Total Quality Management

Syllabus

UNIT I INTRODUCTION

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Unit – 1

Introduction:

What is quality?

Quality can be interpreted as “Customer’s expressed and implied requirements are met fully: This is a core statement from which some eminent definitions of quality have been derived. They include: “the totality of features and characteristics of a product or service that bears on its ability to meet a stated or implied need”[ISO,1994], “ fitness for use”[Juran,1988], and “ conformance to requirement”[Crosby, 1979]. It is important to note that satisfying the customers’ needs and expectations is the main factor in all these definitions. Therefore it is an imperative for a company to identify such needs early in the product/service development cycle. The ability to define accurately the needs related to design, performance, price, safety, delivery, and other business activities and processes will place a firm ahead of its competitors in the market.

In 1992, Crosby broadened his definition for quality adding an integrated notion to it:”Quality meaning getting everyone to do what they have agreed to do and to do it right the first time is the skeletal structure of an organization, finance is the nourishment, and relationships are the soul.” Some Japanese companies find that “conformance to a standard” too narrowly reflects the actual meaning of quality and consequently have started to use a newer definition of quality as “providing extraordinary customer satisfaction”. There is a trend in modern day competition among Japanese companies to give you rather more in order to ‘delight’ you. So when you buy a lamp bulb which has a ‘mean time between failure’ of 1,000 hours, the Japanese manufacturer will try their best to ensure that you can get at least 20% more. Likewise, when you buy a Japanese brand video tape specifying 180 minutes, it can normally record up to 190 minutes. When you buy a ‘mink’ coat from a department store in Japan, they would invite you to store the fur coat in their temperature-control room during the hot summer season free-of-charge. They call these extra little things as ‘extra-ordinary customer satisfaction’ or ‘delighting the customers’.

Definition of Quality:

Despite being in use for nearly 50 years, the term TQM still poses problems of definition for writers on quality, and consequently often remain a rather abstract term. There are a number of well-known quality definitions. ISO 8402 [ISO, 1986] defines quality as "the totality of features and characteristics of a product or service that bears on its ability to meet a stated or implied need". [Crosby, 1979] defines quality as "conformance to requirement". [Juran, 1988] defines quality as "fitness for use". Japanese companies found the old definition of quality "the degree of conformance to a standard" too narrow and consequently have started to use a new definition of quality as "user satisfaction" [Wayne, 1983]. Table below defines quality from the view point of different quality professionals and to provide a conceptual scheme for the discussion of TQM. This can be classified in three sections: Customer-base, Service and Manufacturing-base, and Value-based definition.

Quality Definition

Customer-based Definitions

- Edwards [1968] Quality consists of the capacity to satisfy wants...
- Gilmore [1974] Quality is the degree to which a specific product satisfies the wants of a specific consumer.·
- Kuehn & Day [1962] In the final analysis of the marketplace, the quality of a product depends on how well it fits patterns of consumer preferences.
- Juran [1988] Quality is fitness for use.
- Oakland [1989] the core of a total quality approach is to identify and meet the requirements of both internal and external customers.

Manufacturing & Service-based definitions

- Crosby [1979] Quality [means] conformance to requirements
- Price [1985] Do it right first time

Value-based definitions

- Broh [1982] Quality is the degree of excellence at an acceptable price and the control of variability at an acceptable cost.
- Feigenbaum [1983] Quality is the degree to which a specific product conforms to a design or specification
- Newell & Dale [1991] Quality must be achieved in five basic areas: people, equipment, methods, materials and the environment to ensure customer's need are met.
- Kanji [1990] Quality is to satisfy customers' requirements continually; TQM is to achieve quality at low cost by involving everyone's daily commitment.

Dimensions of Quality

Quality is an attitude of mind. Quality is in the eye of the consumers. It is the total sum of features liked by the consumers while purchasing a product or service. Let's take an example of product. For some consumers, it is the processor of mobile and for some consumers it is the RAM, which matters. For some consumers both RAM and process of mobile matter. In the case of a restaurant, for some consumer's taste of meal and parking matters, while for some consumers it is the aesthetics of the restaurant that matters. For some consumers both aesthetics and taste of meal matter. Therefore, quality is the specific feature of the product and service that satisfies the needs of the consumers.

Quality is advanced design and engineering technology. Let's take an example of automobile industry where every company is striving hard to deliver at least two new cars in the market. Have you ever imagined how the companies like Toyota, Ford, Volkswagen, Audi, and Mercedes Benz are capable of giving newer model of cars with innovated and advanced features in-built in a car? They are committed to deliver flawless products consistently. Delivering flawless products is called quality. They have precise manufacturing facilities in their plants. Their processes are standardized. Having standardized processes is called quality. The standardization of processes gives them advantage to deliver quality products consistently. They have achieved excellence in quality output. They have no room for errors. Here, Quality is having policy of no room for errors. The Indian companies like Tata Motors, Maruti Suzuki are not far behind in delivering quality products and services internationally. They also have zero error

policy. 5 Quality is also called zero error policy. Quality could be called as giving standard products with zero defects. So, we can say that companies live with quality commitment. The management works very hard to deliver error free standardized products consistently. They strive hard to give innovated products to the market. The ultimate satisfaction of consumers leads to upgrade the standard of living of the society.

Quality Planning

The first and foremost step in quality planning is to plan and know who your customer is, and what are his needs and wants. After optimizing the product or service features, the organization designs and develops the product or service. The next step is to standardize the processes so that the products or services can be standardized. The consistent production of desired quality products and services require high involvement and contribution of employees in planning.

Cost of Quality

Meaning:

Cost of Quality is a term that's widely used and widely misunderstood. The 'cost of quality' isn't the price of creating a quality product or service. It's the cost of NOT creating a quality product or service. Every time work is redone, the cost of quality increases. The examples include the reworking of a manufactured item, the retesting of an assembly, the rebuilding of a tool, the correction of a bank statement etc. The term 'Cost of Quality' is sometimes confusing to some persons. It does not indicate the costs such as costs of producing high quality products or services. The term refers to all of the costs that are incurred to prevent poor quality. Preventing, detecting and dealing with defects cause costs that are called costs of quality.

Cost of quality is a method that allows an organization to determine the extent to which its resources are used for activities that prevent defects or failures. The prior knowledge of the resources used in as the result of internal and external failures allows an organization to determine the potential savings to be gained by implementing process improvements. The cost of quality is defined as the sum of the costs that would not have been required if everything had done right the first time. It refers to the costs incurred due to the lack of quality. Generally, the most effective way to manage quality costs is to avoid having defects in the first place. It is much less costly to prevent a problem from ever happening than it is to find and correct the problem after it has occurred.

There are four types of quality costs namely: (i) Prevention Costs, (ii) Appraisal Costs, (iii) Internal Failure Costs and (iv) External Failure Costs and these four quality costs are divided into two groups. The first two types of quality costs (prevention costs and appraisal costs) are included in one group because these are incurred to prevent poor quality production of products or services. The organizations adopt various quality tools and techniques of total quality management like statistical process control, business process engineering, quality circle, training, etc. to avoid poor or defective quality products and services. The last two types of quality costs ('internal failure costs' and 'external failure costs') are grouped because internal and external failure costs are incurred because defects are produced despite efforts to avoid them therefore these costs are also known as costs of poor quality. Four types of quality costs are briefly explained below:

(i) Prevention Costs

The purpose of this cost is to prevent the number of defects or to avoid quality problems. These costs are associated with the product design, product or service requirements, quality tools implementation, quality planning, quality assurance, quality training, maintenance of the production systems, etc.

These costs follow:

- Process control Costs¬

  It is related with the costs of analysing production processes and implementing standard processes, establishment of specifications for incoming materials, finished products or services etc.
- Quality Planning Costs

  It is related with the planning of the quality standards, product design, reliability, operations, production, new equipment design, teams, inspection, etc.
- Quality Assurance Costs

  It is related with the prevention of defects or errors in the production and maintenance of the quality system.
- Training Costs

  It is related with development, preparation, and training of programs to educate the employees as well as suppliers.

(ii) Appraisal Costs

Appraisal costs are associated with measuring and monitoring activities related to quality. These costs are associated with the efforts to ensure conformance to requirements like test and inspection costs, verification costs, suppliers rating costs, quality audits etc. Appraisal costs are sometimes called inspection costs because these are incurred to identify defective products before the products are shipped to customers.

(iii) Internal Failure

Costs Internal failure costs are all the raw materials and labour expenses incurred due to waste, scrap or rework. These costs occur when the output of production work fails to reach designed & planned standard quality. Internal failure costs are resulted from identification of defects before they are shipped to customers. These costs include scrap, rejected products, reworking of defective units, and downtime caused by quality problem.

(iv) External Failure

Costs External failure costs include all costs incurred due to defected delivery to the customer. These are incurred to remedy defects discovered by customers. These costs occur when products or services that fail to reach design quality standards are not detected until the products are used by the customers. These include repairs, servicing, recall, legal suit settlements, lost sales, warranty claims, handling complaints, returns, transport costs, etc.

Basic Concepts of Total Quality Management

Total Quality Management is mainly concerned with continuous improvement in all works and functional activities of an organization. It is a long term planning. It is the consistent improvement in the quality. It is a never ending process. It describes a management approach to long–term success through customer satisfaction. In a TQM effort, all members of an organization are involved in improving processes, products, services, and create a culture in which they work. The success of the TQM depends on the significant changes in organization design, work processes, and culture. There are various approaches to TQM. Some organizations give importance to the use of quality programme like statistical process control and some organizations give importance to the tool like quality function deployments. Sometimes, the organizations fail to realize quality improvements because of lack of holistic understanding of the quality tool(s) or concept(s) by the entire organization.

"Total Quality Management (TQM) is a comprehensive and structured approach to organizational management that seeks to improve the quality of products and services through ongoing refinements in response to continuous feedback. TQM requirements may be defined separately for a particular organization or may be in adherence to established standards, such as the International Organization for Standardization's ISO 9000 series. TQM can be applied to any type of organization; it originated in the manufacturing sector and has since been adapted for use in almost every type of organization imaginable, including schools, highway maintenance, hotel management, and churches. As a current focus of e-business, TQM is based on quality management from the customer's point of view." (www. searchcio.techtarget.com)

Total Quality Management is a management approach for an organization, centered on quality, based on the participation and commitment of all the internal and external customers and aiming at strategically long-term success through customer satisfaction, and benefits to all members of the organization and to society. It uses strategy, data, and effective communications to integrate the quality discipline into the culture and activities of the organization. So, some organizations adopt a problem-solving focus and concentrate on production as well as customer service processes. They adopt quality circles and team approaches. Some organizations concentrate on error prevention through continuous process improvement and business process reengineering. Most of the successful companies have adopted unique approaches of total quality management according to their own requirements because one approach suitable for one organization may be not suitable for another organization. The reason is the difference in the culture. Every organization has different culture. Total Quality Management requires a set of guiding principles and concepts. The all-over world famous quality gurus like Deming, Juran, Crosby, Ishikawa, as well as many others, have made substantial contribution to the theory and practice of quality management. Their philosophies, concepts, principles have helped to shape the framework for quality management. Quality management as a discipline is incomplete without their contribution and approaches to total quality.

HISTORICAL BACKGROUND OF "QUALITY" CONCEPTS

The word "Quality" is used in every area our life today, if we trace the history of this word it has got root since our Ancient time. Those days also quality was given big weight age and importance. Confucius (China) a famous philosopher before Chris? said that Public administration depends upon seeking qualitative, honest, unselfish and capable public officers.

Kautilya a famous Guru of Arthashastra said during Chandragupta Maurya regime that various principles, values remain in dealing of public. Camera list (a group of German and Austrian public administrator considered) in 16*" -18* century. “a systematic and quality administration is the strength of any organization".

In western countries also if we trace F. W. Taylor a father of scientific management (190O-1930) while narrating various elements of scientific management gave stress on standardization a quality concept to improve production and productivity. Hence if we look back into the history of human evolution it will be observed that quality has always been integrated in to development of human society. It is quite possible that ancient builders and artists were more skilled and quality conscious than what we profess today. However the quality was confined to manual skills, workmanship and proficiency. The entire work of building of houses, halls, temples, producing agricultural equipments as well as arms and ammunition was taken as a matter of art.

In the period before industrial revolution in Europe,"* the entire manufacturing activities was carried out by cotton industries spread over villages and remote areas away from large towns and were having craftsmen. They were further treated as apprentices and after heavy training they were taken over as trained apprentices. Thus skills and quality were passed on from one generation to another generation. With advent of industrial revolution, manufacturing activities were broken into small parts and in turn craftsmen became inspectors and standards started emerging and gradually 3 or 4 classes of workmen were formed as highly skilled, skilled, semiskilled and finally unskilled. After two world wars normal manufacturing was changed to mass production method in almost all areas of engineering units and technology for speedy production. Later on mechanizations and afterwards automation were introduced in manufacturing units. With rise of skill, quality consciousness was given more weightage to ensure quality of product.

Principles of TQM

Total quality management is an organization-wide philosophy to satisfy customers. It is continuously improving the quality of its product and services as well as the quality of processes. The main focus is to meet and exceed customers’ desired expectations. TQM is the task of everyone in the organization (from top to bottom). Teamwork plays a key role in providing quality of products, services and processes. All the stakeholders like the suppliers and the customers are part and parcel of the quality improvement programme. Some of the principles of total quality management are: TQM starts from Top Management, Customer Satisfaction, Create an Ultimate TQM Environment, Employee Involvement and

Commitment, Integrated System Approach, Continuous Improvements in Quality. The details are as follows:

- TQM starts from Top Management

  The quality concept is initiated by the top management. The whole credit of the initiation of total quality management goes to the top management. The top management is responsible to create a quality oriented culture which can prevent problems and improve processes.

- Customer Satisfaction

  Total Quality Management's focus is customers' satisfaction. The customer ultimately determines the level of quality. No matter what an organization does to foster quality improvement, the customer determines whether the efforts are worthwhile or not. The consistent improvements in the processes help to meet customer's expectations and to lower down the customer dissatisfaction level.

- Create an Ultimate TQM Environment

  Every employee must be mentally prepared to make and accept changes in the TQM processes. Make quality a buzz word and as the nature of all the employees. Without it, all the corporate statements, procedures and standards will prove to be rules that are meant to be broken. Employees and departments should not feel burden and as if they are in competition with one another. The ultimate TQM environment will help the employees to feel pride to be member of cross-functional teams in the organization. The organization should increase attention towards the individual's contribution and reward for the self-improvement and cooperative efforts.

- Employee Involvement and Commitment

  Employee involvement is very important in achieving and sustaining high levels of quality. All the employees should participate in working for achieving common goals. Employees must be encouraged and involved to participate in quality improvement programmes. The employees must be empowered and developed to be totally committed for the quality improvement. For that regular training and development of employees is essential for achieving and sustaining high levels of quality.

- Integrated System Approach

  The organizations comprise of different departments for different functions. The focus of all the departments of the organization should be on quality and continuous improvement. Every department in the organization should have a thorough understanding of the quality policies, standards, objectives, and important processes. It will help to generate commitment for continuous improvement. Involve all the departments in cross-functional quality

improvements processes. It is very important to promote a quality work culture in the organization as it helps to achieve excellence and surpass customer expectations. An integrated system ensures continual improvement and helps organizations to gain competitive advantage.

- Continuous Improvements in Quality

  Continuous improvement in quality is a never ending process and the top management is completely involved in the quality improvement process rather than simply supportive of it. For this purpose, a strategic plan is very necessary to ensure quality for long period. The strategic planning includes the formulation of strategic plans that integrates quality as a core process with other processes. The management should focus on identifying and eliminating causes of poor quality consistently. Quality should be made the responsibility of everyone in the organization

Seven Principles by Gerald F. Smith

The following seven principles have been suggested by Gerald F. Smith, in his book 'Quality Problem Solving':

(i) Strive for the quality in all things.
(ii) The customer is the criterion of quality.
(iii) Improve the process or system by which products are produced.
(iv) Quality improvement is continuous and never ending activity.
(v) Workers' involvement is essential.
(vi) Ground decisions and actions in knowledge.
(vii) Encourage team work and co-operation..

LEADERSHIP:-

"Leadership is lifting of man's visions to higher sights, the raising of man's performance to a higher standard, the building of man's personality beyond its normal limitations".

CHARACTERISTICS FOR LEADERSHIP:-

The customers will

- Value people.
- Built supplier partnership.
- Empower people.
- Demonstrate involvement/commitment.
- Strive for excellence.

- Explain and deploy policy. Improve communication. Promote teamwork. Benchmark continuously. Establish system. Encourage collaboration.

