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A Review on Quality Management Using 7 QC Tools

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Abstract: *Dr. Kaoru Ishikawa was the first person associated with Total Quality Management (TQM) and the development and advocacy of using the seven quality control (QC) tools in the organizations for problem solving and process improvements. Seven old quality control tools are a set of the QC tools that can be used for improving the performance of the production processes, from the first step of producing a product or service to the last stage of production. Today's competitive environment has, lower manufacturing cost, more productivity in less time, high quality product, defect free operation are required to follow to every foundry man. So, the general purpose of this paper is to introduce these 7 QC tools. This study found that these tools have significant roles to monitor, obtain and analyze data in order to facilitate the achievement of performance excellence in the organizations.*

Keywords– *Manufacturing, Productivity, Profitability, Seven QC Tools, Total Quality Management.*

I. INTRODUCTION

The 7 QC Tools are simple statistical tools used for problem solving. The first guru who proposed seven basic tools was Dr. Kaoru Ishikawa in 1968, by publishing a book entitled "Gemba no QC Shuho" that was concerned managing quality through techniques and practices for Japanese firms. It was intended to be applied for "self-study, training of employees by foremen or in QC reading groups in Japan. It is in this book that the seven basic quality control tools were first proposed. These tools have been the foundation of Japan's astonishing industrial resurgence after the Second World War. For solving quality problems seven QC tools used are Pareto Diagram, Cause & Effect Diagram, Histogram, Control Charts, Scatter Diagrams, Graphs and Check Sheets. All this tools are important tools used widely at manufacturing field to monitor the overall operation and continuous process improvement. This tools are used to find out root causes and eliminates them , thus the manufacturing process can be improved. The modes of defects on production line are investigated through direct observation on the Production line and statistical tools.

II. THE 7 QC TOOLS

2.1 Pareto Diagram

It is introduced by an Italian economist, named Vilfredo Pareto, who worked with income and other unequal distributions in 19th century, he noticed that 80% of the wealth was owned by only 20% of the population. later, Pareto principle was developed by Juran in 1950. A Pareto chart is a special type of histogram that can easily be apply to find and prioritize quality problems, conditions, or their causes of in the organization. On the other hand, it is a type of bar chart that shows the relative importance of variables, prioritized in descending order from left to right side of the chart. The aim of Pareto chart is to figure out the different kind of "nonconformity" from data figures, maintenance data, repair data, parts scrap rates, or other sources. It is a tool that arranges items in the order of the magnitude of their contribution, thereby identifying a few items exerting maximum influence. This tool is used in SPC and quality improvement for prioritizing projects for improvement, prioritizing setting up of corrective action teams to solve problems, identifying products on which most complaints are received, identifying the nature of complaints occurring most often, identifying most frequent causes for rejections or for other similar purposes. Dr.Juran suggested the use of this principle to quality control for separating the "vital few" problems from the "trivial many" now called the "useful many".

2.2 Cause and Effect Diagram

Kaoru Ishikawa is considered by many researchers to be the founder and first promoter of the 'Fishbone' diagram (or Cause-and-Effect Diagram) for root cause analysis and the concept of Quality Control (QC) circles. Cause and effect diagram was developed by Dr. Kaoru Ishikawa in 1943. It has also two other names that are Ishikawa diagram and fishbone because the shape of the diagram looks like the skeleton of a fish to identify quality problems based on their degree of importance. The cause and effect diagram is a problem-solving tool that investigates and analyzes systematically all the potential or real causes that result in a single effect. On the other hand, it is an efficient tool that equips the organization's management to explore for the possible causes of a problem. This diagram can provide the problem-solving efforts by "gathering and organizing the possible causes, reaching a common understanding of the problem, exposing gaps in existing knowledge, ranking the most probable causes, and studying each cause".

2.3 Histogram

Histograms or Frequency Distribution Diagrams are bar charts showing the distribution pattern of observations grouped in convenient class intervals and arranged in order of magnitude. Histograms are useful in studying patterns of distribution and in drawing conclusions about the process based on the pattern. It is a type of bar chart that visualizes both attribute and variable data of a product or process, also assists users to show the distribution of data and the amount of variation within a process. It displays the different measures of central tendency (mean, mode, and average). It should be designed properly for those working into the operation process can easily utilize and understand them. Also, a histogram can be applied to investigate and identify the underlying distribution of the variable being explored.

2.4 Control charts

Control chart or Shewhart control chart was introduced and developed by Walter A. Shewhart in the 1920s at the Bell Telephone Laboratories, and is likely the most "technically sophisticated" for quality management. Control charts is a special form of "run chart that it illustrates the amount and nature of variation in the process over time". Also, it can draw and describe what has been happening in the process. Variability is inherent in all manufacturing processes. These variations may be due to two causes: Random / Chance causes (un-preventable) and Assignable causes (preventable). These charts separate out assignable causes. Control chart makes possible the diagnosis and correction of many productions troubles and brings substantial improvements in the quality of the products and reduction of spoilage and rework. It tells us when to leave a process alone as well as when to take action to correct trouble.

