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APPLICATION OF 7 QUALITY TOOLS FOR CONTINUOUS IMPROVEMENT OF MANUFACTURING PROCESSES

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Abstract: **In in paper a details and systematic study and uses of old and new 7 QC Tools. The main aim of this paper is to provide an easy introduction and understanding of the basics of old and new 7 QC tools for the improvement of manufacturing processes. Quality tools are the means of collecting data, analysis data, identification of root causes and measuring the results. Old 7 QC tools are related the numerical data processing and new 7 QC tools are related the verbal data. All of these tools together can provide good process tracking and analysis that can be very helpful for quality improvement. These tools make quality improvements easier to see, implement and track.**
It enhances their ability to think, generate ideas, solve problems 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.

Key Word: **QC Tool, PDCA, Continuous improvement, Manufacturing Process, Root cause analysis.**

I. INTRODUCTION

The Old Seven, the First Seven and the Basic Seven quality pros have many names for these seven basics tools of quality, first emphasized by Kaoru Ishikawa, a professor of engineering at Tokyo University and the father of "quality circles." The old 7 QC Tools are simple statistical tools used for problem-solving. These tools were either developed in Japan or introduced to Japan by Quality Gurus such as Deming and Juran. In terms of importance, these are the most useful. Kaoru Ishikawa has stated that these 7 tools can solve 95% of all problems. These tools have been the foundation of Japan's astomishing industrial resurgence after the second world war. For solving quality problems, the old 7 QC tools used are Pareto Diagram, Cause & Effect Diagram, Histogram, Control Charts, Scatter Diagrams, Graphs and Check Sheets. The aim of development of new 7 QC tools to work in conjunction with the original basic 7 QC tools. The new 7 QC tools Affinity Diagrams, Relations Diagrams, Tree Diagrams, Matrix Diagrams, Arrow Diagrams, Process Decision Program Charts, and Matrix Data Analysis are also used for solving the quality problem and improving the manufacturing processes.

II. LITERATURE REVIEW

The Goal of any organization was to eliminate all type of defects and short comings cause any problems to ensure flawless manufacturing process, for this purpose basic seven and new quality tools were implemented.

The following are the basic 7 Quality Tools.

1. Pareto Diagram
2. Cause and effect diagram
3. Histograms
4. Check Sheet
5. Scatter Diagrams
6. Control Charts
7. Flow Charts

Detailing of Basic 7QC Tools

1) Pareto Diagram: - The Pareto Diagram is a useful tool that arranges items according to their contribution's magnitude, enabling us to identify the few items that have the most significant impact. This tool is often used in SPC and quality improvement to prioritize projects, set up corrective action teams, identify the most frequent complaints, and determine the most common causes of rejection. The tool's origin dates back to Italian economist Vilfredo Pareto, who observed that a large portion of wealth

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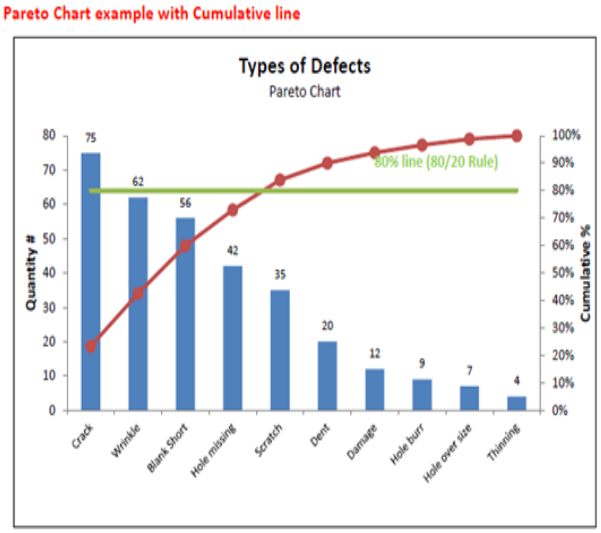
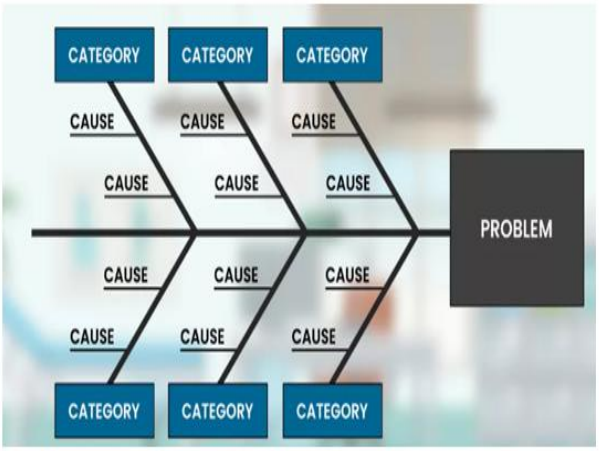
was concentrated in the hands of a few people, a pattern that was common in most fields. The Pareto principle, also known as the 80/20 rule, is used in materials management for ABC analysis, where only 20% of the items purchased by a company account for 80% of the total value. These items are classified as "A" and receive the most attention. Dr. Juran used this principle to separate the "vital few" problems from the "trivial many" which are now called the "useful many."