LEADERSHIP ROLES:-

1. Producer role.

2. Director role.

3. Coordinator role roles.

4. Checker role.

5. Stimulator role.

6. Mentor role.

7. Innovator role.

8. Negotiator role

Leaders

- Shape the Organization's value
- Promote the Organization's value
- Protect the Organization's value and
- Exemplifies the Organization values

CHARACTERISTICS OF QUALITY LEADERS:

1. They give priority attention to external and internal customers and their needs.

2. They empower, rather than control, subordinates.

3. They emphasis improvement rather than maintenance.

4. They emphasis prevention.

5. They emphasis collaboration rather than competition.

6. They train and coach, rather than direct and supervise.

7. They learn from the problems.

8. They continually try to improve communications.

9. They continually demonstrate their commitment to quality.

10. They choose suppliers on the basis of quality, not price.

11. They establish organizational systems to support the quality effort.

12. They encourage and recognize team effort.

LEADERSHIP CONCEPTS:

A leader should have the following concepts

1. People, Paradoxically, need security and independence at the same time.

2. People are sensitive to external and punishments and yet are also strongly self motivated.

3. People like to hear a kind word of praise. Catch people doing something right, so you can pat them on the back.

4. People can process only a few facts at a time; thus, a leader needs to keep things simple.

5. People trust their gut reaction more than statistical data.

6. People distrust a leader's rhetoric if the words are inconsistent with the leader's actions.

THE 7 HABITS OF HIGHLY EFFECTIVE PEOPLE:

1. Be Proactive

2. Begin with the End in mind

3. Put First Things First

4. Think Win – Win

5. Seek First to Understand, then to Be Understood

6. Synergy

7. Sharpen the Saw (Renewal)

ROLE OF SENIOR MANAGEMENT

1. Management by Wandering Around (MBWA).
2. Strategy of problem solving and decision making.
3. Strong information base.
4. Recognition and Reward system.
5. Spending most of the time on Quality.

6. Communication.
7. Identify and encourage potential employee.
8. Accept the responsibility.
9. To play a role model.
10. Remove road blocks.
11. Study TQM and investigate how TQM is implemented elsewhere.
12. Establish policies related to TQM.
13. Establish „priority of quality" and „customer satisfaction" as the basic policy.
14. Assume leadership in bringing about a cultural change.
15. Check whether the quality improvement programmes are conducted as planned.
16. Become coaches and cheer leaders to implement TQM
17. Generate enthusiasm for TQM activities.
18. Visit other companies to observe TQM functioning.
19. Attend TQM training programme.
20. Teach others for the betterment of society and the surroundings.

QUALITY COUNCIL

A quality council is established to provide overall direction. The council is composed of

- Chief Executive Officer
- Senior Managers
- Coordinator or Consultant
- A representative from the Union

Duties of the council are

- Develop the core values, vision statement, mission statement and quality policy statement
- Develop the strategic long term plan with goals and Annual Quality improvement Program with objectives
- Create the total education and training plan
- Determine and monitor the cost of poor quality
- Determine the performance measures
- Determine projects those improve the process
- Establish multifunctional project and work group teams
- Revise the recognition and rewards system

A typical meeting agenda will have the following items

- Progress report on teams
- Customer satisfaction report
- Progress on meeting goals
- New project teams
- Benchmarking report

Within three to five years, the quality council activities will become ingrained in the culture of the organization.

Quality Statements

VISION STATEMENT:

- It is a short declaration of what an organization aspires to be tomorrow.
  Example:
  Disney Theme Park - Happiest place on earth
  Polaroid - Instant photography
- Successful visions provide a guideline for decision making

MISSION STATEMENT:

It answers the following questions

- Who are the customers?
- What we do?
- How we do it?

It describes the function of the organization. It provides a clear statement of purpose for employees, customers & suppliers

A simpler mission statement is —

To meet customers transportation and distribution needs by being the best at moving their goods on time, safely and damage free.

Example: National Railways

Quality Policy Statement

It is guide for everyone in the organization as to how they should provide products and services to the customers.

Common characteristics are

- Quality is first among equals
- Meet the needs of the internal & external customers
- Equal or exceed competition
- Continuously improve the quality
- Utilize the entire workforce

Strategic Quality Planning

Goals – Long term planning (Eg: in the war)

Objectives – Short term planning (Eg: Capture the bridge)

Goals should

- Improve customer satisfaction, employee satisfaction and process
- Be based on statistical evidence
- Be measurable
- Have a plan or method for its achievement
- Have a time frame for achieving the goal
- Finally, it should be challenging yet achievable

SEVEN STEPS TO STRATEGIC QUALITY PLANNING:

1. Customer needs
2. Customer positioning
3. Predict the future
4. Gap analysis
5. Closing the gap
6. Alignment
7. Implementation

TQM IMPLEMENTATION:

- Begins with Management Commitment
- Leadership is essential during every phase of the implementation process and particularly at the start
- Senior Management should develop an implementation plan
- Timing of the implementation process is very important

DEMING Philosophy

1. Create and publish the Aims and Purposes of the organization.

2. Learn the New Philosophy.

3. Understand the purpose of Inspection.

4. Stop awarding business based on price alone.

5. Improve constantly and forever the System.

6. Institute Training.

7. Teach and Institute Leadership.

8. Drive out Fear, Create Trust and Create a climate for innovation.

9. Optimize the efforts of Teams, Groups and Staff areas.

10. Eliminate exhortations for the Work force.

11a. Eliminate numerical quotas for the work force.

11b. Eliminate Management by objectives.

12 Remove Barriers THAT ROB PEOPLE OF PRIDE OF WORKMANSHIP.

13. Encourage Education and Self-improvement for everyone. Take action to accomplish the transformation.

OBSTACLES (BARRIERS) IN IMPLEMENTING TQM:

1. Lack of Management Commitment

2. Inability to change Organizational culture

3. Improper planning

4. Lack of continuous training and education

5. Incompatible organizational structure and isolated individuals and departments.

6. Ineffective measurement techniques and lack of access to data and results.

7. Paying inadequate attention to internal and external customers

8. Inadequate use of empowerment and teamwork

9. Failure to continually improve

Unit - II

TOTAL QUALITY MANAGEMENT PRINCIPLES

Benefits of TQM

Customer Satisfaction Oriented Benefits

1. Improvement in product quality
2. Improvement in product design
3. Improvement in production flow
4. Improvement in employee morale and quality consciousness
5. Improvement in product service
6. Improvement in market place acceptance

Economic improvement oriented benefits:

1. Reduction in operating costs

2. Reduction in operating losses

3. Reduction in field service costs

4. Reduction in liability exposure

Quality Statements

a. Vision statement,
b. Mission statement and
c. Quality policy statement

a. Vision statement

1. The vision statement is a short declaration of what an organization aspires to be tomorrow.
2. It is the ideal state that might never be reached; but on which one will work hard continuously to achieve. Successful vision provides a brief guideline for decision making.
3. The vision statement should be coined in such a way that the leaders and the employees working in the organization should work towards the achievements of the vision statements.

b. Mission statement

It describes the function of the organization. It provides a clear statement of purpose for employees, customers, and suppliers.

The mission statement answers the following questions: who we are? Who are our customers? ; What we do? and how we do it?

i. The quality policy is a guide for everyone in the organization as to how they provide products and service to the customers.
ii. It should be written by the CEO with feedback from the workforce and be approved by the quality council.
iii. iii. A quality policy is a important requirement of ISO 9000 quality systems.

CUSTOMER FOCUS:

Customer is the King. “Quality what the customer wants” It emphasis on the customer. Customer satisfaction must be the primary goal of any organization, therefore it is essential that every employee in the organization understands the importance of the customer. A satisfied customer will led to increased profits.

CUSTOMER SATISFACTION MODEL:

Customer satisfaction is not an objective but a feeling or attitude. Since it is subjective it is not easy to measure. There are so many facets to a customer experience with a product and service that need to be measured individually to get the accurate picture of customer satisfaction.

Types of Customers:

1. Internal customers

2. External customers

Internal Customers:

1. The customers inside the organization

2. The flow of work, product and service in the organization, each department is dependent on one and another.

3. Every person in a process is considered as the customer of the other preceding operation.

External Customers:

1. Uses the product or service

2. Who purchase the product?

3. Who influence the sale of the Product or services?

CUSTOMER COMPLAINTS:

Customer Satisfaction analysis helps the organization in the following ways:

1. A totally satisfied customer contributes to revenue of the company.

2. A totally dissatisfied customer decrease revenue.

CUSTOMER FEEDBACK:

Customer feedback is required for the following reasons.

1. To discover customer dissatisfaction

2. To identify the customer needs

3. To discover relative priories of quality

4. To compare performance with competition

5. To determine opportunities for improvement

Tools of customer's complaint:

a. Comment card
b. Customer Questionnaire
c. Focus groups
d. Toll free telephone
e. Customer visit
f. Report card
g. Internet & Computers
h. Employee feedback
i. Mass customization

CUSTOMER RETENTION

It means "retaining the customer" to support the business. It is more powerful and effective than customer satisfaction. For Customer Retention, we need to have both "Customer satisfaction & Customer loyalty".

The following steps are important for customer retention.

1. Top management commitment to the customer satisfaction.

2. Identify and understand the customers what they like and dislike about the organization.

3. Develop standards of quality service and performance.

4. Recruit, train and reward good staff.

5. Always stay in touch with customer.

6. Work towards continuous improvement of customer service and customer retention.

7. Reward service accomplishments by the front-line staff.

8. Customer Retention moves customer satisfaction to the next level by determining what is truly important to the customers.

9. Customer satisfaction is the connection between customer satisfaction and bottom line

Benefits of employee involvement:

1. Employees make better decisions using their expert knowledge of the process.
2. Employees are better able to spot and pin-point areas for improvement.
3. Employees are better able to take immediate corrective action.
4. Employee involvement reduces labor/management friction.
5. Employee involvement increases morale.
6. Employees have an increased commitment to goals because they are involved.

EMPLOYEE MOTIVATION

It is the process of stimulating people or attempting to influence other to do your will or accomplish desire goals through the possibility of reward

1. Improves employee involvement

2. Reduces absenteeism and increases turn over

3. Promotes job satisfaction

THEORIES OF MOTIVATION

1.Maslow's Hierarchy of needs

HERZBERG'S TWO FACTOR THEORY

1. Motivation Factor: People are motivated by recognition, responsibility, achievement, advancement and the work itself. These are called as motivators

2. Dissatisfies or Hygiene Factor: Low salary, minimal fringe benefits, poor working conditions, ill defined organizational policy, mediocre technical supervision are dissatisfies which implies they are preventable.

EMPLOYEE WANTS

1. Good pay factor is normally in the middle of ranking.

2. Normal Wants are interesting work, appreciation, involvement job security, Good pay, Promotion/growth, Good working conditions, Loyalty to employees, Help with personal problems arid Tactful Discipline.

EMPLOYEE EMPOWERMENT.

It is an environment in which people have the ability, the confidence and the commitment to take his responsibility and ownership to improve the process and initiate the necessary steps to satisfy customer requirements within well-defined boundaries in order to achieve organizational values and goals. Job Enrichment: Is expanding content of the Job. Job Empowerment: Is expanding the context of the job.

GENERAL PRINCIPLES OR CHARACTERISTICS FOR' EMPOWERING EMPLOYEES

1. Tell people what their responsibilities are.
2. Given the authority equal to the responsibility assigned to them.
3. Set standards of excellence.
4. Give them knowledge information and feedback.
5. Trust them and treat them with dignity and respect. ,

CONDITIONS TO CREATE THE EMPOWERED ENVIRONMENT

1. Everyone should understand the need to change
2. The system need to change to new paradigm.
3. The organization must provide information, education, and skill to its employees.

EMPLOYEE INVOLVEMENT

It is the total involvement from every person at all levels in the organization ASPECTS OF EMPLOYEE INVOLVEMENT

1. Employee motivation
2. Employee Empowerment
3. Teams and Team work
4. Recognition and Reward Schemes
5. Performance Appraisal

TEAMS AND TEAM WORKS

A team can be defined as a group of people working together to achieve common objectives or goals Team work is the cumulative actions of the team during which each member of the team subordinates his individual interest and opinions for the fulfilling of objectives of the group.

TYPES OF TEAMS

Process improvement team: Involved in improvement of sub processes or processes. Usually has 6-10 members. Disbanded when the objective is reached. May include the local supplied and customer depending on the location

Cross functional teams: 6-10 members temporary team. Members are Top management level from various functional areas of management. Discuss complex problems and break down into smaller parts to refer it to various departmental teams for further solution.

Natural work teams: Not voluntary and the total work unit is part of the team. Manager also a part of the team and the management selects the projects to be improved. Managers must also ensure that the entire team is comfortable with each other.

Self directed / self managed work team: Extension of natural work teams but here the group of individuals is empowered not only to do work but manage it. No manger will present but a coordinator (Which will be normally rotated among members) will be appointed. Additional responsibilities of the team hiring/ dismissal, performance evaluation, customer relations, supplier relations, recognition/rewards and training.

CHARACTERISTICS OF SUCCESSFUL TEAMS

1. **Sponsor**: In order to have effective liaison with quality council, there should be sponsor. The sponsor is a person from the quality council; he is to provide support to the organization

2. **Team Charter**: A team charter is a document that defines the team‘s mission boundaries, the background of the problem, the team‘s authority and duties and resources. It also identifies the members and their assigned roles – leader, recorder, time keeper and facilitator.

3. **Team Composition**: Not exceeding 10 members except natural work team and self managed teams.

4**. Training**: The team members should be trained in the problem solving techniques team dynamics and communication skills

5. **Ground Rules:** The team should have separate rules of operation and conduct. Ground rules should be discussed with the members, whenever needed it should be reviewed and revised

6. **Clear objectives, Accountability**: Periodic status report should be submitted to quality council for review

7. **Well defined decision procedure, Resources**: Adequate information should be provided

8. **Trust by the management, Effective problems solving**: Not by hunches or quick fires

9. **Open communication, Appropriate Leadership, Balanced participation and Cohesiveness**

ELEMENTS OF EFFECTIVE TEAM WORK

Regular scheduling with a fixed time limit, purpose, role and responsibilities, activities, decision, results and recognition.

TEAM MANAGEMENT WHEEL

To make a lean more effective a team management wheel has been evolved. The activities are advising, innovating, promoting, developing, organization, producing, inspecting, maintaining and linking. The roles of wheel are advisor, explore, organizer and controller.

STAGES OF TEAM DEVELOPMENT

- Forming stage- Initial stage with only group of individuals and no team work. Team purpose, roles are created.
- Storming Stage -Initial agreement roles are challenged. Hostilities, emerge which may be resolved
- Norming Stage-Formal informal relations get established.
- Performing Stage -Team operates in a successful manner with trust, openness, healthy conflict and decisiveness among the members.
- Maintenance stage – Functioning should not deteriorate with time
- Evaluating Stage – Evaluating team performance

RECOGNITION AND REWARD.

Recognition is a process whereby management shows acknowledgement (Verbal or written) of an employee outstanding performance. Recognition is a form of employee +ve motivation. Reward is a tangible one such as increased salaries, commission, cash bonus, gain sharing etc., to promote desirable behavior. It can be even theatre tickets, dinner for two, a small cash awards, etc., The employees are recognized to improve their morale, show the company's appreciation for Better Performance, create satisfied and motivated workplace and stimulate creative efforts.

INTRINSIC VS EXTRINSIC REWARDS

INTRINSIC REWARDS	**EXTRINSIC REWARDS**
Related to feeling of accomplishment or self 1. Non monetary forms of recognition to achievement of quality improvement goals 2. Celebrations to acknowledge achievement of quality improvement goals 3. Regular expression of appreciation by managers and leaders to employees to acknowledge achievement of quality improvement goals 4. 360o performance appraisals feedback from co-workers, subordinates or customers is incorporated into performance appraisal 5. Formal suggestion system available for individuals to make quality improvement suggestion 6. Developmental based performance appraisals 7. Quality based promotion	Related to pay or compensation issues worth 1. Profit sharing acknowledge 2. Gain sharing 3. Employment security 4. Compensation time 5. Individual based performance systems 6. Quality based performance appraisals

STEVE SMITH'S TWENTY DIFFERENT WAYS TO RECOGNIZE THE EMPLOYEES

- Send thank letter whenever possible
- Develop behind the scenes award
- Create the best ideas of the year booklet
- Feature the quality team of the month and put their picture in prominent place
- Honor peers by recognizing them

- Allow people to attend meetings in your name when you are not available
- nvolve teams with external customers and suppliers by visiting them
- Invite a team for coffee or lunch whenever possible
- Create a visibility will displaying posters, pictures, to thank the contributions of employee
- Credit the team to higher authorities when their ideas are accepted
- Take interest in employee‘s development
- Get the team picture in company newspaper
- Mention the ideas of others during your meetings, so that they are recognized• Write a letter of praise to contributed team member and copy to boss
- Ask people to help you with the project which is difficult but challenging
- Send a team to special seminars, workshops to cover topics they are really interested in
- Ask your boss to send a letter of acknowledgement and thanks
- Honor outstanding contribution with awards
- Have a stock of small gifts to give to people on the spot whom you catch doing things
- right Promote or nominate for promotion, those people who contribute most

PERFORMANCE APPRAISAL.

