7 BASIC TOOLS OF QUALITY MANAGEMENT: A Brief Tutorial

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CONTINUOUS QUALITY IMPROVEMENT TRAINING

7 TOOLS: An Overview

- Developed by Kaoru Ishikawa
- Indispensable basic quality tools for process improvement
- Tools:
  1. Cause-and-Effect Diagram
  2. Check Sheet
  3. Control Chart
  4. Histogram
  5. Pareto Chart
  6. Scatter Diagram
  7. Stratification

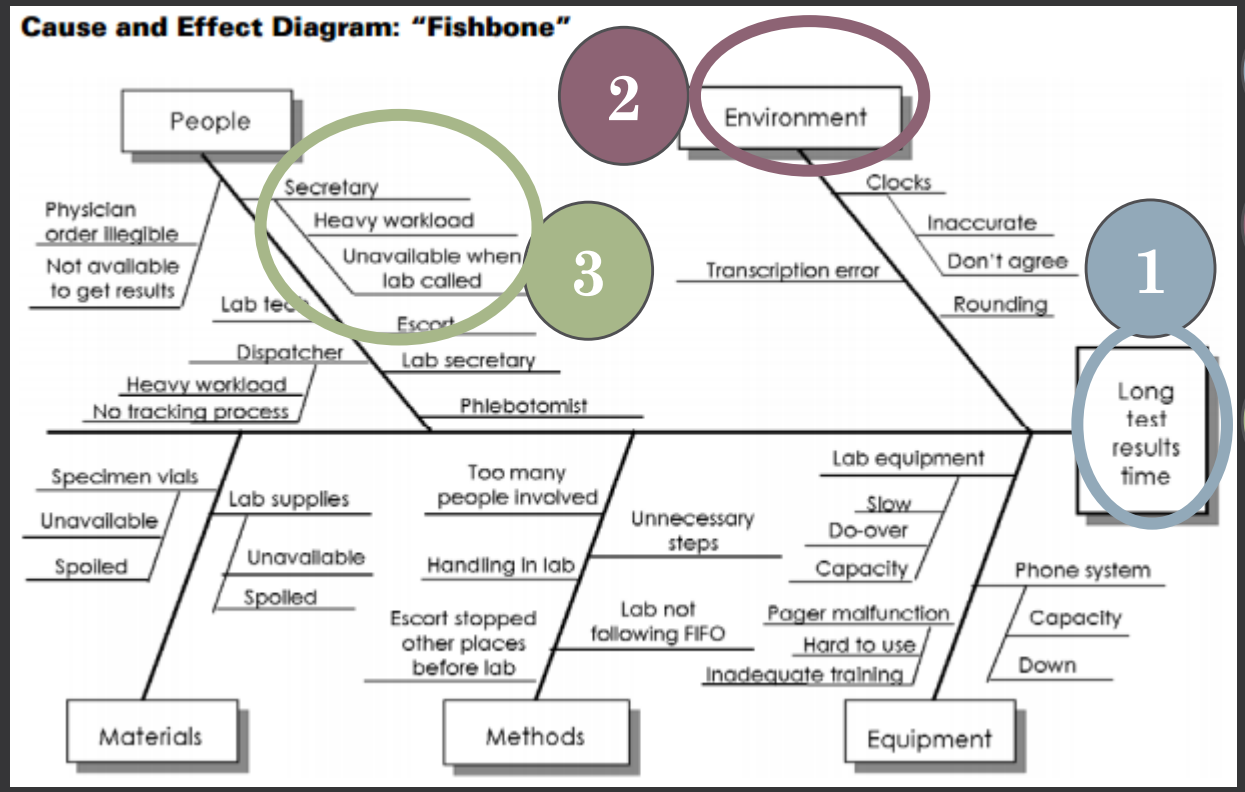
Source (ASQ.org, n.d.)

CAUSE-AND-EFFECT DIAGRAM: Overview

- Also called “Ishikawa” or “Fishbone Diagram”
- Identifies many possible causes for an effect or problem and sorts ideas into useful categories
  - “Effect” is the problem or outcome of interest
  - “Cause” are the major groupings of potential individual causes of the effect
- This tool provides structure and focus to a brainstorming session and the final diagram visually portrays the relationships between various potential causes of a particular effect.

