

**UNIT-III**

**TQM TOOLS & TECHNIQUES I**

**3.1 FAILURE MODE AND EFFECT ANALYSIS**

- FMEA is an analytical technique that combines the technology and experience of people in identifying failure modes of a product or process and planning for its elimination.
- FMEA can be explained as a group of activities intended to
  - Recognize and evaluate the potential failure of a product or process and its effects.
  - Identify actions that could eliminate or reduce the chance of potential failures.
  - Document the process.

There are several stages of FMEA

- Design FMEA
- Process FMEA
- Equipment FMEA
- Maintenance FMEA
- Concept FMEA
- Service FMEA
- System FMEA
- Environmental FMEA

**3.2 STAGES OF FMEA**

The four stages of FMEA are

**1. Specifying possibilities**

- (a) Functions
- (b) Possible failure modes
- (c) Root causes
- (d) Effects
- (e) Detection/ prevention

**2. Qualifying risk:**

- (a) Probability of cause
- (b) Severity of effect
- (c) Effectiveness of control
- (d) Risk priority number

**3. Correcting high risk causes**

- (a) Prioritizing work
- (b) Detailing action
- (c) Assigning action responsibility
- (d) Check p[oints on completion

**4. Re-evaluation of risk**

- (a) Recalculation of Risk priority number

**The design FMEA document**

Design FMEA and process FMEA is shown below

**FMEA Number**

On the top left corner of the document is the FMEA number, used for tracing.

**Item**

Item space is used to clarify which exact component or process is being analyzed.

**Design Responsibility**

The team in charge of the design or process should be identified in the space designated Design responsibility.

**Prepared By**

The name, telephone number and address should be included in prepared by space.

**Model Number/ Year**

Both the name and identification number of the system , subsystem should be included in the model number /year space.

**Key Date**

The date and initial FMEA should be placed in the key date space.

**FMEA Date**

The date of the original FMEA was compiled and latest revision date should be placed in FMEA date space.

**Specifying possibilities;**

**(a) Functions**

Identify the functions that are item process is expected to perform

**(b) Possible failure mode**

Identify the known and potential failures that could prevent or degrade the ability of the item or process to perform its expected functions.

**(c) Root causes**

Identify the known and potential causes for each failure.

**(d) Effects**

Identify the known and potential effect that would result from the occurrence of each failure. It is advisable to consider the effects at the item level, at the next higher level assembly and at the system level.

**(e) detection/Prevention**

This is to analyze to get an idea of to what extent it is possible to detect / prevent potential causes/ effects.

**2. Qualifying risk:**

**(a) Probability of cause**

Estimate the probability of occurrence of each of the identified known and potential cause for each failure.

**(b) Severity of cause**

Each failure effect is to be judged for its potential seriousness. This is usually done by scoring the effect on a 1 to 5 scale.

**(c) Effectiveness of control to prevent cause:**

Examine the effectiveness of the control mechanism that will be in place to eliminate or reduce the likelihood that the potential failures will occur.

**(d) Risk priority Number:**

This is the number to view the relative measure of the design risk. Its value ranges from 1 to 1000, with 1 being the smallest design risk possible.

**3. Correcting high risk causes:**

**(a) Prioritizing work**

Using the risk priority number priorities issues for corrective action.

**(b) Detailing action:**

Identify the corrective action that needs to be taken in order to eliminate or reduce the risk

**3. Assigning action responsibility**

All corrective actions should be clearly allocated to individuals or departments or organizations and a deadline given

**(d) Check points on completion;**

This is to ensure that the corrective actions have been implemented. This is done by recording the actual action taken and by keeping as update on the status of action.

Revaluation of risk:

**(a) Revaluation of risk priority number**

This is to recalculate, that is revise the RPN value following the corrective action. This will enable number(RPN) full traceability between, potential problems and the outcomes of actions.

**3.3 SEVEN TOOLS OF QUALITY**

One of the test technical tools for improving product and service quality is statistical process control. This technical yool not only controls the process but also has the capability to improve it as well

Prof. Ishikawa proposed seven elemental tools based on statistical techniques. Seven tools of quality are

1. Check sheets (Data collection sheet)
2. Histograms
3. Pareto diagram
4. Process chart and flow diagram
5. Cause and effect diagram
6. Scatter diagram