It is a systematic and objective assessment or evaluation of performance and contribution of individual Needs Identifying employees for salary revision, promotion, transfer, demotion, lay off to determine training needs of employee To take organizational inventory of people To know personal strength and weakness of individuals To validate the selection procedure.

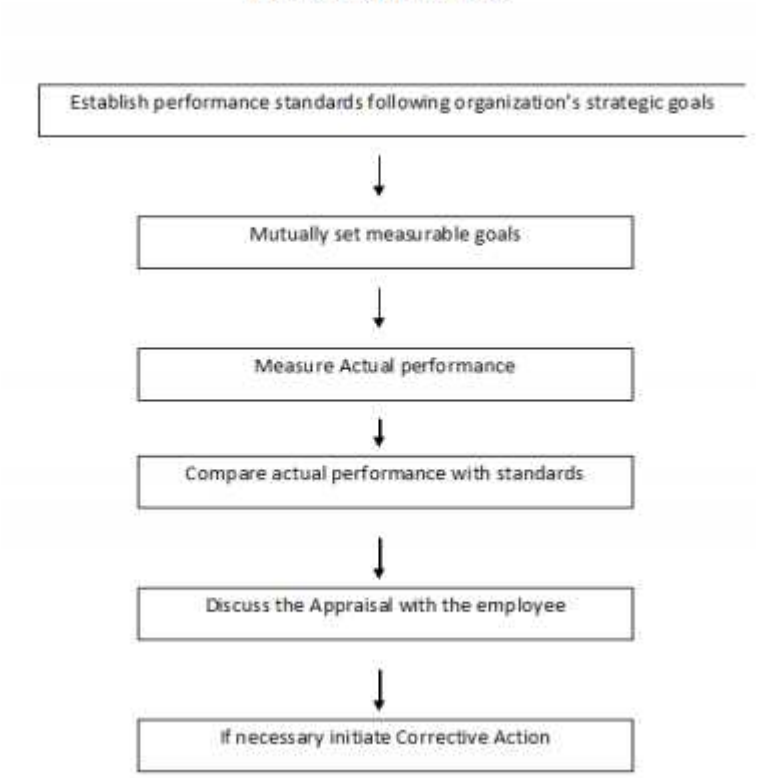
APPRAISAL FORMATS

Ranking (From highest to lowest), Narrative (Telling strength and weakness), Graphics (Graphical display of duties by rating), Forced choice (Placing each employee with a predetermined % like Good 25%, Poor 10% etc) Performance appraisal.

It is a systematic and objective assessment or evaluation of performance and contribution of individual

Needs Identifying employees for salary revision, promotion, transfer, demotion, lay off To determine training needs of employee To take organizational inventory of people To know personal strength and weakness of individuals To validate the selection procedure.

APPRAISAL PROCESS



BENEFITS OF PERFORMANCE APPRAISAL

1. Provides a feedback to identify employees for salary revision, transfer, lay-off

2. Helps in determining training needs of employee

3. Provides organization inventory of people

4. Helps to evaluate personal strength and weakness of individuals

5. To validate the selection procedure.

6. Provide the basis for promotion, demotion etc

7. May provide some information on external factors like family circumstances, health, financial or personal matters that may be affecting the performance

CONTINUOUS PROCESS IMPROVEMENT:

Continuous process improvement is designed to utilize the resources of the organization to achieve a quality-driven culture.

PDCA (plan-do-check-act) PDCA

(plan-do-check-act, sometimes seen as plan-do-check-adjust) is a repetitive four stage model for continuous improvement in business process management.

The PDCA model is also known as the Deming circle/cycle/wheel, Shewhart cycle, control circle/cycle, or plan–do–study–act (PDSA).

PDCA was popularized by Dr. W. Edwards Deming, an American engineer, statistician and management consultant. Deming is often considered the father of modern quality control.

TQM processes are often divided into the four sequential categories: plan, do, check and act.

Plan: Define the problem to be addressed, collect relevant data, and ascertain the problems root cause.

Do: Develop and implement a solution, decide upon a measurement to gauge its effectiveness

Check: Confirm the results through before-and-after-data comparison.

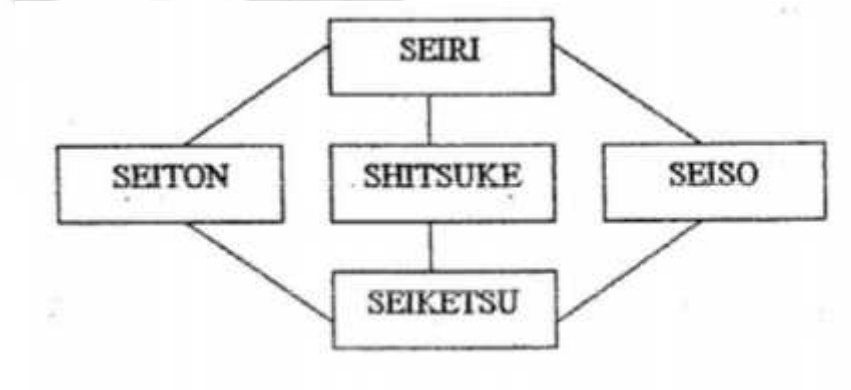
Act: Document the results, inform others about process changes, and make recommendations for the problem to be addressed in the next PDCA cycle.

5S HOUSE KEEPING

This is a house keeping technique used to establish and maintain a productive and quality environment in an organization. This method is invented in Japan which will give safer, more efficient and more productive operation results in boosting of morale of workers, job involvement and satisfaction and ownership of their responsibilities.

JAPANESE TERM	MEANING
SEIRI	Cleaning – Throw away all rubbish unrelated materials in the work place
SEITON	Arranging – Set everything in proper place for quick retrieval and storage
SEISO	Sweeping – Clean the work place, every SEISO thing without fail
SEIKETSU	Maintaining Cleanliness – Standardizing the way of maintaining cleanliness
SHISUKE	Self Discipline – Practice _5S‘ daily. Make it a way or life. This also means commitment

RELATIONSHIP BETWEEN VARIOUS 5S



OBJECTIVES OF 5S

- Create a neat and clean work place
- Create systemize day to day working
- Improve work efficiency
- Standardize work practice
- Improve work discipline
- Improve the quality of work and products

FACTORS IN IMPLEMENTING 5S

Participation by all - Should be understood and practiced by all employees

Top management commitment – CEO and Senior management team need personally commitment practice and supervise the program

Should be self sustaining – Banners, slogan posters and new tutors should be fully utilized to draw attention of every one

Review the program – Every month group of people from different areas of responsibilities plan and evaluate each zone

BENEFITS IN IMPLEMENTING 5S

- Work place becomes proud place to work
- Results in good image and- generates business
- Operations become easier and safer in work place
- Disciplined people
- Improve productivity' and morality
- Better quality awareness
- More usable space
- Less Material handling time
- Less production cost
- Preventive maintenance
- High employee involvement
- Less accidents
- More time to improvement.

KAIZEN: [KAI = Change, ZEN = Good]

Kaizen is the practice of continuous improvement. Kaizen was originally introduced to the west by Masaaki Imai in his book kaizen. The key to Japan's competitive success in 1986. Kaizen is continuous improvement that is based on certain guiding principles.

1. Good processes brings good results
2. Go see for yourself to grasp the current situation
3. Speak with data, manage by facts
4. Take action to contain and correct root causes of the problem
5. Work as a team
6. Kaizen is everybody's business

Kaizen's Wheel:

The Kaizen's improvement focuses on the use of:

1. Value – added and non-value work activities.
2. Muda, which refers to the seven classes of waste- over-production, delay, transportation, processing, inventory, wasted motion, and defective parts.
3. Principles of materials handling and use of one-piece flow.
4. Documentation of standard operation procedures.
5. The five S's for workplace organization.
6. Visual management.
7. Just-in-time principles.
8. Principles of motion study and the use of cell technology.
9. Poka-Yoke.
10. Team dynamics.

SUPPLIER PARTNERSHIP

Partnering is defined as a continuous relationship, between a buying firm and a supplying firm, involving a commitment over an extended time period, an exchange of information, and acknowledgements of the risks and rewards of the relationship. The relationship between customer and supplier should be based upon trust, dedication to common goals and objectives, and an understanding of each parties expectations and values.

Benefits of partnering:

a) Improved quality
b) Reduced cost
c) Increased productivity
d) Increased efficiency
e) Increase market share
f) Increased opportunity for innovation and
g) Continuous improvement of products/services

The three key elements to a partnership relationship are

a) Long term commitment
b) Trust
c) Shared Vision

A commitment to continuous quality improvement cannot be translated into reality without treating supplier as partner

PRINCIPLES OF CUSTOMER / SUPPLIER RELATION

- Both the customer and the supplier are fully responsible for the control quality
- Both the customer and the supplier should be independent of each other and respect each other‘s independence
- The customer is responsible for providing the supplier with clear and sufficient requirements so that the supplier can know precisely what to produce
- Both the customer and the supplier should enter into an non adversarial contract with respect to quality, quality, price, delivery method and terms of payments
- The supplier is responsible for providing the quality that will satisfy the customer and submitting necessary data upon the customer‘s request
- Both the customer and the supplier should decide the methods to evaluate the quality of the product or service to the satisfaction of both parties
- Both the customer and the supplier should establish in the contract the method by which they can reach an amicable settlement of any disputes that may arise
- Both the customer and the supplier should continually exchange information, sometimes using multifunctional teams, in order to improve the product or service quality
- Both the customer and the supplier should perform business activities such as procurement, production and inventory planning, clerical work and system so that an amicable and satisfactory relationship is maintained
- When dealing with business transactions both the customer and the supplier should always have the best interest of the end user in mind

SUPPLIER PARTNERING

It is defined as a continuing relationship, between a buying firm and supplying firm, involving a commitment over an extended time period, an exchange of information, and acknowledgement of the risks and rewards of the relationship.

BENEFITS OF SUPPLIER PARTNERING

Improved Quality Reduced cost Increased Productivity Increased efficiency Increased market share Increased opportunity for innovation Continuous improvement of products/services. .

JAPANES REVIEW OF PARTNERING

The Japanese partnering concept is KELRESTU – developing long term relationships with a few key suppliers rather than having short term relationship with many suppliers.

Key elements to Partnering Long term Commitment Trust Shared vision - To satisfy the end users is the common goal of both supplier and customer.

SUPPLIER SOURCING

Sole sourcing - only one supplier for the entire organization. This may be forced. to happen because of patent, technical specification, raw material location, monopolistic supplier Multiple sourcing - For a single item having two or more supplier, resulting in better quality, better service at lower cost.

SUPPLIER RATING

Supplier rating is done

1. To obtain an overall rating of supplier performance
2. To communicate with suppliers regarding their performance
3. To provide each supplier with a detailed and true record of problems for corrective actions
4. To enhance the relationship between the buyer and the supplier.

PERFORMANCE MEASURES

Performance measures are required for the managers for managing an organization perfectly.

Performance measures are used to measure the following objectives:

1. To establish performance measures and reveal trends.
2. To identify the processes to be improved.
3. To determine the processes gains and losses.
4. To compare the actual performance with standard performance.
5. To provide information for individual and team evaluation
6. To determine overall performance of the organization
7. To provide information for making proper decisions.

What should be measured?

HUMAN RESOURCES

1. Lost time due to accidents, absenteeism
2. Employee turnover
3. Employee satisfaction index
4. Training cost per employee
5. Number of grievances.

Customers

1. Number of complaints from the customers
2. Number of on-time deliveries
3. Warranty data
4. Dealer satisfaction

Production

1. Inventory
2. SPC charts
3. Amount of scrap/rework
4. Machine down time

Research and development

1. New product time to market
2. Design change orders
3. Cost estimating errors

Suppliers

1. On-time delivery
2. Service rating
3. Quality performance
4. Average lead time

Marketing sales

1. Sales expense to revenue
2. New customers

Administration

1. Revenue per employee
2. Purchase order error
3. Billing accuracy
4. Cost of poor quality

STRATEGY:

The quality council has the overall responsibility for the performance measures. It ensures that all the measures are integrated into a total system of measures.

Typical systems contain the following measures:

- Quality
- Cost
- Flexibility
- Reliability
- Innovation

Performance measure presentation:

These are six basic techniques for presenting performance measures. They are

1. Time series graph
2. Control charts
3. Capability Index
4. Taguchi's loss function
5. Cost of poor quality
6. Malcolm Baldrige National Quality Award

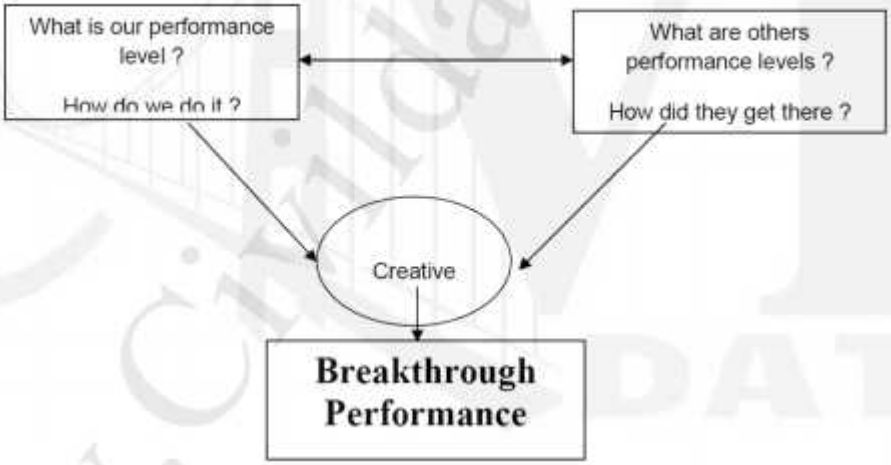
Unit - II

TOTAL QUALITY MANAGEMENT TOOLS

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:



Reasons to Benchmark:

1. It is a tool to achieve business and competitive objectives.
2. It can inspire managers(and organizations) to compete
3. It is time and cost effective.
4. It constantly scans the external environment to impress the process.
5. Potential and useful technological breakthroughs can be located and adopted early.

Process of Benchmarking:

1. Decide what to benchmark
2. Understand current performance
3. Plan
4. Types of benchmarking
5. Study others
6. Learn from the data

Decide what to benchmark:

1. Benchmark can be applied to any business or production process
2. The strategy is usually expressed in terms of mission and vision statements
3. Best to begin with the mission and critical factors
4. Choosing the scope of the benchmarking study
5. Pareto analysis – What process to investigate
6. Cause and effect diagram – for tracing outputs back.

Understand current performance:

1. Understand and document the current process
2. Those working in the process are the most capable of identifying and correcting problems
3. While documenting, it is important to quantify.
4. Care should be taken during accounting information.

Plan:

1. A benchmarking team should be chosen
2. Organizations to serve as a benchmark need to be identified.
3. Time frame should be agreed upon for each of the benchmarking tasks,

Types of benchmarking:

1. Internal
2. Competitive
3. Process

Study others:

Benchmarking studies look for two types of information

- How best the processes are practices
- Measurable results of these practices

Three techniques for conducting the research are,

- Questionnaire
- Site visits
- Focus groups

Learn from the data:

- What is the gap? How much it is?
- Why is there a gap? What does the best-in-class do differently that is better?
- If best-in-class practices were adopted, what would be the resulting improvement?

Benchmarking studies can reveal three different outcomes:

- Negative gap
- Parity
- Positive gap

Significance:

1. Benchmarking is a systematic method by which organizations can measure themselves against the best Industry practices.
2. It promotes superior performance by providing an organized framework through which organization learn how the “best in class” do things.
3. It helps for continuous improvement.
4. Benchmarking inspire managers (and organization) to compete.
5. Through benchmarking process organization can borrow ideas, adopt and refine them to gain competitive advantages.