Source (ASQ.org, 2005)

CAUSE-AND-EFFECT DIAGRAM: Create



1. Start with the Problem or Condition
2. Potential causes are grouped and analyzed by categories
3. Problems are explored to find the root causes that can be addressed. Continue this step until you reach a stopping point

Source (IHI, 2004)

CHECK SHEET: Overview

- Also called “Defect Concentration Diagram”
- A check sheet is a structured form for collecting and analyzing data.
- Use a Check Sheet:
  - when data can be observed and collected repeatedly by the same person or at the same location; or
  - when collecting data on the frequency or patterns of events or problems
- The data gathered from the Check Sheet can be turned into a Histogram, Bar Chart, or Pareto Chart for data and trend visualization

Source (ASQ.org, 2005)

CHECK SHEET: Create

Telephone Interruptions

Reason	Day					
	Mon	Tues	Wed	Thurs	Fri	Total
Wrong number	𝍸	||	|	𝍸	𝍸 ||	20
Info request	||	||	||	||	||	10
Boss	𝍸	||	𝍸 ||	|	||||	19
Total	12	6	10	8	13	49

Check Sheet Example

Source (ASQ.org, 2005)

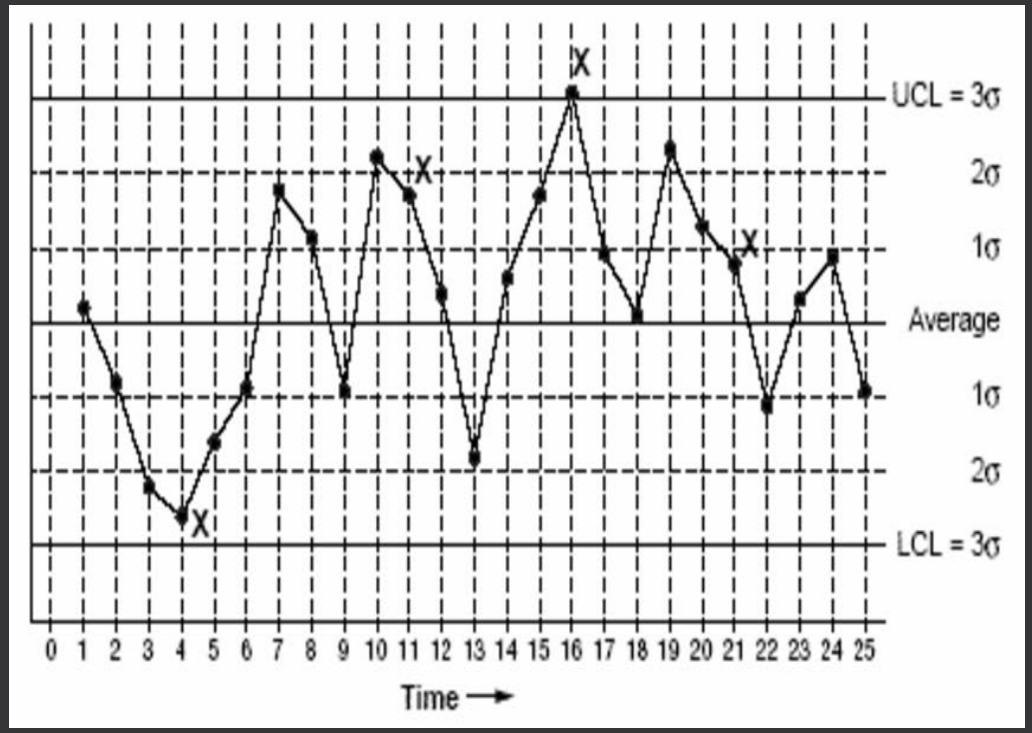
1. Decide what event or problem will be observed and develop operational definitions.
2. Decide when data will be collected and for how long.
3. Design the form so data can be recorded simply (tally or checkmarks) and label all spaces on the form.
4. Test the Check Sheet for a short trial period to be sure it collects the appropriate data and is easy to use.
5. Begin using the Check Sheet to gather data by documenting each time the targeted event or problem occurs on the Check Sheet.

