again, if it is desired to increase the frequency of using statistical process control techniques, quality managers would have to be made aware of the uses of statistics in decision making.
- A significant correlation exists between the use of statistics in decision-making and the level of statistical knowledge. A correlation coefficient of 0.854 indicates a strong relationship between the use of statistics in decision-making and the level of statistical knowledge. It does make sense too that as the use of statistics in decision making increases, so does the level of statistical knowledge increase

5. Recommendations:

The focus of this study was firstly, to determine whether managers have statistical knowledge and whether they use statistical quality control techniques in order to improve the quality of their products and services. This is seen as important by the researcher, as statistical quality control techniques and charts, help in determining whether the quality of the manufacturing is satisfactory. It also ensures uniformity of the quality of products manufactured, thus, making it possible to produce according to specific standards.

Secondly, the researcher was also interested in establishing whether the quality control managers in the Manufacturing Industry use statistical quality control charts. The researcher believes that the charts are useful for monitoring a process and they provide a means for communicating information about the performance of a process.

Thirdly, the researcher wanted to establish whether there was a need for statistical consultancy in the manufacturing Industry. This would be based on the number of respondents who do not use statistical

control techniques and charts. In other words, if too few respondents use these, this would support the motivation for the need of statistical consultants in the Manufacturing Industry

Every business everywhere is staffed with imperfect human beings and exists by providing a product or service to other imperfect human beings. Organizations must constantly strive to offer "better" products and services than their competitors. With increasing choice, customers are able to favor organizations, which deliver "quality" products and services. It is thus of great concern that manufacturers improve the quality of their products and services if they want to remain in business.

Hence it is recommended that manufacturing industry should be made aware of the uses of statistics in decision making and be made aware of the uses of statistical quality control techniques and charts. It is hoped that if more quality control managers are aware of the uses of statistics in decision-making and the uses of statistical quality control techniques and charts, more quality control managers will use statistics in decision making and more will use statistical quality control techniques and charts, and hence, the quality of products and services will be improved .

6.Conclusion:

Only few of the quality managers use statistical quality control techniques or charts to monitor and improve the quality of their products and services. It could be possible that the quality control managers are not aware of the uses of statistical process control techniques or charts, as only 63% of the respondents indicated that they use statistical process control techniques and only 32% indicated that they use statistical process control charts. The need for the awareness of the uses of statistical quality control techniques and charts. In order to compete effectively with other companies, managers need to make decisions based on data. Just over 50% of managers use statistics in decision-making, this indicates the need for the awareness of the uses of statistics. It gives remedy for statisticians to make managers in the manufacturing industry and other industries aware of the uses of statistics in decision-making.

It was also found that the higher the respondents' statistical knowledge, the more frequently statistical quality control techniques are used. It may be concluded that if managers' statistical knowledge is improved, they would use statistical process control techniques more frequently and this would increase the number of managers making sound decisions in the assessment of the quality of their products. The quality of these managers' products would improve and their companies would be able to compete effectively in the global market.

A significant correlation existed between statistical knowledge and the use of statistics in decision-making. It does make sense that as the level of statistical knowledge increases so too does the use of statistics in decision-making. It is thus absolutely necessary for statisticians to help managers improve their level of statistical knowledge so that they use statistics more often when making decisions. This would result in managers making better decisions and this would improve the Indian economy.

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