Quality Function Deployment:

Prerequisite discussion:

Ultimately the goal of QFD is to translate often subjective quality criteria into objective ones. That can be quantified and measured and which can then be used to design and manufacture the product. It is a complimentary method for determining how and where priorities are to be assigned in product development. Quality Function Deployment was developed by Yoji Akao in Japan in 1966.

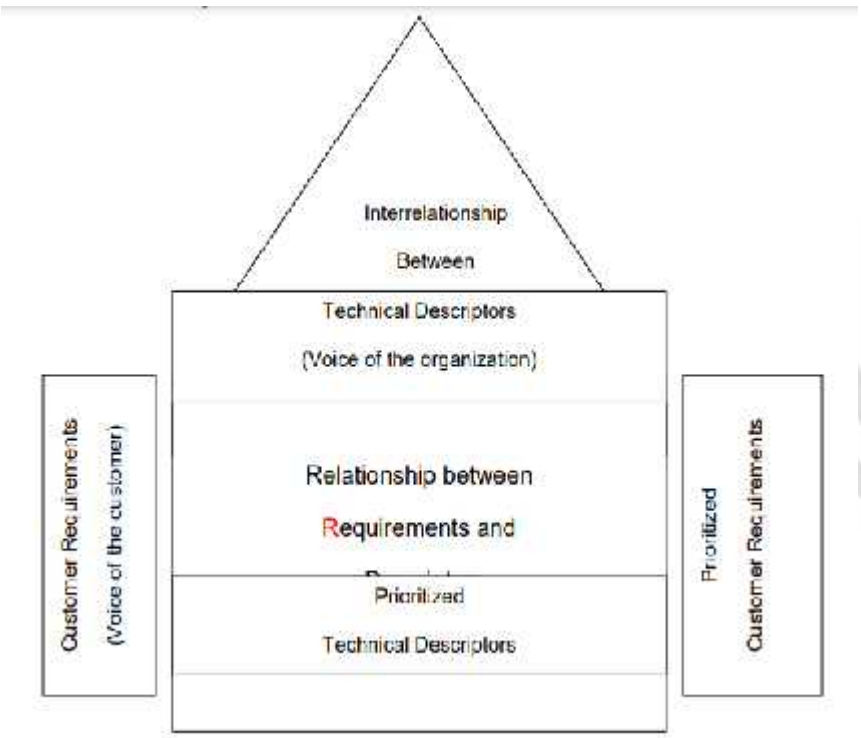
QFD TEAM:

There are two types of teams namely 1. Team for designing a new product 1. Team for improving an existing product

BENEFITS OF QFD :

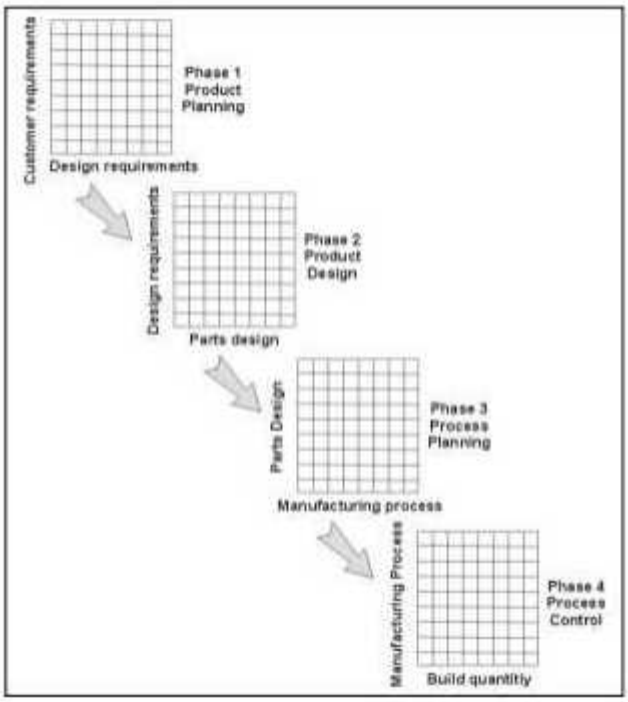
1. Improves Customer satisfaction
    - Creates focus on customer requirements
    - Uses competitive information effectively
    - Prioritizes resources
    - Identifies items that can be acted upon
2. Reduces Implementation Time
    - Decreases midstream design changes
    - Limits post introduction problems
    - Avoids future development redundancies
3. Promotes Team Work Based on consensus
    - Creates communication
    - Identifies actions
4. Provides Documentation
    - Documents rationale for design
    - Adds structure to the information
    - Adapts to changes (a living document)

House of Quality:



THE STEPS IN BUILDING A HOUSE OF QUALITY ARE:

1. List Customer Requirements (WHAT's)
2. List Technical Descriptors (HOW's)
3. Develop a Relationship Matrix Between WHAT's and HOW's
4. Develop an Inter-relationship Matrix between HOW's
5. Competitive Assessments
    a. Customer Competitive Assessments
    b. Technical Competitive Assessments
6. Develop Prioritized Customer Requirements
7. Develop Prioritized Technical Descriptors



Phase 1, Product Planning: Building the House of Quality. Led by the marketing department, Phase 1, or product planning, is also called The House of Quality.

Phase 1 documents customer requirements, warranty data, competitive opportunities, product measurements, competing product measures, and the technical ability of the organization to meet each customer requirement. Getting good data from the customer in Phase 1 is critical to the success of the entire QFD process.

Phase 2, Product Design: This phase 2 is led by the engineering department. Product design requires creativity and innovative team ideas. Product concepts are created during this phase and part specifications are documented. Parts that are determined to be most important to meeting customer needs are then deployed into process planning, or Phase 3.

Phase 3, Process Planning: Process planning comes next and is led by manufacturing engineering. During process planning, manufacturing processes are flowcharted and process parameters (or target values) are documented.

Phase 4, Process Control: And finally, in production planning, performance indicators are created to monitor the production process, maintenance schedules, and skills training for operators. Also, in this phase decisions are made as to which process poses the most risk and controls are put in place to prevent failures.

Significance:

QFD "is a method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the production phase. ...

QFD is a way to assure the design quality while the product is still in the design stage.

- Quality Function Deployment is a planning tool used to fulfill customer expectations
- Quality Function Deployment focuses on customer expectations or requirements, often referred to as voice of the customer.

HOUSE OF QUALITY:

The primary planning tool used in QFD is the house of quality. The house of quality converts the voice of the customer into product design characteristics. QFD uses a series of matrix diagrams, also called 'quality tables', resembles connected houses.

Basic structure of house of quality:

1. Customer requirements
2. Prioritized customer requirements
3. Technical descriptors
4. Relationship matrix
5. Prioritized technical descriptors
6. Competitive assessments
7. Develop a relationship matrix between WHATS AND HOWS

Constructing the house of quality:

Step1: List customer requirements

Step2: List technical descriptors

Step3: Develop a relationship matrix between HOWS

Step4: competitive assessments

Step5: Develop prioritized customer requirements

Step6: Develop prioritized technical descriptors

QUALITY FUNCTION DEVELOPMENT PROCESS:

Phase 1: product planning

Step1: list customer requirements

Step2: List technical descriptors

Step3: Develop a relationship between WHATS AND HOWS

Step4: Develop a interrelationship matrix between HOWS

Step5: Do competitive assessments

Step6: Develop prioritized customer requirements

Step7: Develop prioritized technical descriptors.

Phase 2: part development

Step8: Deploy QFD process down to sub-components level both in terms of requirements and characteristics.

Step9: Deploy the component deployment chart. Relate the critical sub-component control characteristics.

Phase 3: process planning

Step10: Develop the relationship between the critical characteristics and process used to create the characteristics

Step11: Develop the control plan relating critical control to critical processes. Phase 4: production planning

Step 12: Tabulate operating instructions from process requirements

Step13: develop prototype and do testing

Step14: Launch the final product to the market.

APPLICATION:

QFD is applied in a wide variety of services, consumer products, military needs, and emerging technology products. The technique is also included in the new ISO 9000:2000 standard which focuses on customer satisfaction. While many books and articles on "how to do QFD" are available, there is a relative paucity of example matrices available. QFD matrices become highly proprietary due to the high density of product or service information found therein.

TAGUCHI'S QUALITY LOSS FUNCTION

Taguchi's Quality Loss Function concept combines cost, target and variation in one metric with specifications being of secondary importance.

Taguchi has defined quality as the loss imparted to society from the time a product is shipped. Societal losses include failure to meet customer requirements, failure to meet ideal performance and harmful side effects.

CUSTOMERS PERCEIVE QUALITY AS MEETING THE TARGET RATHER THAN JUST MEETING THE SPECIFICATIONS.

There are three common quality loss functions

1. Nominal - the - best.

2. Smaller - the - better.

3. Larger - the – better

Total Productive Maintenance

Dr. Shyamal Gomes

Introduction: TPM - History:

TPM is an innovative Japanese concept. The origin of TPM can betraced back to 1951 when preventive maintenance was introduced in Japan. However the concept of preventive maintenance was taken from USA. Nippondenso was the first company to introduce plant wide preventive maintenance in 1960. Preventive maintenance is the concept wherein, operators produced goods using machines and the maintenance group was dedicated with work of maintaining those machines, however with the automation of Nippondenso, maintenance became a problem as more maintenance personnel were required. So the management decided that the routine maintenance of equipment would be carried out by the operators. (This is Autonomous maintenance, one of the features of TPM). Maintenance took up only essential maintenance works .Thus Nippondenso which already followed preventive maintenance also added Autonomous maintenance done by production operators.

The maintenance crew went in the equipment modification for improving reliability. The modifications were made or incorporated in new equipment. This leads to maintenance prevention. Thus preventive maintenance along with Maintenance prevention and Maintainability Improvement gave birth to Productive maintenance. The aim of productive maintenance was to maximize plant and equipment effectiveness to achieve optimum life cycle cost of production equipment.

In Total Quality Management, Total Productive Maintenance (TPM) is an important and effective tool for the excellence. Total productive maintenance (TPM) is keeping the current plant and equipment at its highest productivity level through cooperation of all areas of the organization. Generally, the first bridge to cross is to break down the traditional barriers between maintenance and production personnel so they are working together. Now, Maintenance management is planning, organizing, controlling maintenance activities such that the overall maintenance cost is the minimum. Maintenance is required not only by equipment but also by other facilities such as building, land, garden, lawn etc.

Maintenance lawns and garden of the premises of the factory may be important aspects of environment protection especially in process industries. However, maintenance of equipment used directly in the production process is much more important for a business enterprise. Maintenance of facilities and equipment is done to ensure that these are in good working condition at any point of time and if breakdowns occur, necessary repairs should be done in order to bring these back to running condition as early as possible.

What is Maintenance and what is Maintenance Management?

Maintenance is an initiatives that covers all those operations such as monitoring , inspecting, adjusting, repairing and / or doing whatever is necessary to keep a machine, a facility, a piece of equipment or transportation vehicle in the proper working conditions. Maintenance Management is reviewing, planning, organizing and controlling maintenance activities such that the overall maintenance cost is the minimum.

Maintenance development stages:

Break-down maintenance: is remedial or corrective maintenance that occurs when equipment fails and must be repaired on an emergency or priority basis. It means that people waits until equipment fails and

repair it. Such a thing could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost.

Obviously this is not an ideal way of keeping equipment or machinery operating because of the down time of the equipment or machinery when break down occurs.

This results in loss of production due to idling of equipment and machinery and consequently idling of labor also. Ultimately customer's orders cannot be delivered as promised.

Preventive maintenance (1951):

It is a daily maintenance (cleaning, inspection, oiling and retightening), design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. It is further divided into periodic maintenance and predictive maintenance. Just like human life is extended by preventive medicine, the equipment service life can be prolonged by doing preventive maintenance.

Periodic maintenance (Time based maintenance - TBM):

Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems.

Predictive maintenance:

This is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life. Compared to periodic maintenance, predictive maintenance is condition based maintenance. It manages trend values, by measuring and analyzing data about deterioration and employs a surveillance system, designed to monitor conditions through an on-line system. In this concept, OPERATORS operates the machines for production and the MAINTENANCE group is responsible with work of maintaining those machines, however, maintenance became a problem as more maintenance personnel are required.

Autonomous Maintenance:

When the maintenance part is not always controlled by outside forces like maintenance group and the operator can able to handle it everyday, called autonomous maintenance.

Productive Maintenance:

Thus preventive maintenance along with Maintenance prevention and Maintainability Improvement gave birth to Productive maintenance. According to Nakajima, 'Total productive Maintenance is productive maintenance carried out by all employees through small group activities. In TPM, the machine operator is responsible for the maintenance of the machine as well as its operation.

What is Total Productive Maintenance?

It can be considered as the medical science of machines. Total Productive Maintenance (TPM) is a maintenance program which involves a newly defined concept for maintaining plants and equipment. TPM seeks to maximize equipments effectiveness throughout the life time of that equipment. It strives to maintain optimum equipment conditions in order to prevent unexpected break downs, speed loses, and quality defects arising from process activities.

Total = all encompassing by maintenance and production individuals working together.

Productive = Production of goods and services that meet or exceed customer's expectations.

Maintenance = Keeping equipments and plant in as good as or better than the original condition at all times.

The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction.

TPM brings maintenance into focus as a necessary and vitally important part of the business. It is no longer regarded as a nonprofit activity. Down time for maintenance is scheduled as a part of the manufacturing day and, in some cases, as an integral part of the manufacturing process. The goal is to hold emergency and unscheduled maintenance to a minimum.

Why TPM / the objective of TPM:

TPM was introduced to achieve the following objectives:

- Avoid wastage in a quickly changing economic environment.
- Producing goods without reducing product quality.
- Reduce cost.
- Produce target quantity at the earliest possible time.
- Goods send to the customers must be non defective.

To fulfill those objectives and the goal TPM has dual targets:

1. Zero defects, zero accidents and zero loss;
2. Zero breakdown (100% equipment availability). It is true that when defects and breakdown are reduced the operating costs come down and hence productivity increases and the products are delivered to the customer at a reasonable cost and at the right time.

Six core principles of TPM:

1. Obtain Minimum 90% OEE (Overall Equipment Effectiveness) Run the machines even during lunch. (Lunch is for operators and not for machines!)
2. Operate in a manner, so that there are no customer complaints.
3. Reduce the manufacturing cost by 30%.
4. Achieve 100% success in delivering the goods as required by the customer.
5. Maintain a accident free environment.
6. Increase the suggestions by 3 times. Develop Multiskilled and flexible workers.

Now the question comes -why should we consider TPM is an effective tech. for continuous Improvement? Because it aims to maximize equipment effectiveness – overall effectiveness. Various departments – engineering, operations, and Maintenance – collectively implement it. Involves every single employee from the top management to workers in the shop floor. In TPM the machine operator is responsible for the maintenance of the machine as well as its operation.

However, Smart TPM requires the following:

- Restoring equipment to a like – new condition.
- Having operators involved in the maintenance of the equipment.
- Improving maintenance efficiency and effectiveness.

- Training the labour force to improve upon their job skills.
- Equipment management and maintenance prevention, which is considered inherent in the reliability strategy and
- The effective use of preventive and predictive maintenance technology.

Therefore, the aim of productive maintenance was to maximize plant and equipment effectiveness to achieve optimum life cycle cost of production equipment. In 1971, the Japan Institute of Plant Maintenance (JIPM) defined TPM as a system of maintenance. JIPM introduced TPM award to respective organization as a standard of quality in 1972.

Motives of TPM

1. Adoption of life cycle approach for improving the overall performance of production equipment.
2. Improving productivity by highly motivated workers which is achieved by job enlargement.
3. The use of voluntary small group activities for identifying the cause of failure, possible plant and equipment modifications.

Uniqueness of TPM

The major difference between TPM and other concepts is that the operators are also made to involve in the maintenance process. The concept of "I (Production operators) Operate, You (Maintenance department) fix" is not followed.

TPM Objectives

1. Achieve Zero Defects, Zero Breakdown and Zero accidents in all functional areas of the organization.
2. Involve people in all levels of organization.
3. Form different teams to reduce defects and Self Maintenance.

Direct benefits o f TPM

1. Increase productivity and OPE (Overall Plant Efficiency) by 1.5 or 2 times.
2. Rectify customer complaints.
3. Reduce the manufacturing cost by 30%.
4. Satisfy the customer’s needs by 100 % (Delivering the right quantity at the right time, in the required quality.)
5. Reduce accidents. 6. Follow pollution control measures.

