UNIT III
TQM TOOLS AND TECHNIQUES I

Unit Overview: This unit deals in statistical ways to measure and calculate the impact of quality. Any thing has to be measured and analyzed for which statistics plays a major role. The unit also gives idea of new and old tools to analyze quality. The modern quality concept six sigma is also discussed here.

Statistics is a mathematical science pertaining to the collection, analysis, interpretation or explanation, and presentation of data. It is applicable to a wide variety of academic disciplines, from the natural and social sciences to the humanities, government and business.

The word **statistics** is also the plural of **statistic** (singular), which refers to the result of applying a statistical algorithm to a set of data, as in economic statistics, crime statistics, etc.

Seven tools of Quality

I - Pareto chart: Italian economist Vilfredo Pareto

Shows on a bar graph which factors are more significant. This method helps to find the vital few contributing maximum impact.

Purpose: The purpose of the Pareto chart is to prioritize problems No company has enough resources to tackle every problem, so they must prioritize.

Pareto Principle: The Pareto concept was developed by the describing the frequency distribution of any given characteristic of a population. Also called the 20-80 rule, he determined that a small percentage of any given group (20%) account for a high amount of a certain characteristic (80%).

Conclusion: The most important thing in improving quality is to start somewhere, doing something. As you begin using the Pareto chart to decide where your problems are, you will discover many things about your processes and will come because you will know where to improve.

II - Flowchart: A technique that separates data gathered from a variety of sources so that patterns can be seen (some lists replace "stratification" with or "run chart").

Purpose: Flow Charts provide a visual illustration of the sequence of operations required to complete a task. A picture of the steps the process undergoes to complete it's task.

Every process will require input(s) to complete it's task, and will provide output(s) when the task is completed. Flow charts can be drawn in many styles.

Flow charts can be used to describe a single process, parts of a process, or a set of processes. There is no right or wrong way to draw a flow chart. The true test of a flow chart is how well those who create and use it can understand it.

Input ---------------------Process----------------Output

III - Cause-and-Effect Diagrams - 1943 by Mr. Kaoru Ishikawa at the University of Tokyo

Purpose: One important part of process improvement is continuously striving to obtain more information about the process and it's output. Cause-and-effect diagrams allow us to do not just that, but also can lead us to the root cause, or causes, of problems.

Constructing the Cause-and-Effect Diagram:

Step 1: Select the team members and a leader. Team members knowledgeable about the quality. Team members focus on the problem under investigation.

Step 2: Write the problem statement on the right hand side of the page, and draw a box around it with an arrow running to it. This quality concern is now the effect.

Step 3: Brain-storming. The team members generate ideas as to what is causing the effect.

Step 4: This step could be combined with step 3. Identify, for each main cause, its related sub-causes that might affect our quality concern or problem (our Effect). Always check to see if all the factors contributing to the problem have been identified. Start by asking why the problem exists.

Step 5: Focus on one or two causes for which an improvement action(s) can be developed using other quality tools such as Pareto charts, check sheets, and other gathering and analysis tools.

Conclusion: Improvement requires knowledge. The more information we have about our processes thebetter we are at improving them. Cause-and-effect diagrams are one quality tool that is simple yet verypowerful in helping us better understand our processes.

IV - Check Sheets

Purpose: Check sheets allow the user to collect data from a process in an easy, systematic, and organized manner.

Data Collection: Before we can talk about check sheets we need to understand what we mean by data collection. This collected data needs to be accurate and relevant to the quality problem. The first is to establish a purpose for collecting this data. Second, we need to define the type of data that is going to be collected. Measurable data such as length, size, weight, time,...etc., and countable data such as the number of defects.

The third step is to determine who is going to collect that data and when it should be collected.

V- Histograms

Purpose: To determine the spread or variation of a set of data points in a graphical form. It is always a desire to produce things that are equal to their design values.

Histograms: A histogram is a tool for summarizing, analyzing, and displaying data. It provides the user with a graphical representation of the amount of variation found in a set of data.

Constructing a Histogram: The following are the steps followed in the construction of a histogram: Data collection: To ensure good results, a minimum of 50 data points, or samples, need to be collected Calculate the range of the sample data: The range is the difference between the largest and smallest data points. *Range =Largest point - smallest point.*

Calculate the size of the class interval. The class interval is the width of each class on the X axis. It is calculated by the following formula: Class interval = Range / Number of classes.