PROCESS CONTROL CHARTS: Create

- Also called “Statistical Process Control”
- Control charts are a tool used to monitor, control and improve process performance over time by studying variation and its source.
- Use a control charts:
  - when predicting whether a process is in control;
  - when predicting expected range of outcomes from a process; or
  - when correcting ongoing process by finding and correcting problems as they occur

Source (ASQ.org, 2005)

PROCESS CONTROL CHARTS: Create



1. Choose the appropriate control chart for your data.
2. Determine the appropriate time period for collecting or plotting data.
3. Collect data, construct your chart and analyze the data.
4. Look out for "out of control" signals and analyze the signals.
5. Continue to plot data as they are generated and be on the lookout for new out-of-control signals.
6. When you start a new control chart, the process may be out of control.

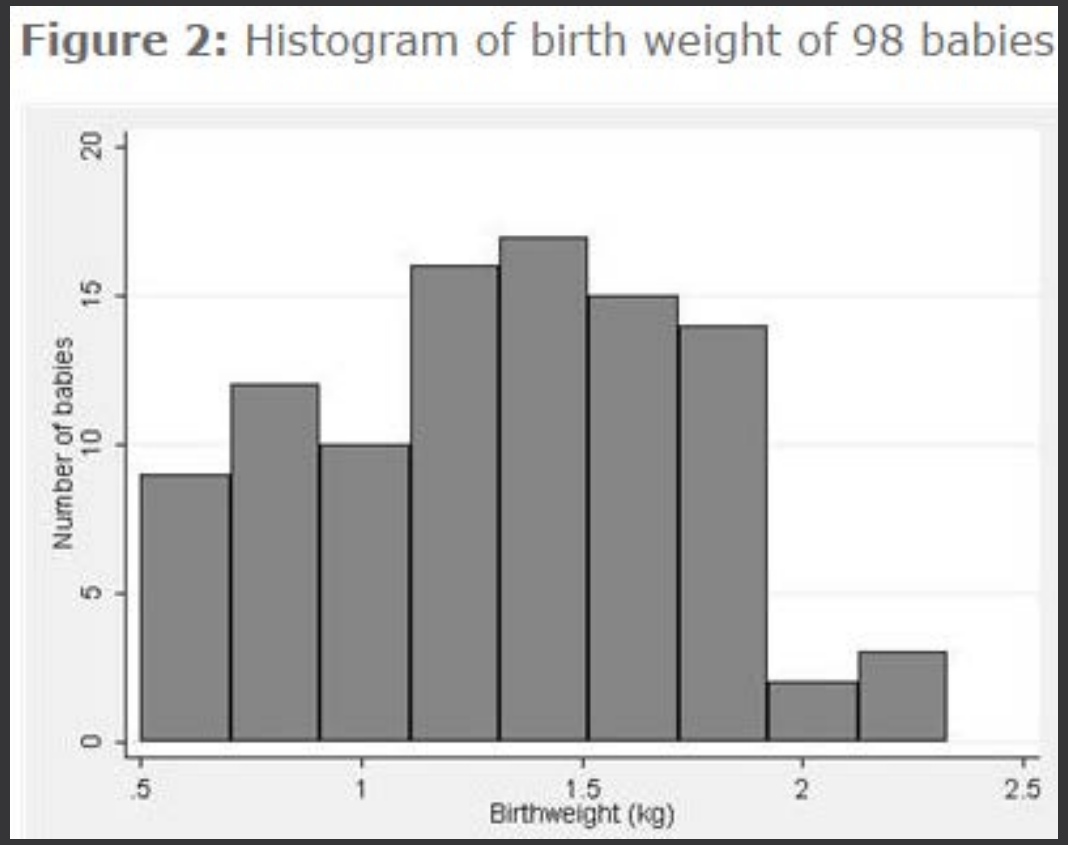
Source (ASQ.org, 2005)

HISTOGRAM: Overview

- A histogram is the most commonly used graph to show how often each different value in a set of data occurs (known as frequency distribution).
- A team can use a histogram:
  - when the data are numerical,
  - to see the shape of the data's distribution,
  - to analyze whether a process meets customer requirements,
  - to review whether a process change has occurred from one time period to another,
  - to determine whether the outputs of two or more processes are different; and
  - to communicate the distribution of data in an easy to understand format.
- Histograms can help a team:
  - recognize and analyze patterns in data that are not apparent; and
  - formulate aims and make decisions by depicting how well or poorly a process is performing.