Indirect benefits of TPM

1. Higher confidence level among the employees.
2. Keep the work place clean, neat and attractive.
3. Favorable change in the attitude of the operators.
4. Achieve goals by working as team.
5. Horizontal deployment of a new concept in all areas of the organization.
6. Share knowledge and experience.
7. The workers get a feeling of owning the machine

Steps in introduction of TPM in an organization:

PREPARATORY STAGE:

STEP 1 - Announcement by Management to all about

TPM introduction in the organization:

Proper understanding, commitment and active involvement of the top management in needed for this step. Senior management should have awareness programmes, after which announcement is made to all. Publish it in the house magazine and put it in the notice board. Send a letter to all concerned individuals if required.

Initial education and propaganda for TPM:

Training is to be done based on the need. Some need intensive training and some just an awareness. Take people who matters to places where TPM already successfully implemented.

Setting up TPM and departmental committees:

TPM includes improvement, autonomous maintenance, quality maintenance etc., as part of it. When committees are set up it should take care of all those needs.

Establishing the TPM working system and target:

Now each area is benchmarked and fix up a target for achievement.

A master plan for institutionalizing: Next step is implementation leading to institutionalizing wherein TPM becomes an organizational culture. Achieving PM award is the proof of reaching a satisfactory level.

STAGE - B - INTRODUCTION STAGE

This is a ceremony and we should invite all. Suppliers as they should know that we want quality supply from them. Related companies and affiliated companies who can be our customers, sisters concerns etc. Some may learn from us and some can help us and customers will get the communication from us that we care for quality output.

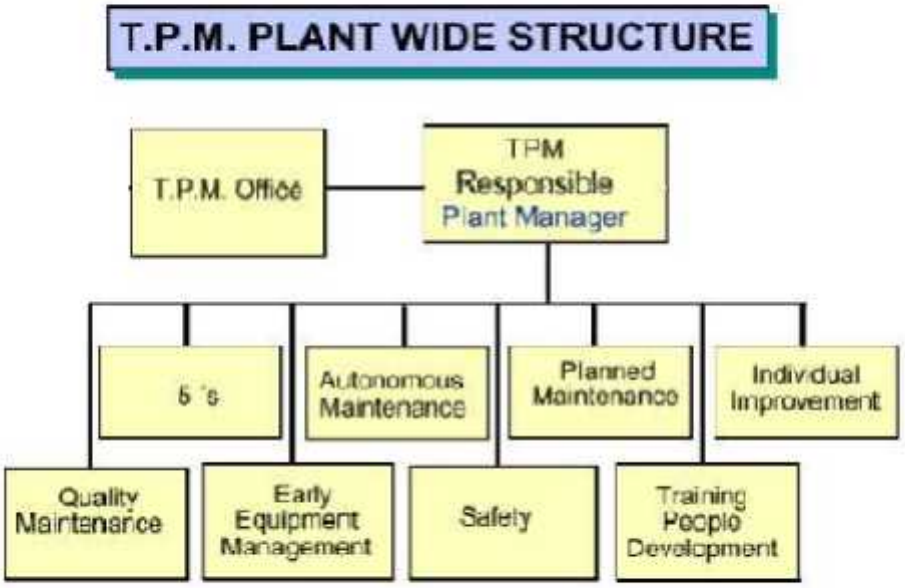
STAGE C – IMPLEMENTATION

In this stage eight activities are carried which are called eight pillars in the development of TPM activity. Of these four activities are for establishing the system for production efficiency, one for initial control system of new products and equipment, one for improving the efficiency of administration and are for control of safety, sanitation as working environment.

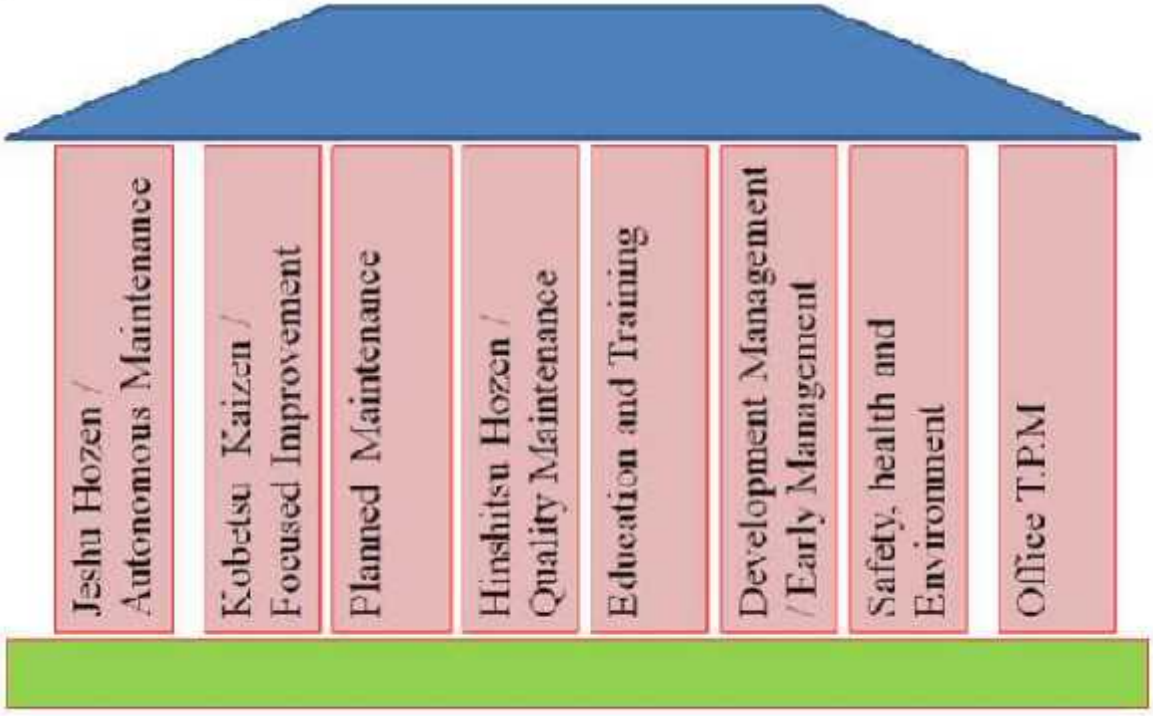
STAGE D - INSTITUTIONALISING STAGE

By all their activities one would has reached maturity stage. Now is the time for applying for PM award. Also think of challenging level to which you can take this movement.

Organization Structure for TPM Implementation:



TPM Pillars:



PILLAR -1 - JISHU HOZEN (Autonomous maintenance):

This pillar is geared towards developing operators to be able to take care of small maintenance tasks, thus freeing up the skilled maintenance people to spend time on more value added activity and technical repairs. The operators are responsible for upkeep of their equipment to prevent it from deteriorating.

Policy:

1. Uninterrupted operation of equipments.
2. Flexible operators to operate and maintain other equipments.
3. Eliminating the defects at source through active employee participation. 4. Stepwise implementation of JH activities.

JISHU HOZEN Targets:

1. Prevent the occurrence of 1A / 1B because of JH.
2. Reduce oil consumption by 50%
3. Reduce process time by 50%
4. Increase use of JH by 50%

Steps in JISHU HOZEN:

1. Preparation of employees.
2. Initial cleanup of machines.
3. Take counter measures
4. Fix tentative JH standards
5. General inspection
6. Autonomous inspection
7. Standardization and
8. Autonomous management.

Each of the above mentioned steps is discussed in detail below.

1. Train the Employees: Educate the employees about TPM, Its advantages, JH advantages and Steps in JH. Educate the employees about abnormalities in equipments.
2. Initial cleanup of machines:
    - Supervisor and technician should discuss and set a date for implementing step1 o Arrange all items needed for cleaning
    - On the arranged date, employees should clean the equipment completely with the help of maintenance department.
    - Dust, stains, oils and grease has to be removed. o Following are the things that has to be taken care while cleaning. They are Oil leakage, loose wires, unfastened nits and bolts and worn out parts.
    - After clean up problems are categorized and suitably tagged. White tags are place where problems can be solved by operators. Pink tag is placed where the aid of maintenance department is needed.
    - Contents of tag are transferred to a register.
    - Make note of area which were inaccessible.

- Finally close the open parts of the machine and run the machine.

3. Counter Measures:
    - Inaccessible regions had to be reached easily. E.g. If there are many screw to open a fly wheel door, hinge door can be used. Instead of opening a door for inspecting the machine, acrylic sheets can be used.
    - To prevent work out of machine parts necessary action must be taken.
    - Machine parts should be modified to prevent accumulation of dirt and dust.
4. Tentative Standard :
    - JH schedule has to be made and followed strictly.
    - Schedule should be made regarding cleaning, inspection and lubrication and it also should include details like when, what and how.
5. General Inspection :
    - The employees are trained in disciplines like Pneumatics, electrical, hydraulics, lubricant and coolant, drives, bolts, nuts and Safety.
    - This is necessary to improve the technical skills of employees and to use inspection manuals correctly.
    - After acquiring this new knowledge the employees should share this with others.
    - By acquiring this new technical knowledge, the operators are now well aware of machine parts.
6. Autonomous Inspection :
    - New methods of cleaning and lubricating are used.
    - Each employee prepares his own autonomous chart / schedule in consultation with supervisor.
    - Parts which have never given any problem or part which don't need any inspection are removed from list permanently based on experience.
    - Including good quality machine parts. This avoids defects due to poor JH. o Inspection that is made in preventive maintenance is included in JH.
    - The frequency of cleanup and inspection is reduced based on experience.
7. Standardization:
    - Up to the previous stem only the machinery / equipment were the concentration. However in this step the surroundings of machinery are organized. Necessary items should be organized, such that there is no searching and searching time is reduced.
    - Work environment is modified such that there is no difficulty in getting any item. o Everybody should follow the work instructions strictly.
    - Necessary spares for equipments is planned and procured.
8. Autonomous Management :
    - OEE and OPE and other TPM targets must be achieved by continuous improve through Kaizen.
    - PDCA (Plan, Do, Check and Act) cycle must be implemented for Kaizen.

PILLAR -2 – KOBETSU KAIZEN:

"Kai" means change, and "Zen" means good (for the better). Basically kaizen is for small improvements, but carried out on a continual basis and involve all people in the organization. Kaizen is

opposite to big spectacular innovations. Kaizen requires no or little investment. The principle behind is that "a very large number of small improvements are more effective in an organizational environment than a few improvements of large value. This pillar is aimed at reducing losses in the workplace that affect our efficiencies. By using a detailed and thorough procedure we eliminate losses in a systematic method using various Kaizen tools. These activities are not limited to production areas and can be implemented in administrative areas as well.

Kaizen Target:

Achieve and sustain zero loses with respect to minor stops, measurement and adjustments, defects and unavoidable downtimes. It also aims to achieve 30% manufacturing cost reduction.

Tools used in Kaizen:

1. Problem analysis
2. (Root cause) Why - Why analysis
3. Summary of losses
4. Kaizen register
5. Kaizen summary sheet.

PILLAR -3 - PLANNED MAINTENANCE:

It is aimed to have trouble free machines and equipments producing defect free products for total customer satisfaction. This breaks maintenance down into 4 "families" or groups which were defined earlier.

1. Preventive Maintenance

2. Breakdown Maintenance

3. Corrective Maintenance

4. Maintenance Prevention with Planned Maintenance we evolve our efforts from a reactive to a proactive method and use trained maintenance staff to help train the operators to better maintain their equipment.

Policy:

1. Achieve and sustain availability of machines

2. Optimum maintenance cost.

3. Reduces spares inventory.

4. Improve reliability and maintainability of machines.

Target:

1. Zero equipment failure and break down.

2. Improve reliability and maintainability by 50 %

3. Reduce maintenance cost by 20 %

4. Ensure availability of spares all the time.

Six steps in planned maintenance:

1. Equipment evaluation and recoding present status.

2. Restore deterioration and improve weakness

3. Building up information management system.

4. Prepare time based information system, select equipment, parts and members and map out plan.

5. Prepare predictive maintenance system by introducing equipment diagnostic techniques and

6. Evaluation of planned maintenance.

PILLAR -4 – Hinshitsu Hozen or QUALITY MAINTENANCE:

It is aimed towards customer delight through highest quality through defect free manufacturing. Focus is on eliminating non conformances in a systematic manner, much like Focused Improvement. We gain understanding of what parts of the equipment affect product quality and begin to eliminate current quality concerns, and then move to potential quality concerns. Transition is from reactive to proactive (Quality Control to Quality Assurance). QM activities are to set equipment conditions that preclude quality defects, based on the basic concept of maintaining perfect equipment to maintain perfect quality of products. The condition is checked and measure in time series to very that measure values are within standard values to prevent defects. The transition of measured values is watched to predict possibilities of defects occurring and to take counter measures before hand.

Policy:

1. Defect free conditions and control of equipments.

2. QM activities to support quality assurance.

3. Focus of prevention of defects at source

4. Focus on poka-yoke. (fool proof system)

5. In-line detection and segregation of defects.

6. Effective implementation of operator quality assurance.

Target:

1. Achieve and sustain customer complaints at zero

2. Reduce in-process defects by 50 % 3. Reduce cost of quality by 50 %.

Pillar – 5: Development Management / Early Management:

Early management or development management helps in drastically reducing the time taken to receive, install, and set – up newly purchased equipments (known as vertical start – up). Early management can also be used for reducing the time to manufacture a new product in the factory.

PILLAR 6 – TRAINING and EDUCATION:

It is aimed to have multi-skilled revitalized employees whose morale is high and who has eager to come to work and perform all required functions effectively and independently. Education is given to operators to upgrade their skill. It is not sufficient know only "Know-How" by they should also learn

"Know-why". By experience they gain, "Know-How" to overcome a problem what to be done. This they do without knowing the root cause of the problem and why they are doing so. Hence it become necessary to train them on knowing "Know-why". The employees should be trained to achieve the four phases of skill. The goal is to create a factory full of experts.

The different phase of skills is:

Phase – 1: Do not know

Phase – 2: Know the theory but cannot do.

Phase – 3: Can do but cannot teach

Phase – 4: Can do and also teach

Policy:

1. Focus on improvement of knowledge, skills and techniques.

2. Creating a training environment for self learning based on felt needs.

3. Training curriculum / tools /assessment etc conductive to employee revitalization

4. Training to remove employee fatigue and make work enjoyable.

Target:

1. Achieve and sustain downtime due to want men at zero on critical machines.

2. Achieve and sustain zero losses due to lack of knowledge / skills / techniques

3. Aim for 100 % participation in suggestion scheme.

PILLAR- 7: SAFETY, HEALTH AND ENVIRONMENT

Target:

1. Zero accident,

2. Zero health damage

3. Zero fires.

In this area focus is on to create a safe workplace and a surrounding area that is not damaged by our process or procedures. This pillar will play an active role in each of the other pillars on a regular basis.

A committee is constituted for this pillar which comprises representative of officers as well as workers. The committee is headed by senior vice President (Technical). Utmost importance to Safety is given in the plant. Manager (Safety) is looking after functions related to safety. To create awareness among employees various competitions like safety slogans, Quiz, Drama, Posters, etc. related to safety can be organized at regular intervals.

PILLAR -8: OFFICE TPM Office

TPM should be started after activating four other pillars of TPM (JH, KK, QM, PM). Office TPM must be followed to improve productivity, efficiency in the administrative functions and identify and eliminate losses. This includes analyzing processes and procedures towards increased office automation. Office TPM addresses twelve major losses.

They are

1. Processing loss

2. Cost loss including in areas such as procurement, accounts, marketing, sales leading to high inventories

3. Communication loss

4. Idle loss

5. Set-up loss

6. Accuracy loss

7. Office equipment breakdown

8. Communication channel breakdown, telephone and fax lines

9. Time spent on retrieval of information

10. Non availability of correct on line stock status

11. Customer complaints due to logistics

12. Expenses on emergency dispatches/purchases

Conclusion:

Today, with competition in industry at an all time high, TPM may be the only thing that stands between success and total failure for some companies. It has been proven to be a program that works. It can be adapted to work not only in industrial plants, but in construction, building maintenance, transportation, and in a variety of other situations. Employees must be educated and convinced that TPM is not just another "program of the month" and that management is totally committed to the program and the extended time frame necessary for full implementation. If everyone involved in a TPM program does his or her part, an unusually high rate of return compared to resources invested may be expected.

FAILURE MODE AND EFFECTS ANALYSIS

Prerequisite discussion:

Failure Mode and Effects Analysis (FMEA) is a method designed to: Identify and fully understand potential failure modes and their causes, and the effects of failure on the system or end users, for a given product or process. Assess the risk associated with the identified failure modes, effects and causes, and prioritize issues for corrective action. Identify and carry out corrective actions to address the most serious concerns. An FMEA is an engineering analysis done by a cross-functional team of subject matter experts that thoroughly analyzes product designs or manufacturing processes early in the product development process. Finds and corrects weaknesses before the product gets into the hands of the customer. If effectively used throughout the product life cycle, it will result in significant improvements to reliability, safety, quality, delivery, and cost.