Calculate the number of data points (frequency) that are in each class. A tally sheet is usually used to find the frequency of data points in each interval.

Conclusion: Histogram is simple tools that allow the user to identify and interpret the variation found in a set of data points. It is important to remember that histograms do not give solutions to problems.

VI - Scatter Diagrams

Purpose: To identify correlations that might exist between a quality characteristic and a factor that might be driving it.

Scatter Diagrams: A scatter diagram is a nonmathematical or graphical approach for identifying relationships between a performance measure and factors that might be driving it. This graphical approach is quick, easy to communicate to others, and generally easy to interpret.

Interpreting the Results: Once all the data points have been plotted onto the scatter diagram, you are ready to determine whether their exists a relation between the two selected items or not. When a strong relationship is present, the change in one item will automatically cause a change in the other. If no relationship can be detected, the change in one item will not effect the other item. Their are three basic types
of relationships that can be detected to on a scatter diagram:

1. Positive relationship
2. Negative relationship
3. No relationship

Conclusion: Scatter diagrams allow the user to graphically identify correlations that could exist between a quality characteristic and a factor that might be driving it. It is a quality tool that is simple, easy to communicate to others, and generally easy to interpret.

VII - Control Charts

Purpose: Process is in control and to monitor process variation on a continuous basis. Identifying the tolerance level in the variations.Control charts is one SPC tool that enables us to monitor and control process variation. Types of variation Common and Special Cause Variation

Control charts: Developed in the mid 1920's by Walter Shewhart of Bell labs. There are two basic types of control charts, the average and range control charts. The first deals with how close

the process is to the nominal design value, while the range chart indicates the amount of spread or variability
around the nominal design value. A control chart has basically three line: the upper control limit UCL, the center line CL, and the lower control limit LCL. A minimum of 25 points is required for a control chart to be accurate.

Measure of Central Tendency and Dispersion

Step 1: Do you want to measure the disperison with in the data? Yes:
Calculate the range (Highest value - Lowest Value)
Step 2: Do you want to know more about other observations in the data sets by avoiding the extreme values?
Yes: Calculate the interquartile range (Q3-Q1)
Step 3: Do you want a better measure of the dispersion that takes every observation in to account:
Yes: Calculate the variance of the population (to calculate Population variance each item in the population by the total number of items in the population. By squaring each distance we are converting the -ve values to the positive values and at the same time assigning more weightage to to the large deviations).
Step 4: Do you want to a measure of dispersion with more convenient units?
Yes: Calculate the standard deviations where the standard deviation of the population is the square root of population variance.
Step 5: Do you want to know how many standard deviation a particular observation lies below or above the mean:
Yes: Calculate the standard score of the population
Step 6: Do you want to know a relative measure of magnitude of the standard deviation as compared to the magnitude of the mean for use in comparing two distributions?
Yes: Calculate the coefficient of variation

Measure Central Tendency

The arithmetic mean is found by adding the numbers and dividing the sum by the number of numbers in the list. This is what is most often meant by an average.
The median is the exact middle number. Place them in order from least to greatest and see which number is in the middle. The mode is the most frequently occurring value on the list.

Measure of Dispersion

Range = highest observation in a series - lowest observation in that series

Standard deviation

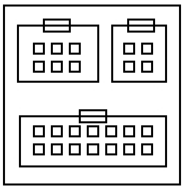
It measures the spreading tendency of the data The smaller the deviation better the quality
Formula for SD
S = sample SD X = observed value X = average N = number of observed value

Population and Sample

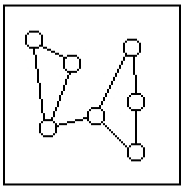
A population is any entire collection of people, animals, plants or things from which we may collect data. It is the entire group we are interested in, which we wish to describe or draw conclusions about. In order to make any generalisations about a population, a sample, that is meant to be representative of the population, is often studied. For each population there are many possible samples. A sample statistic gives information about a corresponding population parameter. For example, the sample mean for a set of data would give information about the overall population mean. It is important that the investigator carefully and completely defines the population before collecting the sample, including a description of the members to be included.
A sample is a group of units selected from a larger group (the population). By studying the sample it is hoped to draw valid conclusions about the larger group.
A sample is generally selected for study because the population is too large to study in its entirety. The sample should be representative of the general population. This is often best achieved by random sampling. Also, before collecting the sample, it is important that the researcher carefully and completely defines the population, including a description of the members to be included.