7. Control charts

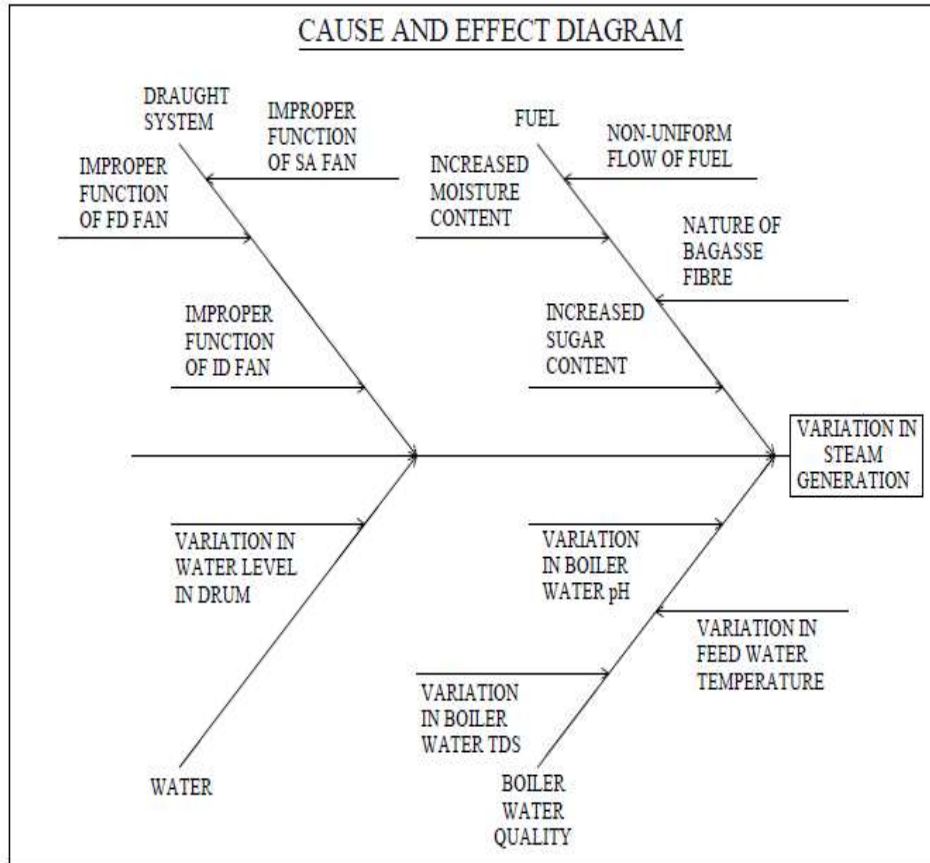


Figure: 1cause and effect diagram

**Steps in constructing a cause & effect diagram :**

- a) Define the problem or effect to be analyzed.
- b) Form the team to perform the analysis. Often the team will uncover potential causes through brainstorming.
- c) Draw the effect box and the centerline.
- d) Specify the major potential cause categories and join them as boxes connected to the centerline.
- e) Identify the possible causes and classify them into the categories in step d. Create new categories, if necessary.
- f) Rank order the causes to identify those that seem most likely to impact the problem.
- g) Take corrective action

**Check sheets**

CHECK SHEET						
Product : Bicycle						
Nonconformity Type	Check					Total
Blister	III	III	III	III	I	21
Light spray	III	III	III			15
Drips	III	III	III	III	III	25
Others	III	III	III	III	III	25
-----TOTAL						86

Figure:2 Check sheet

**Histogram**

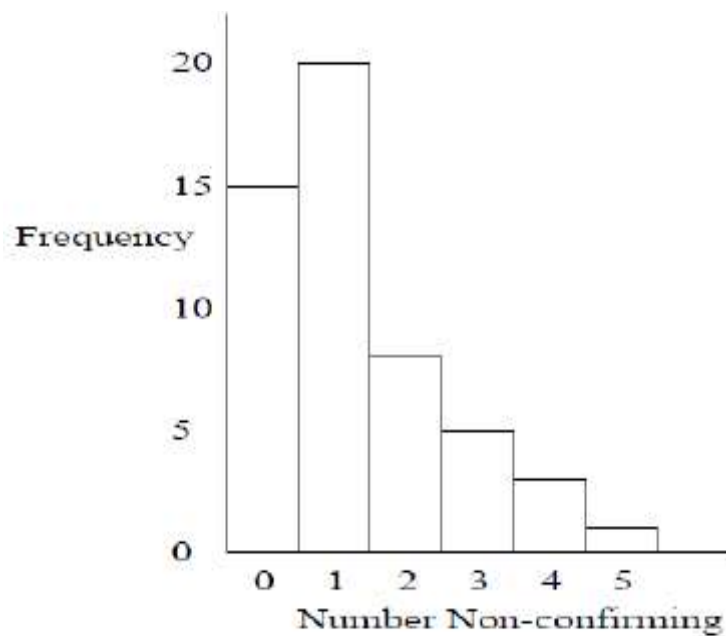


Figure:3 histogram

### Scatter diagram

In scatter diagram, three types of co-relations exist.

1. Positive correlation.
2. Negative correlation.
3. No correlation.

### 3.4 NEW 7 MANAGEMENT TOOLS

These tools are subjective information and used for the following

- Process improvement
- Cost reduction
- Policy deployment
- New product development

The seven management tools are

1. Affinity diagram
2. Matrix diagram
3. Prioritization
4. Relations diagram
5. Tree diagram (systematic diagram)
6. Process decision Program Chart(PDPC)
7. Activity network diagram

The above tools are usually used to find the root cause of the problem by focusing on the process rather than the people

The procedure adopted is

- Describe the problem clearly
- Keep asking why till the root cause is obtain

### Affinity diagram

This diagram allows the team to creatively generate a large number of issues/ ideas and then logically group them for problem understand and possible break through solutions.