MEANING:

Failure mode and effect analysis also known as risk analysis is a preventive measure to systematically display the causes, effects, and possible actions regarding observed failures.

Objectives of FEMA:

1. The objective of FEMA is to anticipate failures and prevent them from occurring. FEMA prioritizes failures and attempts to eliminate their causes.
2. FEMA is an engineering technique is used to define, identify and eliminate known and or potential failures, problems, errors which occur in the system, design, process and service before they reach the customer.
3. FEMA is a before the event action and is done when existing systems products processes are changed or redesigned.
4. FEMA is a never ending process improvement tool.

Types of FEMA:

1. System FEMA
2. Design FEMA
3. Process FEMA
4. Service FEMA
5. Equipment FEMA
6. Maintenance FEMA
7. Concept FEMA
8. Environmental FEMA

Benefits of FEMA:

1. Improve product/process reliability and quality.
2. Increase customer satisfaction.
3. Early identification and elimination of potential product/process failure modes.
4. Prioritize product or process deficiencies
5. Capture engineering/organization knowledge
6. Document and track the actions taken to reduce risk
7. Provide focus for improved testing and development.
8. Minimize late changes and associated cost.
9. Act as catalyst for teamwork and idea exchange between functions

Meaning of reliability:

Reliability is one of the most important characteristics of any product, no matter what its application. Reliability is also an important aspect when dealing with customer satisfaction. Whether the customer is internal or external. Customers want a product that will have a relatively long service life, with long times between failures. However, as products become more complex in nature, traditional design methods are not adequate for ensuring low rates of failure. This problem gave rise to the concept of designing reliability into the product itself.

Reliability requirements:

The acceptance of a certain product or process is subject to meeting certain set of given requirements for reliability of the product or process. It is however important to realize that although the definition for reliability is relatively simple, the customer and the supplier may have different definitions

of what failure constitute. This common agreement on what constitutes reliability should be defined in terms of influence on other related systems, the complexity of the failure, and finally the relative criticality of the failure.

Failure rate:

A vast majority of products follow a very familiar pattern of failure. When no information is known about the reliability or conversely, failure of a product, component, system or process, except the failure rate which is a constant, periods of failure can conveniently be modeled by an exponential distribution. The failures of most products can be classified in to three main categories: debug, chance, and wear out. The first of these includes a high failure rate at the initial stages because of inappropriate use or flaws in the design or manufacturing. The next category is the failure of the product due to accidents, poor maintenance, or limitations on the design. The final category covers failure after the product or process has performed as expected for at least the amount of time given by the manufacturer as the product or process life. A successful design or process ideally fails only in this method.

STAGES OF FEMA.

The FEMA methodology has four stages: they are:

Stage1: specifying possibilities

1. Functions
2. Possible failure modes
3. Root causes
4. Effects
5. Detection/prevention

Stage 2: quantifying Risk

1. probability of cause
2. severity of effect
3. effectiveness of control to prevent cause
4. Risk priority number

Stage3: correcting High risk causes

1. prioritizing work
2. detailing action
3. assigning action responsibility
4. check points on completion

Stage4: re-evaluation of risk

1. Recalculation of risk priority number

STAGES OF FEMA:

1. **Specifying possibilities**
   a. functions
   b. possible failure modes

c. root causes
d. effects
e. detection/prevention

2. **Quantifying risk**
   a. probability of cause
   b. severity of effect
   c. Effectiveness of control to prevent cause.
   d. Risk priority number.
3. **Correcting high risk causes**
   a. prioritizing work
   b. detailing action
   c. Assigning action responsibility.
   d. Checks points on completion.
4. **Re-evaluation of risk**
   a. recalculation of risk priority number

The design of FEMA document:

1. FEMA number
2. item
3. Design responsibility
4. prepared by
5. model number/year
6. key date
7. FEMA date
8. Core team
9. Item function
10. potential failure mode
11. potential effects of failure
12. severity
13. classification
14. potential causes mechanisms of failure
15. occurrence
16. current design controls
17. detection
18. risk priority number
19. Recommend actions Responsibility and target completion dates
20. actions taken

The process of FEMA and documentation

1. process function requirements
2. potential failure mode
3. potential effects of failure
4. severity
5. classification
6. potential causes mechanisms of failure

7. occurrence
8. current process controls
9. detection

SIGNIFICANCE:

Understanding the fundamentals and procedure of FMEAs, including the concepts and definitions preparation steps for each FMEA project applying lessons learned and quality objectives providing excellent facilitation and implementing an effective company-wide FMEA process. Implementing FMEA success factors will uniformly ensure FMEAs achieve safe, reliable and economical products and processes.

APPLICATION:

FMEA OF A CAR DOOR.

An automobile manufacturer had a peculiar problem of corrosion of interior door panel in a car. This affected a appearance functioning and added cost of repaint, etc.

The failure effect led to severity ranking of seven.

The probability of occurrence of corrosion rank 6

The probability of detection of corrosion rank 7

The rpn number is 294 which is high.

The thickness of the paint coating on the interior door panel was revised and raised by 150mm.

The probability of occurrence of corrosion reduced from 6 to 2.

The probability of detection of corrosion reduced from 7 to 2.

Therefore The RPN number is reduced from 294 to 28.

Therefore by conducting FMEA study and carrying out corrective and preventive. .actions one can prevent failures from reaching the customers.

UNIT – IV (Quality Systems)

QUALITY AUDITING:

The term Audit refers to a regular examination and checking of accounts or financial records, settlement or adjustment of accounts. It also refers to checking, inspection and examination of Production Processes.

PURPOSE OF QUALITY AUDIT:

- To establish the adequacy of the system.
- To determine the effectiveness of the system.
- To afford opportunities for system analysis.
- To help in problem solving
- To make decision making easier etc.

TYPES OF QUALITY AUDIT :

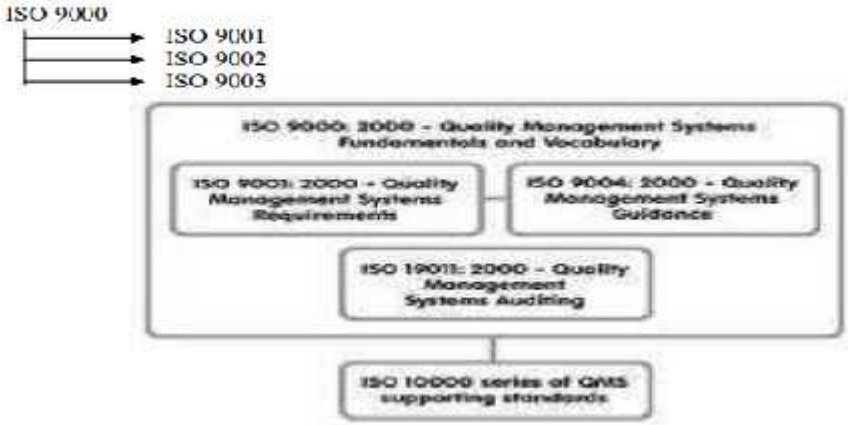
1. First – Party Audit.
2. Second – Party Audit.
3. Third – Party Audit.

Quality audit can also be classified on the basis of the area taken into account for the audit such as

- System Audit.
- Process Audit.
- Product Audit.
- Adequacy Audit.
- Compliance Audit.

ISO 9000 STANDARDS

ISO 9000:2000



ISO 9001

Design, Development, Production, Installation & Servicing

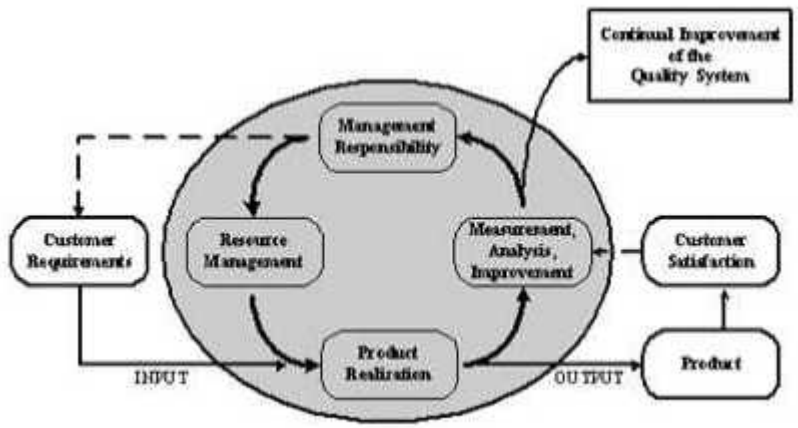
ISO 9002 Production, Installation & Servicing

ISO 9003

Inspection & Testing

ISO 9004

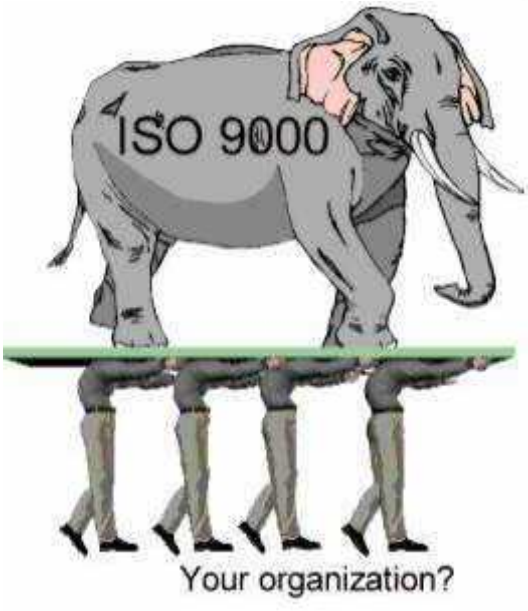
Provides guidelines on the technical, administrative and human factors affecting the product or services.



ISO 9000: 2000 Sector Standard

BENEFITS OF ISO 9000 STANDARDS:

- Achievement of international standard of quality.
- Value for money
- Customer satisfaction.
- Higher productivity.
- Increased profitability
- Improved corporate image
- Access to global market
- Growth of the organization
- Higher morale of employees



CLAUSES (ELEMENTS) OF ISO 9000 (During the year 1987)

Management Responsibility

- Adequate resources for the verification activities
- Need for trained personnel
- Work and verification activities including audits
- A Management Representative to be identified
- Review the Quality System performance and customer complaints periodically
  - Quality System
  - Contract review
  - Design Control
  - Documents Control
  - Purchasing
  - Purchaser – Supplied Product
  - Product Identification and Traceability

- Process Control 4.10 Inspection and Testing
- Inspection Measuring and Test Equipment
- Inspection and Test Status
- Control of Non – Conforming Product
- Corrective Action
- Handling, Storage, Packaging and Delivery
- Quality Records
- Internal Quality Audits
- Training
- Servicing
- Statistical Techniques

CLAUSES (ELEMENTS) OF ISO 9000 (During the year 2000)

1. Scope
2. Normative Reference
3. Terms and Definitions
4. Quality Management System (QMS)
   - General Requirements
   - Documentation
5. Management Responsibility
   - Management Commitment
   - Customer Focus
   - Quality Policy
   - Planning
   - Responsibility, Authority and Communication
   - Management Review
6. Resource Management
   - Provision of Resources

Human Resources
Infrastructure
Work Environment

7. Product Realization
   - Planning of Product Realization
   - Customer related processes
   - Design and Development
   - Purchasing
   - Production and Service Provision
   - Control of Monitoring and Measuring devices

8. Monitoring and Measurement
   - General
   - Monitoring and Measurement
   - Control of Non-Conforming Product
   - Analysis of Data
   - Improvement

IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM:

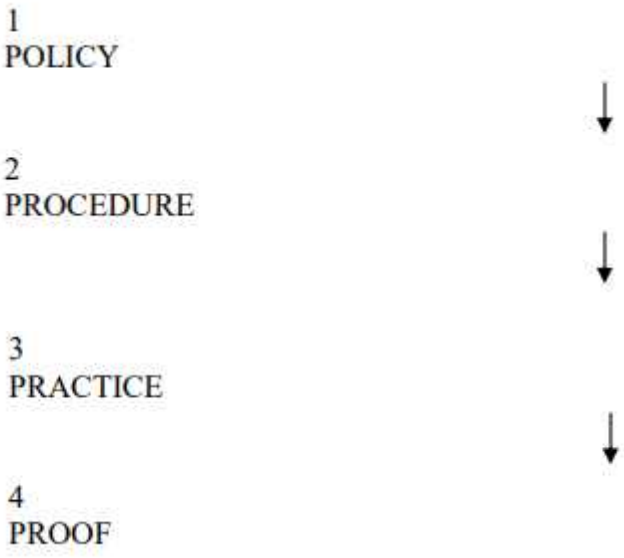
1. Top Management Commitment
2. Appoint the Management Representative
3. Awareness
4. Appoint an Implementation Team
5. Training
6. Time Schedule
7. Select Element Owners
8. Review the Present System
9. Write the Documents
10. Install the New System
11. Internal Audit
12. Management Review
13. Pre-assessment
14. Registration

PITFALLS OF SUCCESSFUL IMPLEMENTATION:

1. Using a generic documentation program or another organization's documentation program
2. Over-documentation or documentation that is too complex
3. Using External Consultants without involvement
4. Neglecting to obtain top management's involvement
5. Developing a system that does not represent what actually occurs

DOCUMENTATION

In every organization, the quality system must be documented properly. The documentation of the system can be seen as a hierarchical format as shown.



ISO 14000 – ENVIRONMENTAL MANAGEMENT SYSTEM

The overall aim of the Environmental Management systems is to provide protection to the environment and to prevent pollution.

- The success of ISO 9000 along with increased emphasis on Environmental issues was instrumental in ISO's decision to develop Environmental Management Standards.
- In 1991, ISO formed the Strategic Advisory Group on the Environment (SAGE) which led tothe formation of Technical Committee (TC) 207 in 1992.
- Mission of TC207 is to develop standards for an Environmental Management System (EMS)¬ which was identified as ISO 14000.
- TC 207 has Established six sub-committees
  1. Environmental Management System (EMS)
  2. Environmental Auditing (EA)
  3. Environmental labeling (EL)
  4. Environmental Performance Evaluation (EPE)
  5. Life-Cycle Assessment (LCA)
  6. Terms & Definitions

Environmental Management System (EMS):

EMS has two Evaluation Standards. They are

1. Organization Evaluation Standards 2. Product Evaluation Standards

REQUIREMENT OF ISO 14001

There are six elements

GENERAL REQUIREMENTS

- EMS should include policy, planning implementation & operation, checking & corrective action, management review.

ENVIRONMENTAL POLICY (Should be based on mission)

The policy must be relevant to the organization's nature.

Management's Commitment (for continual improvement & preventing pollution).

Should be a framework (for Environmental objectives & Targets).

Must be Documented, Implemented, & Maintained.

PLANNING

Environmental Aspects

Legal & other Requirements

Objectives & Targets

Environmental Management Programs

IMPLEMENTATION & OPERATION

Structure & Responsibility

Training, Awareness & Competency

Communication

EMS Documentation

Document Control

Operational Control

Emergency Preparedness & Response

CHECKING & CORRECTIVE ACTION

Monitoring & Measuring

Nonconformance & Corrective & Preventive action

Records

EMS Audit

MANAGENMENT REVIEW

Review of objectives & targets

Review of Environmental performance against legal & other requirement

Effectiveness of EMS elements

Evaluation of the continuation of the policy

BENEFITS OF ENVIRONMENTAL MANAGEMENT SYSTEM:

GLOBAL BENEFITS

Facilitate trade & remove trade barrier

Improve environmental performance of planet earth

Build consensus that there is a need for environmental management and a common terminology for EMS

ORGANIZATIONAL BENEFITS

Assuring customers of a commitment to environmental management \

Meeting customer requirement

Improve public relation

Increase investor satisfaction

Market share increase

Conserving input material & energy

Better industry/government relation 5.28 Low cost insurance, easy attainment of permits & authorization

UNIT-V (Statistical Process Control)

Quality Tools, the Basic Seven

This topic actually contains an assortment of tools, some developed by quality engineers, and some adapted from other applications. They provide the means for making quality management decisions based on facts. No particular tool is mandatory; any one may be helpful, depending on circumstances. A number of software programs are available as aids to the application of some of these tools.