2.5 Scatter Diagram

Scatter diagram is a powerful tool to draw the distribution of information in two dimensions, which helps to detect and analyze a pattern relationships between two quality and compliance variables (as an independent variable and a dependent variable), and understanding if there is a relationship between them, so what kind of the relationship is (Weak or strong and positive or negative). A tool to study the relationship between two variables is known as Scatter Diagram. The shape of the scatter diagram often shows the degree and direction of relationship between two variables, and the correlation may reveal the causes of a problem. Scatter diagrams are very useful in regression modelling. The scatter diagram can indicate that there is which one of these following correlation between two variables: a) Positive correlation; b) Negative correlation, and c) No correlation.

2.6 Graphs

Graphs of various types are used for pictorial representation of data. Pictorial representation enables the user or viewer to quickly grasp the meaning of the data. Different graphical representations of data are chosen depending on the purpose of the analysis and preference of the audience. The different types of graphs used are as given below: 1. Bar Graph -To compare sizes of data 2. Line Graph- To represent changes of data 3. Gantt chart -To plan and schedule 4. Radar chart -To represent changes in data (before and after) 5. Band Graph -Same as above.

2.7 Check sheets

Check sheets are simple forms with certain formats that can aid the user to record data in an firm systematically. Data are "collected and tabulated" on the check sheet to record the frequency of specific events during a data collection period. They prepare a "consistent, effective, and economical approach" that can be applied in the auditing of quality assurance for reviewing and to follow the steps in a particular process. Also, they help the user to arrange the data for the utilization later. The main advantages of check sheets are to be very easily to apply and understand, and it can make a clear picture of the situation and condition of the organization.

They are efficient and powerful tools to identify frequently problems, but they don't have effective ability to analyze the quality problem into the workplace.

III. LITERATURE REVIEW

The literature survey consists of five papers which explain the flexibility of different Quality tools and its scope. Here, in survey I am going to review on different Quality tools which are used in small scale industries. The importance of QC tools is explained by various authors in this survey.

Shraddha Arya , Manish Bhargava , MP Singh [1] In this paper a review of systematic use of 7 QC tools for improving the quality of deep groove ball bearing is presented. QC tools are the means for Collecting data, analyzing data, identifying root causes and measuring the results. Quality Control tools are related to numerical data processing techniques. All of these tools together can deliver prodigious process chasing and analysis that can be very helpful for quality developments. These tools make quality improvements easier to see, implement and track, using 7 QC in mini tab, graphs can be easily calculated with dimension.

Nikunjkumar A. Parmar and Shubham Awasthi [2] presented a brief study and his understanding about Quality and Productivity improvement. In his paper he stated that Today's competitive environment has, lower manufacturing cost, more productivity in less time, high quality product, defect free operation are required to follow to every foundry man. For the improvement of products quality there are diff-diff quality tools used in various review papers. Here I am going to review on these papers and identify the different way of uses of those tools in manufacturing industries to increase the quality of the product. There are so many defects in the manufacturing process and these defects directly affects on productivity, profitability and quality level of organization. His study is aimed to review the research work made by several researcher and attempt to get technical solution for the various defects and to improve the entire process of the manufacturing.

Behnam Neyestani [3], stated that Dr. Kaoru Ishikawa was first total quality management guru, who has been associated with the development and advocacy of using the seven quality control (QC) tools in the organizations for problem solving and process improvements. Seven old quality control tools are a set of the QC tools that can be used for improving the performance of the production processes, from the first step of producing a product or service to the last stage of production. So, the general purpose of this paper was to introduce these 7 QC tools. This study found that these tools have the significant roles to monitor, obtain, analyze data for detecting and solving the problems of production processes, in order to facilitate the achievement of performance excellence in the organizations.

Deepak , Dheeraj Dhingra [4] states that Quality plays very important role in today's highly competitive industrial environment. Quality leads to an improvement in the productivity. By improving quality, the method of optimization reduces process operational cost and variations in product. Quality control (QC) tools are used to solve more than 90 percent of the problems faced by the organizations for improving its effectiveness and meeting or exceeding the customer expectation on a continuous basis. The success of the quality control procedure depends greatly on method of data collection and its accuracy. The Present study is aimed toward reducing the rejection of Bicycle rims by application of Quality Control (QC) Tools.