Sources (ASQ.org, 2004 & IHI.org, 2015)

HISTOGRAM: Create



1. Collect at least 50 consecutive data points from a process.
2. Use a histogram worksheet to set up the histogram.
3. Draw and label the x- and y- axes on graph paper.
4. Plot each data point by shading that portion of the bar.

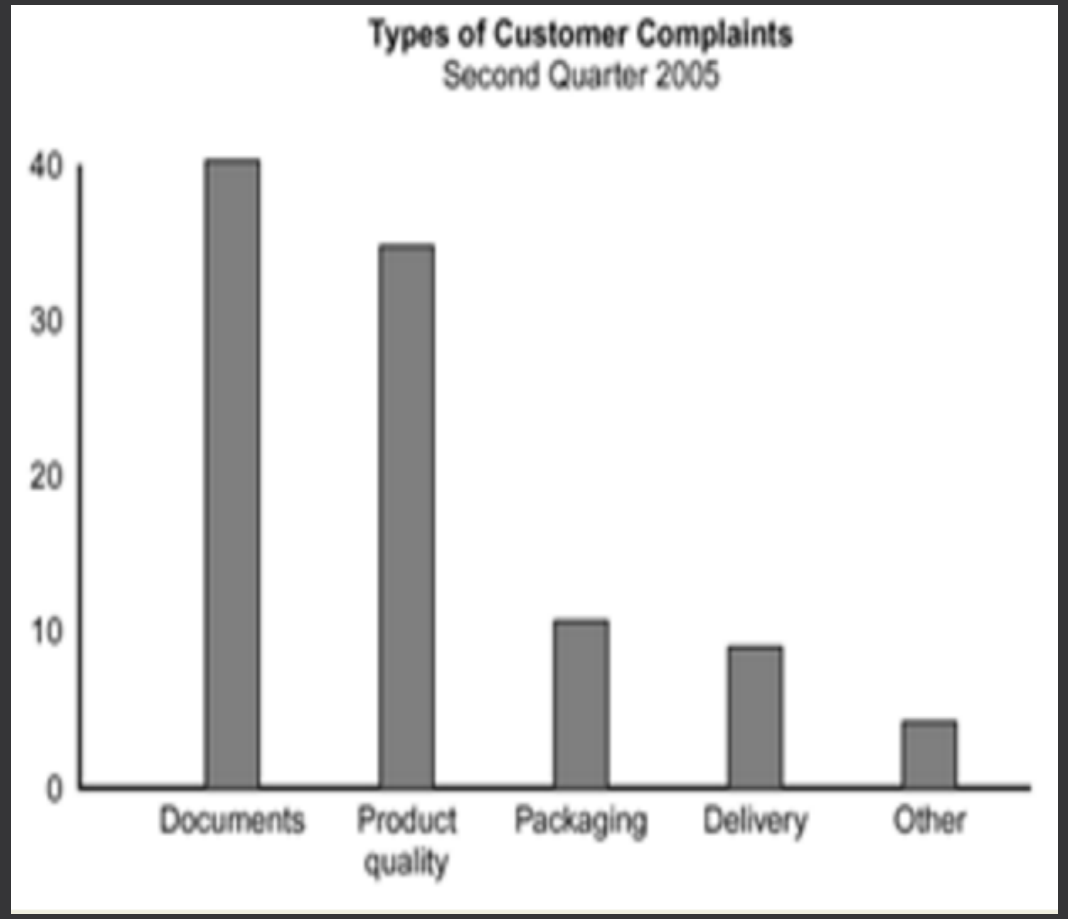
Sources (ASQ.org, 2004 & Simpson, 2004)

PARETO CHART: Overview

- Also known as “Pareto Analysis”
- A Pareto Chart is a tool that depicts the problems with greatest potential for improvement by showing their relative frequency or size in a descending bar graph.
- A team can use a Pareto Chart when:
  - there are many problems and there is a need to focus on the most significant,
  - considering specific components of broader causes or problems,
  - analyzing data about the size or frequency of causes or problems in a process; and
  - communicating with others about your data.
- Pareto Charts can help a team determine which problem will have the greatest positive impact on the system when solved.