Total Quality Management (TQM) and Total Quality Control (TQC) literature make frequent mention of seven basic tools. Kaoru Ishikawa contends that 95% of a company's problems can be solved using these seven tools. The tools are designed for simplicity. Only one, control charts require any significant training. The tools are:

- Flow Charts
- Ishikawa Diagrams
- Checklists
- Pareto Charts
- Histograms
- Scattergrams
- Control Charts

Flow Charts

A flow chart shows the steps in a process i.e., actions which transform an input to an output for the next step. This is a significant help in analyzing a process but it must reflect the actual process used rather than what the process owner thinks it is or wants it to be. The differences between the actual and the intended process are often surprising and provide many ideas for improvements. Figure 1 shows the flow chart for a hypothetical technical report review process. Measurements could be taken at each step to find the most significant causes of delays, these may then be flagged for improvement.

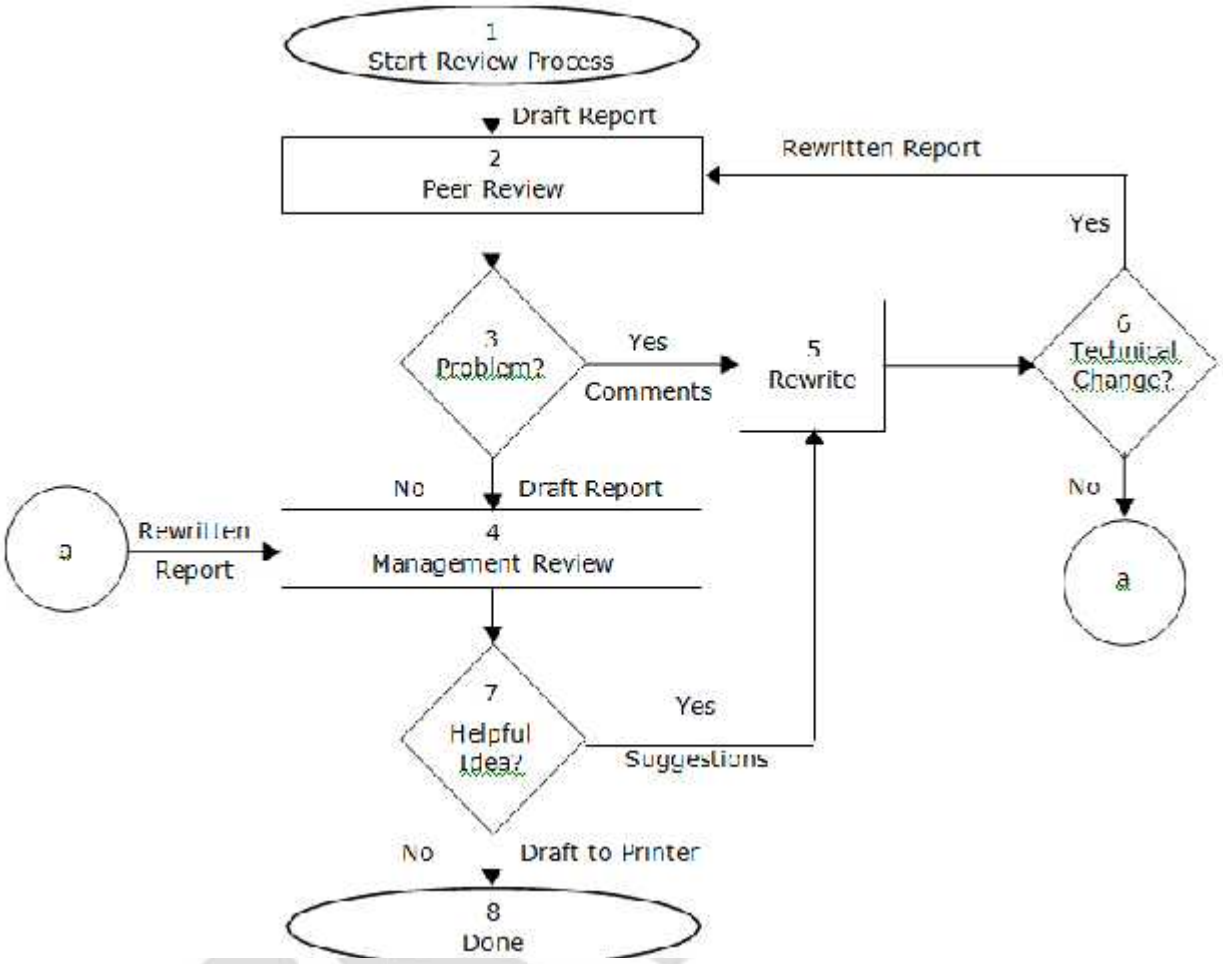


Figure : 1

In making a flow chart, the process owner often finds the actual process to be quite different than it was thought to be. Often, non-value-added steps become obvious and eliminating these provides an easy way to improve the process. When the process flow is satisfactory, each step becomes a potential target for improvement. Priorities are set by measurements. In Figure 1, the average time to complete peer review (get from Step 2 to Step 4) and to complete management review (get from Step 4 to Step 8) may be used to decide if further analysis to formulate corrective action is warranted. It may be necessary to expand some steps into their own flow charts to better understand them. For example, if we have an unsatisfactory amount of time spent in management review we might expand Step 4 as shown in Figure 2.

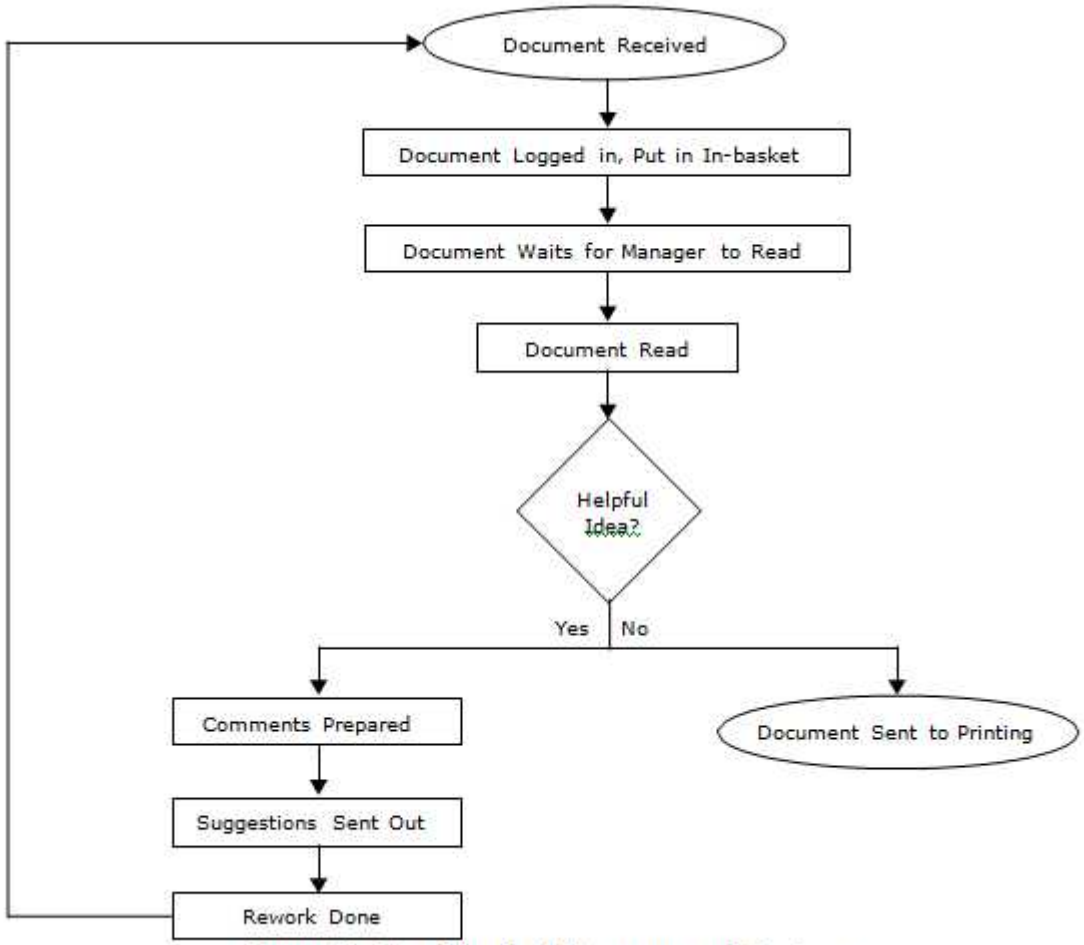


Figure 2. Flow Chart of Management Review

Figure 2 shows many possibilities for delay in management review. It may be that it takes too long for the manager to get around to reading the document. Or, too much time may be consumed in rework to address the comments of the manager. Only some more measurements will tell. Corrective actions to the former may include the delegation of review authority. Training the technical writers to avoid the most frequent complaints of the managers could possibly cure the latter. It may also be found that the manager feels obligated to make some comment on each report he reviews, and changing this perception may be helpful. Whatever the solution, information provided by the flow chart would point the way.

A danger in flow charting is the use of assumed or desired steps rather than actual process steps in making the chart. The utility of the chart will correlate directly to its accuracy. Another danger is that the steps plotted may not be under the control of the user. If the analyst does not "own the process" the chart may not be too helpful. It may, however, be quite useful to a process improvement team including all the functions involved.

Ishikawa Diagrams

Ishikawa diagrams are named after their inventor, Kaoru Ishikawa. They are also called fishbone charts, after their appearance, or cause and effect diagrams after their function. Their function is to

identify the factors that are causing an undesired effect (e.g., defects) for improvement action, or to identify the factors needed to bring about a desired result (e.g., a winning proposal). The factors are identified by people familiar with the process involved. As a starting point, major factors could be designated using the "four M's": Method, Manpower, Material, and Machinery; or the "four P's": Policies, Procedures, People, and Plant. Factors can be subdivided, if useful, and the identification of significant factors is often a prelude to the statistical design of experiments. Figure 3 is a partially completed Ishikawa diagram attempting to identify potential causes of defects in a wave solder process.

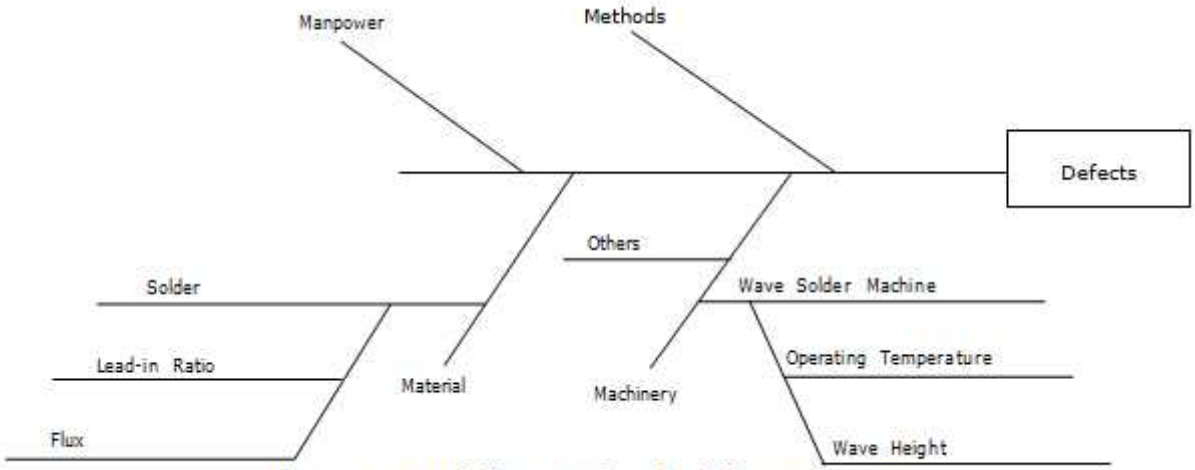


Figure 3. Partially Completed Ishikawa Diagram

Checklists

Checklists are a simple way of gathering data so that decisions can be based on facts, rather than anecdotal evidence. Figure 4 shows a checklist used to determine the causes of defects in a hypothetical assembly process. It indicates that "not-to-print" is the biggest cause of defects, and hence, a good subject for improvement. Checklist items should be selected to be mutually exclusive and to cover all reasonable categories. If too many checks are made in the "other" category, a new set of categories is needed.

Figure 4 could also be used to relate the number of defects to the day of the week to see if there is any significant difference in the number of defects between workdays. Other possible column or row entries could be production line, shift, product type, machine used, operator, etc., depending on what factors are considered useful to examine. So long as each factor can be considered mutually exclusive, the chart can provide useful data. An Ishikwa Diagram may be helpful in selecting factors to consider. The data gathered in a checklist can be used as input to a Pareto chart for ease of analysis. Note that the data does not directly provide solutions. Knowing that "not-to-print" is the biggest cause of defects only starts the search for the root cause of "not- to-print" situations. (This is in contrast to the design of experiments which could yield the optimal settings for controllable process settings such as temperature and wave height.)

Pareto Charts

Alfredo Pareto was an economist who noted that a few people controlled most of a nation's wealth. "Pareto's Law" has also been applied to many other areas, including defects, where a few causes are responsible for most of the problems. Separating the "vital few" from the "trivial many" can be done using a diagram known as a Pareto chart. Figure 5 shows the data from the checklist shown in Figure

4 organized into a Pareto chart.

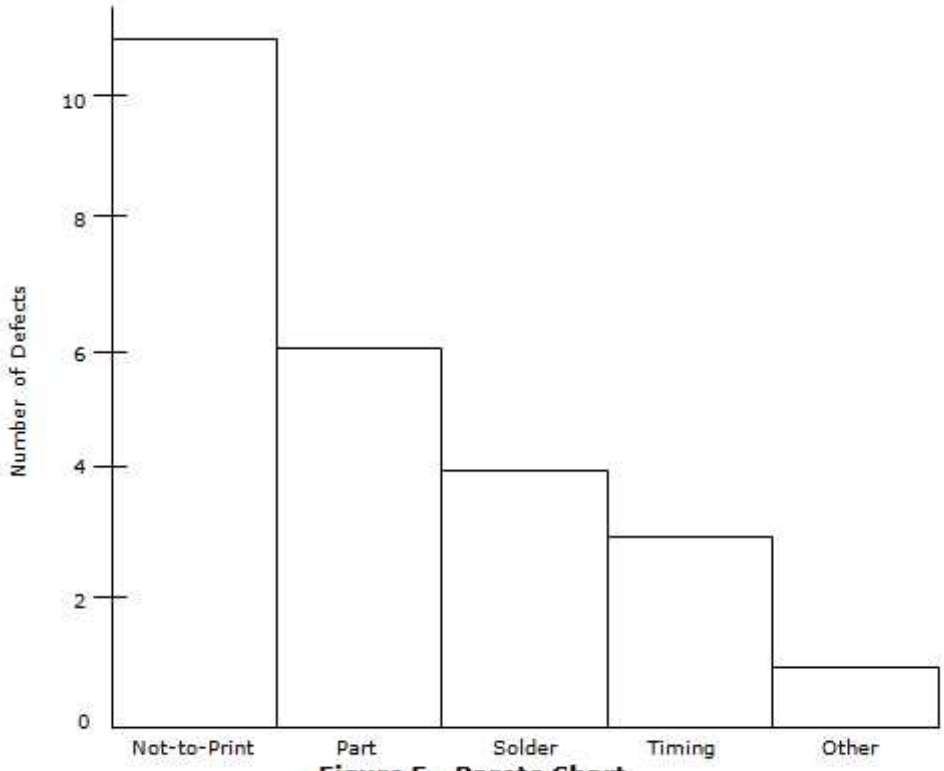


Figure 5. Pareto Chart

Figure 5, like Figure 4, show the "not-to-print" category as the chief cause of defects. However, suppose the not-to-print problems could be cheaply corrected (e.g., by resoldering a mis-routed wire) while a defect due to "timing" was too expensive to fix and resulted in a scrapped assembly. It may then be useful to analyze the data in terms of the cost incurred rather than the number of instances of each defect category. This might result in the chart shown in Figure 6, which would indicate eliminating the timing problems to be most fruitful.