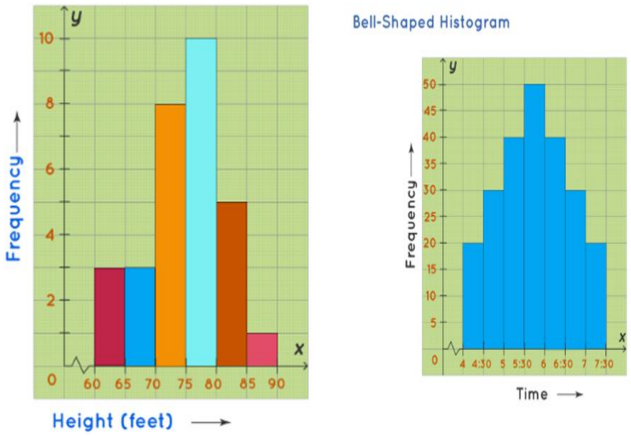
Pareto Chart

2) Cause and effect diagram: -A Cause-and Effect Diagram is a tool that shows systematic relationship between a result or a symptom or an effect and its possible causes. It is an effective tool to systematically generate ideas about causes for problems and to present these in a structured form. This tool was devised by Dr. Kouro Ishikawa and as mentioned earlier is also known as Ishikawa Diagram.



Cause and effect diagram

3) Histogram: - A histogram is a graphical representation of discrete or continuous data. The area of a bar in a histogram is equal to the frequency. The y -axis is plotted by frequency density (which is proportional to the frequency) and the x -axis is plotted with the range of values divided into intervals. Histograms are useful in studying patterns of distribution and in drawing conclusions about the process based on the pattern.



Histogram

4)Control Charts:-A control chart, also known as a Shewhart chart, is a graphical tool used in the 7 QC tools to monitor and analyze the stability of a process over time. It helps determine if a process is "in control" (stable and predictable) or "out of control" (influenced by special causes of variation)

There are two types of data that are commonly use in Control charts.

1) Variable Data: - The control charts for attributes are X Bar & R bar-chart, I & MR-charts
2) Attribute Data: - The control charts for attributes are p-chart, np-chart, c-chart and u-chart. Control charts for defectives are p and np charts. P charts are used when the sample size is constant, and np charts are used when the sample size is variable. In the case where the number of defects is the data available for plotting, c and u charts are used. If the sample size is constant, c charts are used and u charts are used for variable sample sizes.