Source (ASQ.org, 2005)

PARETO CHART: Create



Source (ASQ.org, 2005)

1. Decide what categories items would be grouped under.
2. Decide what measurement is appropriate. Frequency, cost, quantity and time are common measurements.
3. Decide what period of time the Pareto Chart would cover.
4. Collect data under the appropriate category.
5. For each category, do a subtotal of the measurement.
6. Determine an appropriate scale for the measurements and with the subtotals derived in step 5, construct and label bars for each category in descending order.

SCATTER DIAGRAM: Overview

- Also called “Scatter Plot” or “X-Y Graph”
- A scatter diagram is a tool used to show the possible relationship between the changes observed in two different sets of variables usually a dependent and and an independent variable.
- A scatter diagram is used when:
  - the data are quantitative/numerical and paired,
  - there is need to determine the relationship between the cause and effect of variables; and
  - trying to determine the potential root cause of a problem.

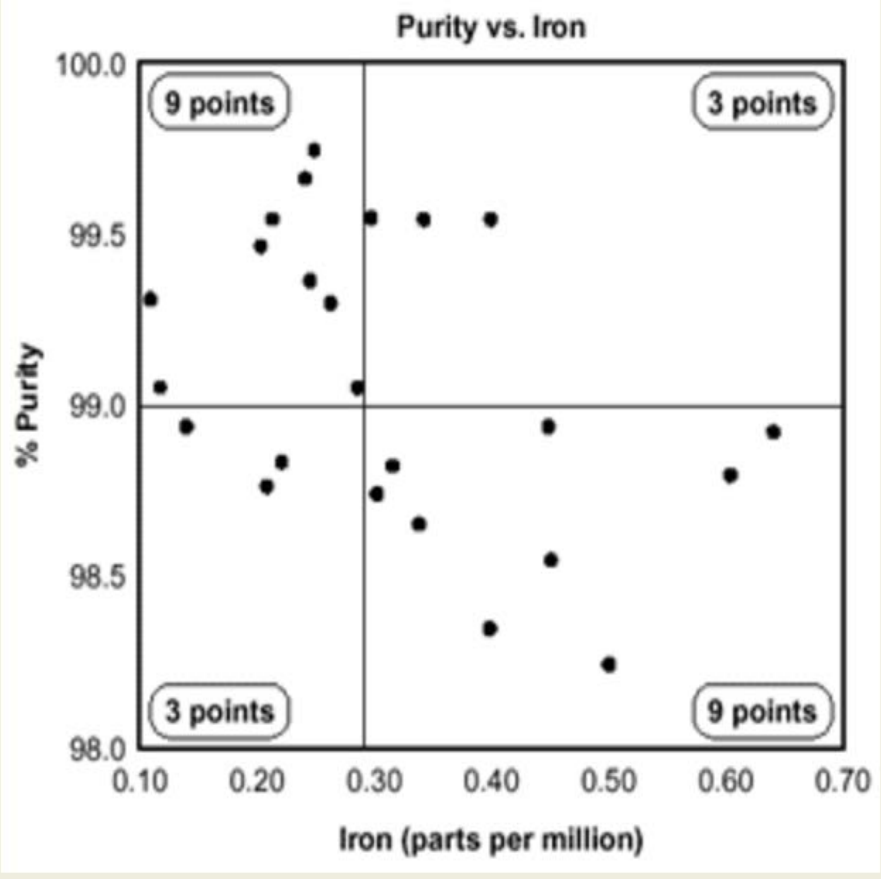
Source (ASQ.org, 2005)

SCATTER DIAGRAM: Create

1. Collect pairs of data where a relationship is suspected.
2. Draw a graph with the independent variable on the horizontal axis and the dependent variable on the vertical axis.
3. For each data pair, put a symbol where both values intersect.
4. Observe the pattern of the symbols to see if an obvious relationship exists. A straight line means that there is a relationship
5. Divide points on the graph into four quadrants. If there are Y number of points on the graph:
    - divide Y by 2 and count that number from top to bottom and then draw a horizontal line
    - divide Y by 2 and count that number from left to right and draw a vertical line
    - if the number of points is initially odd, then just draw a vertical and a horizontal line through the center of the graph

Source (ASQ.org, 2005)

SCATTER DIAGRAM: Create



6. Count the number of points in each quadrant. Do not count points that fall on a line

7. Do the following:

   A = points in upper right quadrant + points in lower left quadrant

   B = points in upper left quadrant + points in lower right quadrant

   N = A + B

   Q is the smaller of A and B

8. Look up the limit of N on the trend table. If Q is less than the limit, the two variables are related. If Q is greater than or equal to the limit, the pattern may be a random occurrence.