Control Charts
When the quality controls have to focus on a quality characteristic hard or expensive to measure on a numerical scale, the control chart for attributes are a useful alternative.
Attributes concern quality characteristics which are able to be classified in two types, conform and not conform to specifications. What is called nonconforming means that the unit controlled is notconformed to standard on one or more of examined quality characteristics.
The goal of control charts for variable is still to control mean and variability of a process but here, we focus of number of nonconforming units or nonconformities in a population. Three types of charts exist. Their use depends on the production (which quality characteristic to control, how many to examine), the characteristic of controls (constant or variable sample size):
I The p-chart: it is a control chart for fraction nonconforming
I The c-chart: it is a control chart for number of defects or nonconformities
I The u-chart: it is a control chart for number of nonconformities per unit It is so
to choose the best adapted control chart to the production.
New Management Tools:

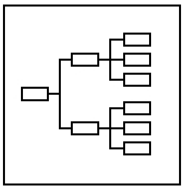
Affinity Diagram
This tool takes large amounts of disorganized data and information and enables one to organize it into groupings based on natural relationships. It was created in the 1960s by Japanese anthropologist JiroKawakita.



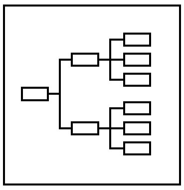
Interrelationship Diagraph
This tool displays all the interrelated cause-and-effect relationships and factors involved in a complex problem and describes desired outcomes. The process of creating an interrelationship diagraph helps a group analyze the natural links between different aspects of a complex situation.



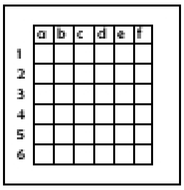
Tree Diagram
This tool is used to break down broad categories into finer and finer levels of detail. It can map levels of details of tasks that are required to accomplish a goal or task. It can be used to break down broad general subjects into finer and finer levels of detail. Developing the tree diagram helps one move their thinking from generalities to specifics.



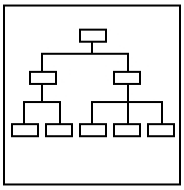
Prioritization Matrix
This tool is used to prioritize items and describe them in terms of weighted criteria. It uses a combination of tree and matrix diagraming techniques to do a pair-wise evalutaion of items and to narrow down options to the most desired or most effective.



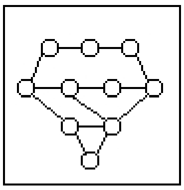
Matrix Diagram
This tool shows the relationship between items. At each intersection a relationship is either absent or present. It then gives information about the relationship, such as its strength, the roles played by various individuals or measurements. Six differently shaped matrices are possible: L, T, Y, X, C and roof-shaped, depending on how many groups must be compared.



Process Decision Program Chart (PDPC)
A useful way of planning is to break down tasks into a hierarchy, using a Tree Diagram. The PDPC extends the tree diagram a couple of levels to identify risks and countermeasures for the bottom level tasks. Different shaped boxes are used to highlight risks and identify possible countermeasures (often shown as 'clouds' to indicate their uncertain nature). The PDPC is similar to the Failure Modes and Effects Analysis (FMEA) in that both identify risks, consequences of failure, and contingency actions; the FMEA also rates relative risk levels for each potential failure point.



Activity Network Diagram
This tool is used to plan the appropriate sequence or schedule for a set of tasks and related subtasks. It is used when subtasks must occur in parallel. The diagram enables one to determine the critical path (longest sequence of tasks). (See also PERT diagram.)