### Procedure

Step 1: Determine the factor that affect a plan

Step 2: Select an appropriate format for matrix

Step 3: Determine relationship symbols

Step 4: Analyze each cell and allocate an appropriate symbol

Prioritization matrix:

This is a tool used to prioritize issues using a weighted criteria, which issue is to be considered first, second and soon will be a question. This question is being taken case of this method.

Prioritization is to be done before detailed planning for implementation is carried out.

It is the combination of tree and matrix diagram

#### **Steps in constructing prioritization matrix**

1. List the issues to be tackled in the first column of the matrix.
2. Adopt the normal grouping technique(NGT) and make the participants to give these team weightage.
3. Horizontally add the weightages against each issues
4. The issue with least total in column 6 is to ranked just. The ranking are shown on the seventh column
5. Now the issues are written separating in the order of the obtained ranking

#### **Relations diagram**

This tool is also known as interrelationship of many factors of a complex situation

This diagram classifies the interrelationship of many factors of a complex situation

The factors that have a high number of relationships are usually the most fundamental or critical factor.

#### **Procedure adopted**

1. Agree on the issues
2. Short with the first issue and evaluate the cause and effect diagram. Draw arrows from stronger issue to weaker issue by comparing. This is done sequentially for each issue.
3. The diagram is completed by tallying the incoming and outgoing arrows and placing these information below each issue.

### **3.5 BENCHMARKING**

Benchmarking is a systematic method by which organizations can measure themselves



against the best industry practices. Benchmarking is a systematic search for the best practices, innovative ideas, and highly effective operating procedures.

**BENCHMARKING CONCEPT**

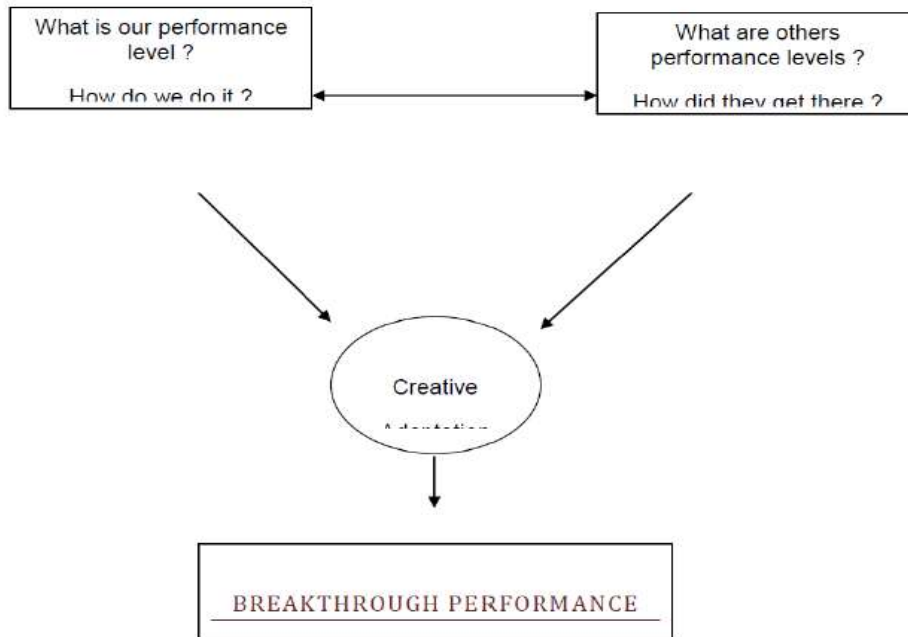


Figure : 4 Benchmarking concept

**Reasons to bench mark**

- It is a tool to achieve business and competitive objectives
- It can inspire managers(and organizations) to compete.
- It is time and cost effective
- It constantly scans the external environment to improve the process
- Potential and useful technological break through can belocated and adopted early

**Process of benchmarking**

The following six steps contain the core techniques of Benchmarking

**1. Decide what to benchmark**

- Benchmarking can be applied to any business or production process
- Choosing the scope of the Benchmarking study
- Pareto analysis – what process to investigate

- Cause and effect diagram for tracing outputs back

## **2. Understand current performance**

- Understand and document the current process
- Those working in the process are the most capable of identifying and correcting problems

### **Pitfalls and criticisms of benchmarking :**

- Idea of copying others
- It is not a cure or a business philosophy
- Some process have to be benchmarked repeatedly
- It is not a substitute for innovation

## **2MARK QUESTIONS WITH ANSWERS**

### **1. Give the Analysis Techniques for Quality Costs?**

- Trend Analysis
- Pareto Analysis

### **2. Define Quality Costs?**

Quality Costs are defined as those costs associated with the non achievement of product or service quality as defined by the requirements established by the organization and its contracts with customers and society.

### **3. Give the primary categories of Quality cost?**

- Preventive cost category
- Appraisal cost category
- Internal failure cost category
- External failure cost category

### **4. Give the sub-elements of Preventive cost category?**

- Marketing/Customer/User
- Product/Service/Design development
- Purchasing
- Operations
- Quality Administration
- Other Prevention Costs