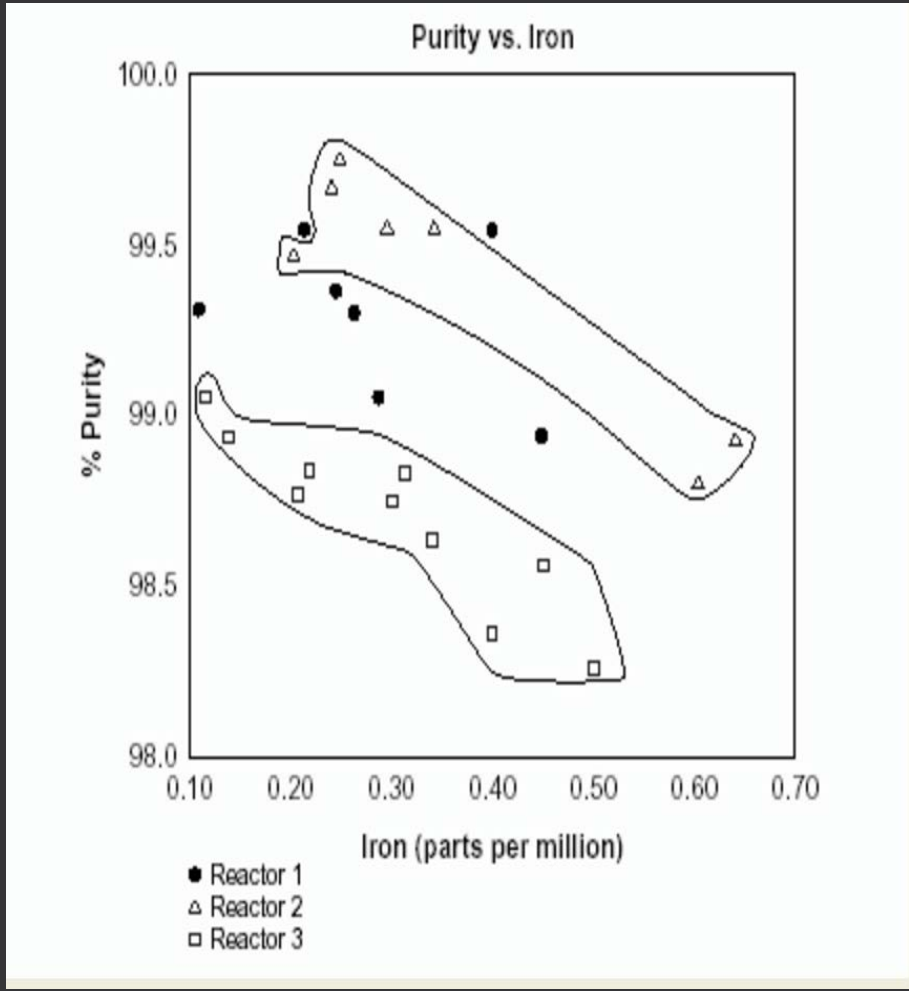
Source (ASQ.org, 2005)

STRATIFICATION: Overview

- This is a technique used to separate data so that patterns can be seen.
- Stratification is used when:
  - when data is about to be collected,
  - when data come from a variety of sources; and
  - when data analysis may require separation of data sources.
- Stratification can help a team derive meaning from data that have been lumped together from a variety of sources or categories.

Source (ASQ.org, 2005)

STRATIFICATION: Create



1. Consider which information about the sources of data might have an effect on the results.
2. When plotting the collected data on an analysis tool, use different colors or marks to distinguish data from the different sources.
3. Analyze the subsets of the stratified data separately.

Source (ASQ.org, 2005)