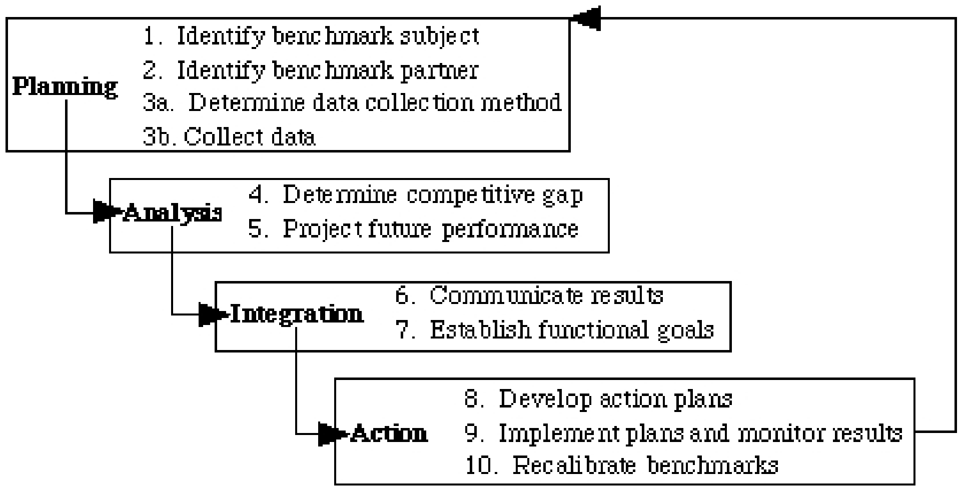
Six Sigma has evolved over the last two decades and so has its definition. Six Sigma has literal, conceptual, and practical definitions.
Features that set Six Sigma apart from previous quality improvement initiatives include -
A clear focus on achieving measurable and quantifiable financial returns from any project.
An increased emphasis on strong and passionate management leadership and support.[1]
A special infrastructure of "Champions," "Master Black Belts," "Black Belts," etc. to lead and implement the Six Sigma approach.[1]
A clear commitment to making decisions on the basis of verifiable data, rather than assumptions and guesswork.[1]
At Motorola University, we think about Six Sigma at three different levels:
As a metric
As a methodology
As a management system

Essentially, Six Sigma is all three at the same time.
Six Sigma as a Metric
The term "Sigma" is often used as a scale for levels of "goodness" or quality. Using this scale, "Six Sigma" equates to 3.4 Defects Per Million Opportunities (DPMO). Six Sigma started as a defect reduction effort in manufacturing and then applied to other business processes for the same purpose. Taking the 1.5 sigma shift into account, short-term sigma levels correspond to the following long-term DPMO values
(one-sided):
I One Sigma = 690,000 DPMO => efficiency 31%
I Two Sigma = 308,000 DPMO => efficiency 69.2%
I Three Sigma = 66,800 DPMO => efficiency 93.32%
I Four Sigma = 6,210 DPMO => efficiency 99.379%
I Five Sigma = 230 DPMO => efficiency 99.977%
I Six Sigma = 3.4 DPMO => efficiency 99.9997% **Six Sigma as a Methodology**
As Six Sigma has evolved, there has been less emphasis on the literal definition of 3.4 DPMO, or counting defects in products and processes. Six Sigma is a business improvement methodology that focuses an organization on:
Understanding and managing customer requirements
Aligning key business processes to achieve those requirements
Utilizing rigorous data analysis to minimize variation in those processes I
Driving rapid and sustainable improvement to business processes
At the heart of the methodology is the DMAIC model for process improvement. DMAIC is commonly used by Six Sigma project teams and is an acronym for:
DMAIC - The basic methodology consists of the following five steps:
D*efine* process improvement goals that are consistent with customer demands and the enterprise strategy.
M*easure* key aspects of the current process and collect relevant data.
A*nalyze*the data to verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered.
I*mprove* or optimize the process based upon data analysis using techniques like Design of Experiments.
C*ontrol* to ensure that any deviations from target are corrected before they result in defects. Set up pilot runs to establish process capability, move on to production, set up control mechanisms and continuously monitor the process.
DMADV
The basic methodology consists of the following five steps:
D*efine* design goals that are consistent with customer demands and the enterprise strategy.
M*easure* and identify CTQs (characteristics that are **C**ritical **ToQ**uality), product capabilities, production process capability, and risks.
A*nalyze*to develop and design alternatives, create a high-level design and evaluate design capability to select the best design.
D*esign* details, optimize the design, and plan for design verification. This phase may require simulations.
Verify the design, set up pilot runs, implement the production process and hand it over to the process owners.
Implementation roles - One of the key innovations of Six Sigma is the professionalizing of quality management functions. Prior to Six Sigma, quality management in practice was largely relegated to the production floor and to statisticians in a separate quality department. Six Sigma borrows martial arts ranking terminology to define a hierarchy (and career path) that cuts across all business functions and a promotion path straight into the executive suite.
Six Sigma identifies several key roles for its successful implementation.[12]