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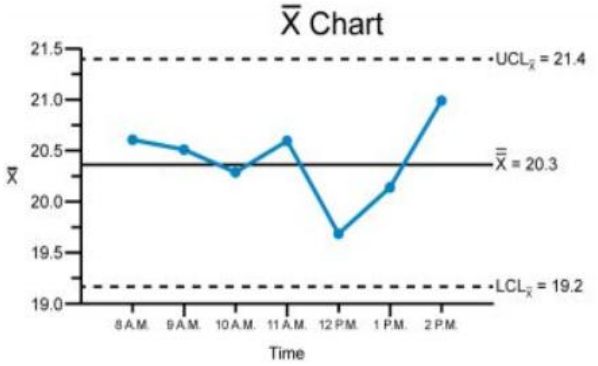
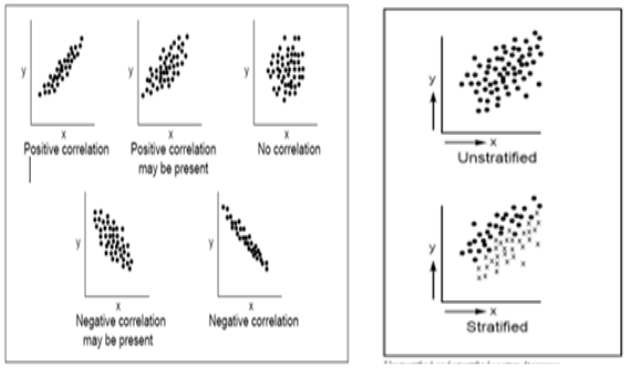


Control Chart

5) Scatter Diagrams: - A scatter diagram, also known as a scatter plot, is one of the seven basic quality control (QC) tools used to visually represent the relationship between two variables. It helps identify potential correlations, whether positive, negative, or no correlation at all, between the two variables.

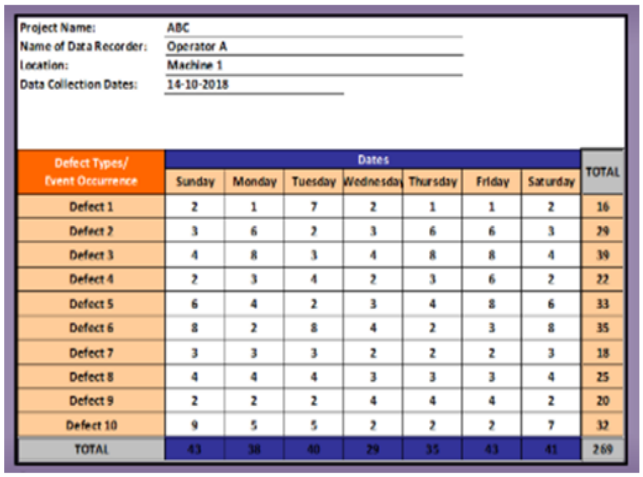
When solving a problem or analyzing a situation one needs to know the relationship between two variables. A relationship may or may not exist between two variables. If a relationship exists, it may be positive or negative; it may be strong or weak and may be simple or complex. A tool to study the relationship between two variables is known as Scatter Diagram. It consists of plotting a series of points representing several observations on a graph in which one variable is on X-axis and the other variable in on Y-axis. If more than one set of values are identical, requiring more points at the same spot, a small circle is drawn around the original dot to indicate second point with the same values. The way the points lie scattered in the quadrant gives a good indication of the relationship between the two variables



Scatter Diagram

6) Check Sheet: -As measurement and collection of data forms the basis for any analysis, this activity needs to be planned in such a way that the information collected is both relevant and comprehensive. Check sheets are tools for collecting data. They are designed specific to the type of data to be collected. Check sheets aid in systematic collection of data. Some examples of check sheets are daily maintenance check sheets, attendance records, production logbooks, etc. Data collected using check sheets needs to be meaningfully classified. Such classification helps gaining a prelim-nary understanding of relevance and dispersion of the data so that further analysis can be planned to obtain a meaningful output. Meaningful classification of data is called stratification. Stratification may be by group, location, type, origin, symptom, etc.

This tool helps identify patterns, trends, and potential causes of problems, making it a valuable tool for quality improvement.