Shyam H. Bambharoliya and Hemant R. Thakkar [5] reviews some selected factors to reducing rejection rate in small scale machining unit using 7 Quality Control Tools. This paper aims to identify the problems related to different products and probable solutions based on that problem. Use of 7 QC Tools is best way to reduce rejection and defect of product after analysing of manufacturing process. Another advantage is increasing customer satisfaction by use of 7 QC Tools in today competitive market. Based on application of these tools will increase the level of standard products which they required as vision of an organization. After reviewing all research papers different defects are observed by application of 7 QC tools and individual solution is given with probable root causes. After studying all problems related to each research papers individual solutions are provided as per requirement based on that problems effect on production is changed as increase in productivity or reduction of rejection rats.

Sanjeev Kadian, Randeep Singh and Ashok Kumar Malik [6] present the influence of using Lean Manufacturing Technology to increase the production in scientific equipment's manufacturing industry in this paper. In this case study the scientific equipment's manufacturing company employs part of the "seven basic quality control (QC) tools" to significantly improved the process rejection and rework. By implementing these quality tools as the problem solving techniques the rejection rate was reduced from 7.3% to 4% and Rework rate from 20% to 11.33%.the competitive business in the scientific market has enhanced the company in this study to provide lower cost quality product. Quality improvement program had been designed and been implemented to increase the potential of profit. By improving the quality, it is also mean to improve the productivity and lower the rejection rate. The key of quality improvement of this company is not only focusing an external customer but its internal customer. The purpose of this study is to improve the quality of circular 15x lenses used in scientific equipment's. the objective of this study is to reduce the rework rate from 20% to 11.33% and rejection rate from

7.3% to 4%. An improvement action plan had been set up, then the data had been collected for the 4 weeks from 10 lots and re-examine the rework and rejection results. The rework has reduced to 11.33% from 20% and rejection has reduced 4% from 7.3%. from the analysis he find that after removing the various root cause of rejection and rework, the rejection of lenses is reduced by 45.20% and rework of lenses is reduced by 43.35%. this also have a positive effect on the productivity of the lenses as the start of this project the productivity of lens was noted as:(278/300)x100=92.6%.As after the implementation, the productivity was noted as : (288/300)x100=96%. It was noted that even a simple QC tools can make significant improvement to the company.

Varsha M. Magar and Dr. Vilas B. Shinde [7] in their paper, a review of systematic use of 7 QC tools is presented. The main aim of this paper is to provide an easy introduction of 7 QC tools and to improve the quality level of manufacturing processes by applying it.QC tools are the means for Collecting data , analyzing data , identifying root causes and measuring the results. these tools are related to numerical data processing.All of these tools together can provide great process tracking and analysis that can be very helpful for quality improvements. These tools make quality improvements easier to see, implement and track.

Shantanu Welekar, Shantanu Kulkarni and Arun Kedar [8] in their paper, "Quality Circle to improve Productivity", deals with various aspects of Quality Circle and how improvement can be made by adopting practices of Quality Circle in chemical industries. The paper also presents a comparative discussion of various features of Quality Circle, Quality Improvement Group and work Group/project team. The paper describes a case study of QC concept in a chemical industry which illustrates the effectiveness of QC approach. Here Alka industry manufactures anodizing of aluminum products and powder coating of GI and CI sheets. In Alka industry Implementation of Quality Circle led to identification of excessive gas consumption in the furnaces due to reasons attributed to deficiency in man, material, method and machine. Each deficiency was handled separately and corrective measures are implemented to optimize the gas Consumption in the plant. Quality Circle technique proved to be very effective for the problem selected by the quality circle members for the powder coating industry. Optimization of gas consumption in the furnaces led to reduction in maintenance costs, enhancement in reliability and availability of the equipment, enhancement in morale and development of a sense of team dynamics among the employees, which proved to be beneficial to the employees and the organization as a whole.

Pratik J. Patel, Sanjay C. Shah, Sanjay Makwana [9] this paper aims to improve the quality level by finding out the root causes of the quality related problems. Quality control tools are important tools used widely at manufacturing field to monitor the overall operation and continuous process improvement. Check Sheet, Pareto Diagram, Histogram, Cause-and-effect diagram, Control Chart, Run-Chart and Scatter-Diagram are used in enhancing the process by continuous monitoring through quality tools. The Quality Control tools are used to find the root Causes and eliminate them, thus manufacturing processes can be improved.

David R. Bamford and Richard W. Greatbanks [10] This paper describes the use and application of a structured approach to the basic implementation of quality management tools and techniques such as the QC7 tools. A methodology based around the application of a structured approach to the use of basic quality management tools is adopted, and provides a simple yet powerful means by which the steps of problem solving can be sequentially linked together. Everyday process examples are used to highlight the benefits of such tools and techniques in contributing to a greater understanding of the process by the process operator or owner. It is not suggested the examples detailed are thoroughly scientific in methodology but they do serve to illustrate that by applying the tools in a systematic manner, even the simplest of processes can be understood in greater detail.