I *Executive Leadership* includes the CEO and other members of top management. They are responsible for setting up a vision for Six Sigma implementation. They also empower the other role holders with the freedom and resources to explore new ideas for breakthrough improvements.
I *Champions* are responsible for Six Sigma implementation across the organization in an integrated manner. The Executive Leadership draws them from upper management. Champions also act as mentors to Black Belts.
I *Master Black Belts*, identified by champions, act as in-house coaches on Six Sigma. They devote 100% of their time to Six Sigma. They assist champions and guide Black Belts and Green Belts. Apart from statistical tasks, their time is spent on ensuring consistent application of Six Sigma across various functions and departments.
I *Black Belts* operate under Master Black Belts to apply Six Sigma methodology to specific projects. They devote 100% of their time to Six Sigma. They primarily focus on Six Sigma project execution, whereas Champions and Master Black Belts focus on identifying projects/functions for Six Sigma.
I *Green Belts* are the employees who take up Six Sigma implementation along with their other job responsibilities. They operate under the guidance of Black Belts.

Benchmarking

"**Benchmarking** is the process of measuring an organization's internal processes then identifying, understanding, and adapting outstanding practices from other organizations considered to be best-inclass. **"Benchmarking**: A continuous, systematic process of evaluating and comparing the capability of one organization with others normally recognized as industry leaders, for insights for optimizing the organizations processes."
Benchmarking is the process of comparing the cost, time or quality of what one organization does against what another organization does. The result is often a business case for making changes in order to make improvements.
CThe systematic process of comparing an organization's products, services and practices against those of competitor organizations or other industry leaders to determine what it is they do that allows them to achieve high levels of performance.J(Society for Human Resources Management)
Advantages of benchmarking
Benchmarking is a powerful management tool because it overcomes "paradigm blindness." Benchmarking opens organizations to new methods, ideas and tools to improve their effectiveness. It helps crack through resistance to change by demonstrating other methods. Allows employees to visualise the improvement which can be a strong motivator for change Helps to identify weak areas and indicates what needs to be done to improve.



The Benchmarking process
The formal 10-step benchmarking process is shown in outline below.
The benchmarking process consists of following phases:
1. Planning. The essential steps are those of any plan development: what, who and how.
I **What is to be benchmarked?** Every function of an organization has or delivers a CproductJ or output. Benchmarking is appropriate for any output of a process or function, whether it's a physical good, an order, a shipment, an invoice, a service

To whom or what will we compare? Business-to-business, direct competitors are certainlyprime candidates to benchmark. But they are not the only targets. Benchmarking must beconducted against the best companies and business functions regardless of where they exist.

How will the data be collected? There's no one way to conduct benchmarking investigations. There's an infinite variety of ways to obtain required data - and most of the data you'll need are readily and publicly available. Recognize that benchmarking is a process not only of deriving quantifiable goals and targets, but more importantly, it's the process of investigating and documenting the best industry practices, which can help you achieve goals and targets.
2. Analysis. The analysis phase must involve a careful understanding of your current process and practices, as well as those of the organizations being benchmarked. What is desired is an understanding of
internal performance on which to assess strengths and weaknesses. Ask:
I Is this other organization better than we are?
I Why are they better?
I By how much?
I What best practices are being used now or can be anticipated?
I How can their practices be incorporated or adapted for use in our organization?
Answers to these questions will define the dimensions of any performance gap: negative, positive or parity. The gap provides an objective basis on which to act—to close the gap or capitalize on any advantage your organization has.
3. Integration. Integration is the process of using benchmark findings to set operational targets for change. It involves careful planning to incorporate new practices in the operation and to ensure benchmark findings are incorporated in all formal planning processes.
Steps include:
Gain operational and management acceptance of benchmark findings. Clearly and convincingly demonstrate findings as correct and based on substantive data.
Develop action plans.