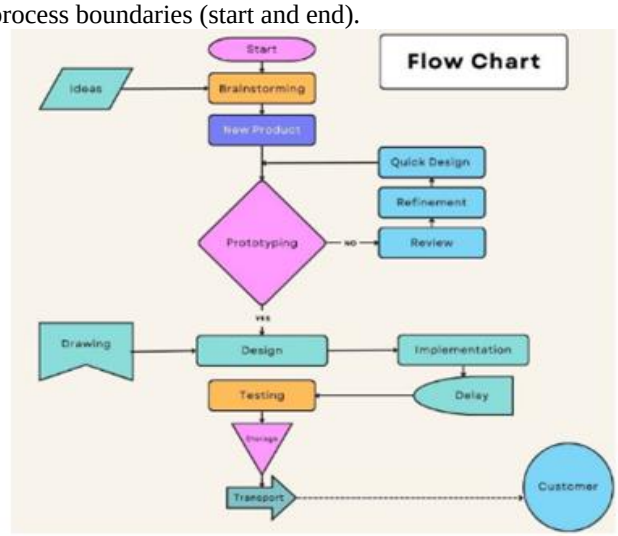


Project Name: ABC
Name of Data Recorder: Operator A
Location: Machine 1
Data Collection Dates: 14-10-2018

Defect Types/ Event Occurrence	Dates							TOTAL
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Defect 1	2	1	7	2	1	1	2	16
Defect 2	3	6	2	3	6	6	3	29
Defect 3	4	8	3	4	8	8	4	39
Defect 4	2	3	4	2	3	6	2	22
Defect 5	6	4	2	3	4	8	6	33
Defect 6	8	2	8	4	2	3	8	35
Defect 7	3	3	3	2	2	2	3	18
Defect 8	4	4	4	3	3	3	4	25
Defect 9	2	2	2	4	4	4	2	20
Defect 10	9	5	5	2	2	2	7	32
TOTAL	43	38	40	29	35	43	41	269

Check Sheet

7) Flow Charts: - Flowcharts are perhaps the most popular out of the 7 quality tools. This tool is used to visualize the sequence of steps in a process, event, workflow, system, etc. In addition to showing the process as a whole, a flowchart also highlights the relationship between steps and the process boundaries (start and end).



Flow Chart

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III. 7QC TOOLSTHROUGH PDCA-CYCLE

The seven QC tools (7QC tools) are a set of techniques used for quality improvement, and they can be effectively integrated into the PDCA cycle (Plan, Do, Check, Act) for continuous process improvement. The PDCA cycle provides a structured framework, while the 7QC tools offer specific methods for analyzing problems, gathering data, and implementing solutions

7QC tools are used within each phase of the PDCA cycle:

1. Plan:
Cause and Effect Diagram (Fishbone Diagram): Identifies potential root causes of problems, making it invaluable for problem definition and initial planning.

Flowchart: Maps out processes, highlighting potential bottlenecks and areas for improvement, thus supporting process planning.

2. Do:
Check Sheet: Collects data to track the frequency of defects or other issues, providing insights into the effectiveness of planned changes.

3. Check:
Histogram: Analyzes data distributions to identify patterns and trends, confirming if the implemented solutions are working.
Pareto Diagram: Prioritizes issues based on their frequency or impact, helping to focus efforts on the most critical areas.
Scatter Diagram: Examines the relationship between two variables, revealing potential correlations that can guide further improvements.
Control Chart: Monitors process performance over time, identifying variations and potential problems, helping to ensure consistency.

4. Act:
All 7QC tools: Provide data and insights that are used to make decisions about further actions, whether to continue with the changes, refine them, or abandon them altogether

Seven basic quality tools (7QC tools)	Steps of PDCA-Cycle				
	Plan	Do	Plan, Check	Plan, Act	Check
	Problem identification	Implement solutions	Process analysis	Solutions development	Result evaluation
Pareto Diagram	√		√		√
Cuase and effect diagram	√		√		
Histogram	√				√
Control Charts	√		√		√
Scatter Diagram	√		√	√	√
Check Sheet	√		√		√
Flow chart	√			√	

IV. CONCLUSION

These following conclusions were derived from the review of above-mentioned papers.
1) Statististical QC is chiefly concerned in making sure that several procedures and working arrangements are in place to provide for effective and efficient statistical processes, to minimize the risk of errors or weaknesses in procedures or systems or in source material.
2) Seven QC tools are most helpful in troubleshooting issues related to quality.
3) All processes are affected by multiple factors and therefore statistical QC tools can be applied to any process.
4) The 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.
5) 7 Quality control tools have shown more better results in quality improvement as referred many use studies.

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