Table 1. Analysis of Literature Review

Author Name	Year	Title	Objective	Finding and observation
Shraddha Arya , Manish Bhargava , MP Singh	2019	Case Study on quality control tools for Bearing industries	Systematic use of 7 QC tools for improving the quality of deep groove ball bearing	To keep uniformity and consistency of the process and to find the defects.
Nikunjkumar A. Parmar and Shubham Awasthi	2018	Review on Quality Management using 7 QC tools	Brief study on Quality and Productivity improvement	Rework and rejection rate can be reduced using 7 Quality control tools which improves both productivity and profitability of the organization.
Behnam Neyestani	2017	Seven Basic Tools of Quality Control: The Appropriate Quality	To introduce 7 QC tools	These tools have the significant roles to monitor, obtain, analyze data for detecting and solving the problems of production processes, in order to facilitate the

		Techniques for Solving Quality Problems in the Organizations		achievement of performance excellence in the organizations
Deepak , Dheeraj Dhingra	2016	Application of quality control tools in a bicycle industry: a case study	It is aimed toward reducing the rejection of Bicycle rims by application of Quality Control (QC) Tools.	It has been found that monthly defects were reduced to greater extent. The various process parameters such as heating voltage, temperature of heated water, time of chemical coating processes, chemical composition of the material and quality of heated water etc. which have influence of the quality of final product have to be controlled.
Shyam H. Bambharoliya and Hemant R. Thakkar	2015	Reducing Rejection Rate In Small Scale Machining Unit Using 7 Quality Control Tools - A Review	To identify the problems related to different products and probable solutions based on that problem.	Increasing customer satisfaction by use of 7 QC Tools in today competitive market by increasing the level of standard of products.
Sanjeev Kadian, Randeep Singh and Ashok Kumar Malik	2015	Increase Production In Small Scale Industry Of India By Use Of Lean Manufacturing Technology	Using Lean Manufacturing Technology to increase the production in scientific equipment's manufacturing industry	By implementing these quality tools as the problem solving techniques the rejection rate was reduced from 7.3% to 4% and Rework rate from 20% to 11.33%
Varsha M. Magar and Dr. Vilas B. Shinde	2014	Application Of 7 Quality Control (7 Qc) Tools For Continuous Improvement Of Manufacturing Processes	Aim of this paper is to provide an easy introduction of 7 QC tools and to improve the quality level of manufacturing processes by applying it	The work shows continuous use of these tools upgrades the personnel characteristics of the people involved. It enhances their ability to think generate ideas, solve problem and do proper planning. The development of people improves the internal environment of the organization, Which plays a major role in the total Quality Culture.
Shantanu Welekar, Shantanu Kulkarni and Arun Kedar	2014	Quality Circle To Improve Productivity: A Case Study In A Medium Scale Aluminium Coating Industry	Presents a comparative discussion of various features of Quality Circle, Quality Improvement Group and work Group/project team. The paper describes a case study of QC concept in a chemical industry which illustrates the effectiveness of QC approach	Implementation of Quality Circle led to identification of excessive gas consumption in the furnaces due to reasons attributed to deficiency in man, material, method and machine. Each deficiency was handled separately and corrective measures are implemented to optimize the gas Consumption in the plant. Optimization of gas consumption in the furnaces led to reduction in maintenance costs, enhancement in reliability and availability of the equipment.

Pratik J. Patel, Sanjay C. Shah, Sanjay Makwana	2014	Application of Quality Control Tools in Taper Shank Drills Manufacturing Industry: A Case Study	Aim of this paper is to improve the quality level by finding out the root causes of the quality related problems	These basic tools were applied on Company data and analyzed this data and found the Root-causes. On the basis of root causes they are going to make action plan for further improvement.
David R. Bamford and Richard W. Greatbanks	2005	The use of quality management tools and techniques: a study of application in everyday situations	Use and application of a structured approach to the basic implementation of quality management tools and techniques such as the QC7 tools	The wider use of the tools, ideally by the process operatives themselves, tangibly lead to a fuller understanding of specific processes. This will ultimately impact upon their organisation.

IV. CONCLUSION

This study identified that it is very essential to apply all seven QC tools for troubleshooting issues within production processes in the organizations. Doubtlessly, all of the quality tools should be considered and used by management for identifying and solving quality problems during producing the products and services. By reducing rework and rejection rate using 7 Quality control tools we are able to improve the Quality. Reduction in rejection is indirectly improving both productivity and profitability of the organization. 7 Quality control tools have shown more better results in quality improvement as referred many use studies. Thus, the production processes can be affected and improved by multiple factors of these statistical QC tools.

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