Communicate findings to all organizational levels to obtain support, commitment and ownership.
4. Action. Convert benchmark findings, and operational principles based on them, to specific actions to be taken. Put in place a periodic measurement and assessment of achievement. Use the creative talents of the people who actually perform work tasks to determine how the findings can be incorporated into the work processes.
Any plan for change also should contain milestones for updating the benchmark findings, and an ongoing reporting mechanism. Progress toward benchmark findings must be reported to all employees.
5. Maturity. Maturity will be reached when best industry practices are incorporated in all business processes, thus ensuring superiority.
Tests for superiority:
If the now-changed process were to be made available to others, would a knowledgeable businessperson prefer it?
Do other organizations benchmark your internal operations?
Maturity also is achieved when benchmarking becomes an ongoing, essential and self-initiated facet of the management process. Benchmarking becomes institutionalized and is done at all appropriate levels of the organization, not by specialists.
Types of Benchmarking
Process benchmarking - the initiating firm focuses its observation and investigation of business processes with a goal of identifying and observing the best practices from one or more benchmark firms. Activity analysis will be required where the objective is to benchmark cost and efficiency; increasingly applied to back-office processes where outsourcing may be a consideration.
Financial benchmarking - performing a financial analysis and comparing the results in an effort to assess your overall competitiveness.
Performance benchmarking - allows the initiator firm to assess their competitive position by comparing products and services with those of target firms.

Product benchmarking - the process of designing new products or upgrades to current ones. This process can sometimes involve reverse engineering which is taking apart competitors products to find strengths and weaknesses.
Strategic benchmarking - involves observing how others compete. This type is usually not industry specific meaning it is best to look at other industries.
Functional benchmarking - a company will focus its benchmarking on a single function in order to improve the operation of that particular function. Complex functions such as Human Resources, Finance and Accounting and Information and Communication Technology are unlikely to be directly comparable in cost and efficiency terms and may need to be disaggregated into processes to make valid

Failure modes and effects analysis (FMEA) is a procedure for analysis of potential failure modes within a system for the classification by severity or determination of the failures' effect upon the system. It is widely used in the manufacturing industries in various phases of the product life cycle and is now increasingly finding use in the service industry as well. Failure causes are any errors or defects in process, design, or item especially ones that affect the customer, and can be potential or actual. *Effects analysis*refers to studying the consequences of those failures.
Step 1: Severity
Determine all failure modes based on the functional requirements and their effects. Examples of failure modes are: Electrical short-circuiting, corrosion or deformation. It is important to note that a failure mode in one component can lead to a failure mode in another component. Therefore each failure

mode should be listed in technical terms and for function. Hereafter the ultimate effect of each failure mode needs to be considered. A failure effect is defined as the result of a failure mode on the function of the system as perceived by the user. In this way it is convenient to write these effects down in terms of what the user might see or experience. Examples of failure effects are: degraded performance, noise or even injury to a user. Each effect is given a **severity number**(S) from 1(no danger) to 10(important). These numbers help an engineer to prioritize. If the severity of an effect has a number 9 or 10, actions are considered to change the design by eliminating the failure mode, if possible, or protecting the user from the effect. A severity rating of 9 or 10 is generally reserved for those effects which would cause injury to a user or otherwise result in litigation.

Step 2: Occurrence

In this step it is necessary to look at the cause of a failure and how many times it occurs. This can be done by looking at similar products or processes and the failures that have been documented for them. A failure cause is looked upon as a design weakness. All the potential causes for a failure mode should be identified and documented. Again this should be in technical terms. Examples of causes are: erroneous algorithms, excessive voltage or improper operating conditions. A failure mode is given a

probability number(O),again 1-10. Actions need to be determined if the occurrence is high (meaning >4 for non safety failure modes and >1 when the severity-number from step 1 is 9 or 10). This step is called the detailed development section of the FMEA process.

Step 3: Detection

When appropriate actions are determined, it is necessary to test their efficiency. Also a design verification is needed. The proper inspection methods need to be chosen. First, an engineer should look at the current controls of the system, that prevent failure modes from occurring or which detect the failure before it reaches the customer. Hereafter one should identify testing, analysis, monitoring and other techniques that can be or have been used on similar systems to detect failures. From thesecontrols an engineer can learn how likely it is for a failure to be identified or detected. Eachcombination from the previous 2 steps, receives a **detection number**(D). This number represents theability of planned tests and inspections at removing defects or detecting failure modes.After these 3 basic steps, Risk Priority Numbers (RPN) are calculated.

Risk Priority Numbers

RPN do not play an important part in the choice of an action against failure modes. They are more threshold values in the evaluation of these actions.

After ranking the severity, occurrence and detectability the RPN can be easily calculated by multiplying these

3 numbers: RPN = S x O x D

This has to be done for the entire process and/or design. Once this is done it is easy to determine the areas of greatest concern. The failure modes that have the highest RPN should be given the highest priority for corrective action. This means it is not always the failure modes with the highest severity numbers that should be treated first. There could be less severe failures, but which occur more often and are less detectable.

QFD - House of Quality

MEANING: The voice of the customer from the market research and various benchmarking is linked to the technicalities of the design and process of the product both new and existing.

DEFINITION: It is kind of conceptual map that provides a means of interfunctional planning and communication.

FEATURES:

- Concept of matrix and its correlation
- Plan as per the voice of the customer
- Focus on Customers need and technicalities
- WHAT the Customer wants and HOW to do it

- It is base tool for quality planning managers
_ WHAT - Customer requirement and priority
_ HOW - Technical description and priority
_ Relationship with WHAT and HOW the main area
_ Interrelationships - Roof the cause of concern and importance

Step I - List customer requirement

CWHATJ - Decide Primary and secondary needs of the customer

Step II - List technical descriptions "HOW"

- Again primary and secondary is decided
- Primary - Material and Process
- Subdividing materials and process required
- Here current materials and process must be considered

Step III - Relation ship matrix between WHAT & HOW

- The crucial stage
- Relating WHAT & HOW
- Interlinking both primary and secondary No scope for variation
- Points and grading is done here
- Gives results of WHAT and HOW
- Key elements are discussed
- The Management decides the combination
- Costing and current process must be considered

Step IV - Interrelation matrix between HOW's

- The materials and manufacturing is analyzed
- Ratings are done
- Enables the decisions in the process
- Current process to be considered
- Technical knowledge is a must for the analyst

Step V - Our product with others

- Analyzingcompetitors products customer expectation
- Difficult to get data
- Mismatch in requirements is possible
- Helps in identifying customer trend

Step VI - Technical Competitive assessment

- Analyzing how the similar companies are handling Towhat they give importance.
- Impact on technical process to meet the customers request.

Step VII - Prioritize Technical Descriptors

- Degree of technical difficulty
- Most needed change is decided
- Target value
- Physical attributes to be considered

Uses of FMEA

Development of system requirements that minimize the likelihood of failures.
Development of methods to design and test systems to ensure that the failures have been eliminated.Evaluation of the requirements of the customer to ensure that those do not give rise to potential failures.
Identification of certain design characteristics that contribute to failures, and minimize or eliminate those effects.
Tracking and managing potential risks in the design. This helps avoid the same failures in future projects. Ensuring that any failure that could occur will not injure the customer or seriously impact a system.

Advantages

Improve the quality, reliability and safety of a product/process
Improve company image and competitiveness
Increase user satisfaction
Reduce system development timing and cost
Collect information to reduce future failures, capture engineering knowledge
Reduce the potential for warranty concerns
Early identification and elimination of potential failure modes
Emphasis problem prevention
Minimize late changes and associated cost
Catalyst for teamwork and idea exchange between functions

Disadvantages

If used as a top-down tool, FMEA may only identify major failure modes in a system. Fault tree analysis (FTA) is better suited for "top-down" analysis. When used as a "bottom-up" tool FMEA can augment or complement FTA and identify many more causes and failure modes resulting in top-level symptoms. It is not able to discover complex failure modes involving multiple failures within a subsystem, or to report expected failure intervals of particular failure modes up to the upper level subsystem or system.

Additionally, the multiplication of the severity, occurrence and detection rankings may result in rank reversals, where a less serious failure mode receives a higher RPN than a more serious failure mode. The reason for this is that the rankings are ordinal scale numbers, and multiplication is not a valid operation on them. The ordinal rankings only say that one ranking is better or worse than another, but not by how much. For instance, a ranking of "2" may not be twice as bad as a ranking of "1," or an "8" may not be twice as bad as a "4," but multiplication treats them as though they are. See Level of measurement for further discussion.