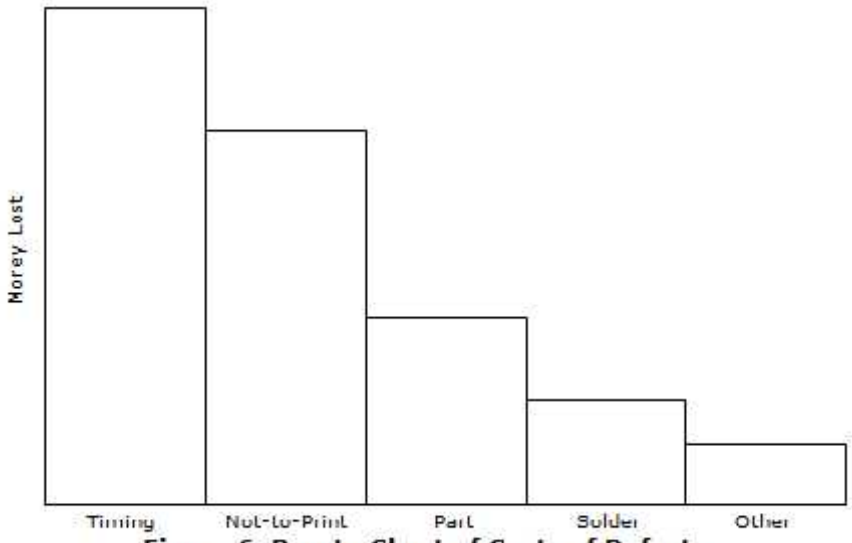


Figure 6. Pareto Chart of Costs of Defects

A useful application of Pareto Charts is Stratification, explained in the subtopic Stratification.

Stratification is simply the creation of a set of Pareto charts for the same data, using different possible causative factors. For example, Figure 7 plots defects against three possible sets of potential causes. The figure shows that there is no significant difference in defects between production lines or shifts, but product type three has significantly more defects than do the others. Finding the reason for this difference in number of defects could be worthwhile.

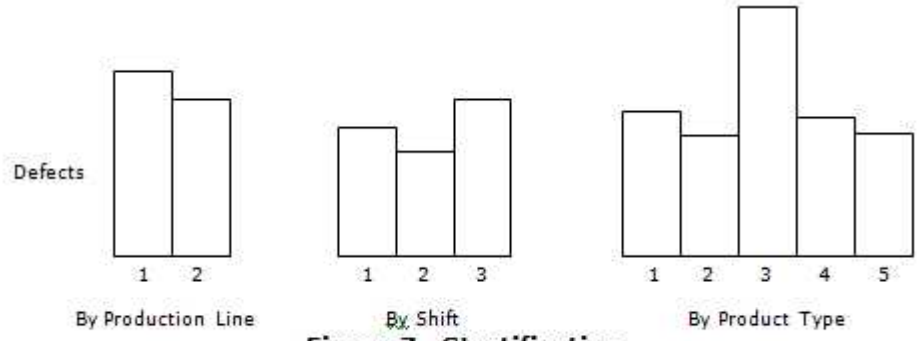


Figure 7. Stratification

Histograms

Histograms are another form of bar chart in which measurements are grouped into bins; in this case each bin representing a range of values of some parameter. For example, in Figure 8, X could represent the length of a rod in inches. The figure shows that most rods measure between 0.9 and 1.1 inches. If the target value is 1.0 inches, this could be good news. However, the chart also shows a wide variance, with the measured values falling between 0.5 and 1.5 inches. This wide a range is generally a most unsatisfactory situation.

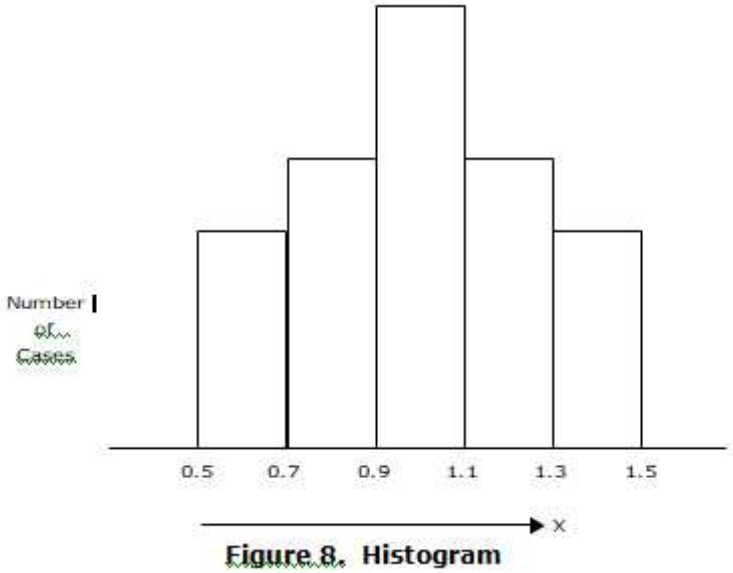


Figure 8. Histogram

Besides the central tendency and spread of the data, the shape of the histogram can also be of interest. For example, Figure 9 shows a bi-modal distribution. This indicates that the measurements are not from a homogeneous process, since there are two peaks indicating two central tendencies.

There are two (or more) factors that are not in harmony. These could be two machines, two shifts, or the mixed outputs of two suppliers. Since at least one of the peaks must be off target, there is evidence here that improvements can be made.

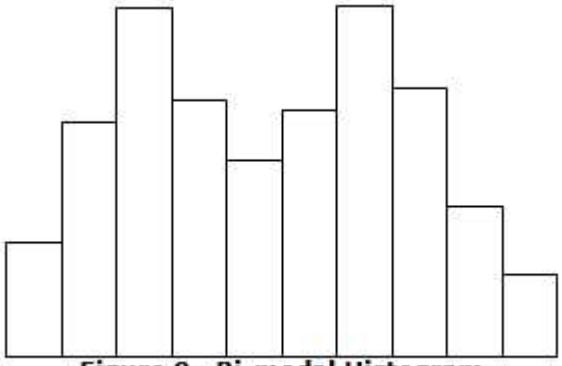


Figure 9. Bi-modal Histogram

In contrast, the histogram of Figure 10 shows a situation in which the spread of measurements is lower on one side of the central tendency than on the other. These could be measurements of miles per gallon attained by an automobile. There are many situations that decrease fuel economy, such as engine settings, tire condition, bad weather, traffic jams, etc., but few situations that can significantly improve it. The wider variance can be attacked by optimizing any of the controllable factors such as tuning the engine, replacing the tires used, etc. Moving the central tendency in the direction of the smaller variance is unlikely unless the process is radically changed (e.g., reducing the weight of the vehicle, installing a new engine, etc.).

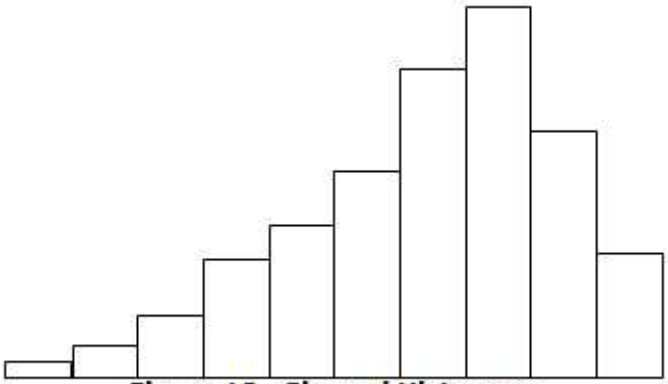


Figure 10. Skewed Histogram

Scattergrams

Scattergrams are a graphical, rather than statistical, means of examining whether or not two parameters are related to each other. It is simply the plotting of each point of data on a chart with one parameter as the x-axis and the other as the y-axis. If the points form a narrow "cloud" the parameters are closely related and one may be used as a predictor of the other. A wide "cloud" indicates poor correlation. Figure 11 shows a plot of defect rate vs. temperature with a strong positive correlation, while Figure 12 shows a weak negative correlation.

efect Rate

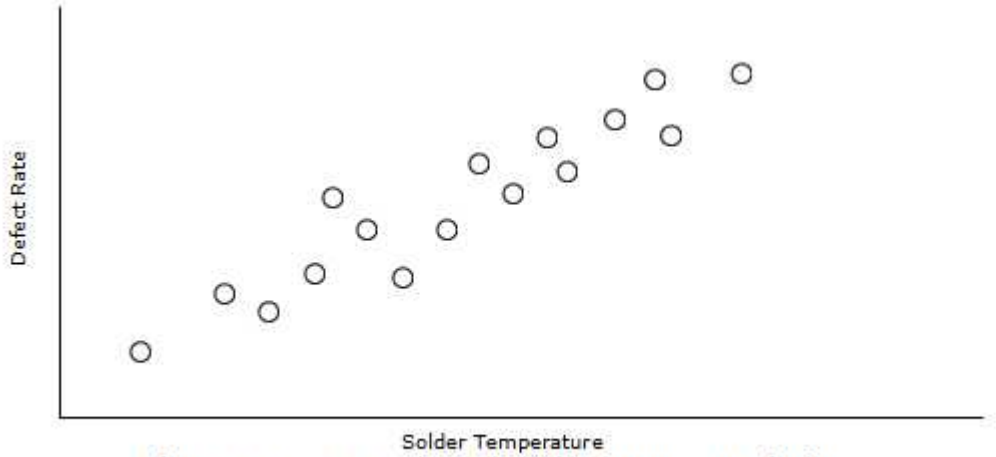
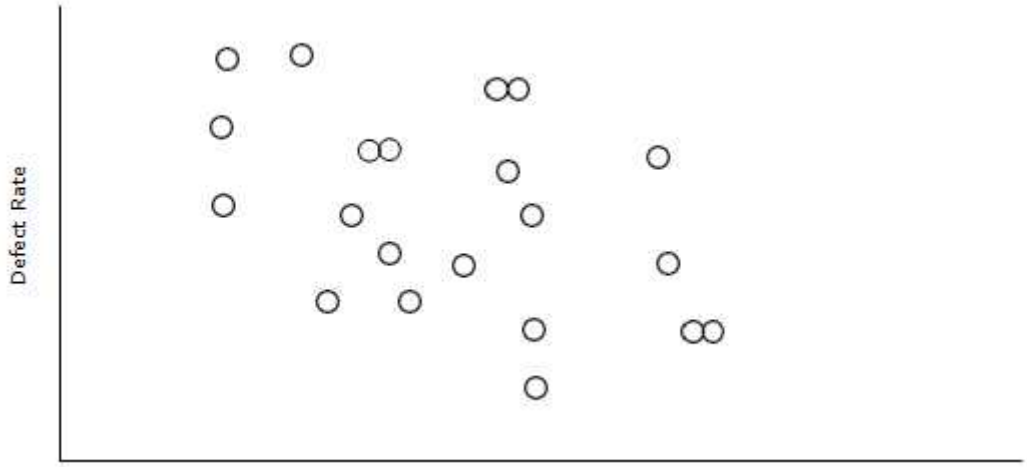


Figure 11. Scattergram Showing Strong Correlation



It should be noted that the slope of a line drawn through the center of the cloud is an artifact of the scales used and hence not a measure of the strength of the correlation. Unfortunately, the scales used also affect the width of the cloud, which is the indicator of correlation. When there is a question on the strength of the correlation between the two parameters, a correlation coefficient can be calculated. This will give a rigorous statistical measure of the correlation ranging from -1.0 (perfect negative correlation), through zero (no correlation) to +1.0 (perfect correlation).

Control Charts

Control charts are the most complicated of the seven basic tools of TQM, but are based on simple principles. The charts are made by plotting in sequence the measured values of samples taken from a process. For example, the mean length of a sample of rods from a production line, the number of defects in a sample of a product, the miles per gallon of automobiles tested sequentially in a model year, etc. These measurements are expected to vary randomly about some mean with a known variance. From the mean and variance, control limits can be established. Control limits are values that sample measurements are not expected to exceed unless some special cause changes the process. A sample measurement outside the control limits therefore indicates that the process is no longer stable, and is usually reason for corrective action. Other causes for corrective action are non-random

behavior of the measurements within the control limits. Control limits are established by statistical methods depending on whether the measurements are of a parameter, attribute or rate. A generic control chart is shown as Figure 13.

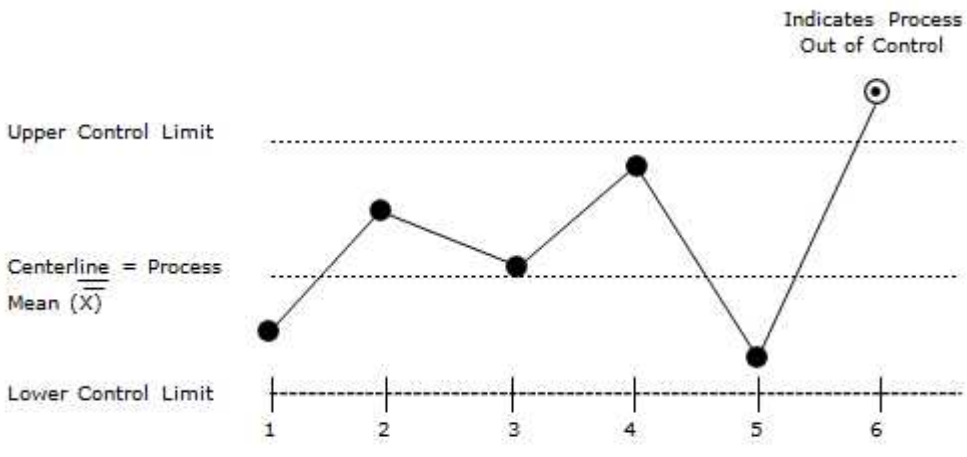


Figure 13. Control Chart

Statistical Fundamentals

Statistical Process Control (SPC) or Statistical Quality Control (SQC) is the main area covered under statistical tools for quality. This area includes the following techniques:

1. Control Charts

   (a) Control charts for variables

   (b) Control charts for attributes

2. Sampling Inspection

Control charts are aimed at process control. Use of control charts ensures that the process continues to work with its natural capability and any significant variation in the process is promptly detected and corrected. Scientific sampling ensures that amount of inspection is reduced while agreed upon quality levels are adhered to. Sampling inspection can be applied to only those products which have been produced with a controlled process.

Both control charts and sampling inspection make use of statistics and probability. Before Notes discussing statistical process control in detail, a brief description of the statistical and probability concepts is necessary.

1. Variations and Their Representation

Variation is the law of nature. Examples of variations are marks of students in a class, dimensions of similar products made in mass production and so on. In statistical process control efforts are made to reduce these variations. The first requirement however is to represent the variation. There are two categories of methods to represent variation. One of them is to draw a frequency distribution from the actual data by counting frequencies of each value. Histograms, frequency polygon and frequency bar charts fall in this category. The other measure is to calculate the

average and dispersion of various values of the data and then from these two statistics represent the variation. The measures of central tendency and dispersion are briefly explained below.

2. Measures of Central Tendency:

Mean, Median and Mode of a Set of Data A collection of specific values, or "scores", x1 , x2 , ..., xn of a random variable X is called a sample. If {x1 , x2 , ..., xn } is a sample, then the sample mean of the collection is

$\bar{X}$ = (X1+X2+X3….Xn)/n where n is the sample size i.e. the number of scores.

The sample median m is the middle score (in the case of an odd-size sample), or average of the two middle scores (in the case of an even-size sample), when the scores in a sample are arranged in ascending order.

A sample mode is a score that appears most often in the collection. (There may be more than one mode in a sample.)

If the sample x1 , x2 , ..., xn we are using consists of all the values of X from an entire population (for instance, the marks of the students in a subject, we refer to the mean, median, and mode above as the population mean, median, and mode. We write the population mean as instead of $\bar{X}$.

3. Measures of Dispersion

Sample Variance and Sample Standard Deviation Given a set of numbers x1 , x2 , ..., xn the sample variance is

$$S^2 = \Sigma \frac{(X_i - \bar{X})^2}{n-1}$$

$$= \frac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + \ldots + (X_n - \bar{X})^2}{n-1}$$

The *sample standard deviation* is the square root, s, of the sample variance.

Population Variance and Population Standard Deviation

The population variance and standard deviation have slightly different formulas from those of the corresponding statistics for samples. Given a set of numbers x1 , x2 , ..., xn the population variance, σ, is found from the expression

$$\sigma^2 = \Sigma \frac{(X_i - \bar{X})^2}{n}$$

$$= \frac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + \ldots + (X_n - \bar{X})^2}{n}$$

The population standard deviation, s, is the square root of the population variance.

4. Random Variables

A random variable is an abstraction of the concept of chance into the theoretical domains of mathematics, forming the foundations of probability theory and mathematical statistics. Intuitively, a random variable describes a system that can exist in several states, with each state having a certain probability. For example, a coin used for tossing can be described as a random variable with two states, 'head' and 'tail', with each state having probability one half.

The theory and language of random variables were formalized over the last few centuries alongside ideas of probability. Full familiarity with all the properties of random variables requires a strong background in the more recently developed concepts of measure theory, but random variables can be understood intuitively at various levels of mathematical fluency; set theory and calculus are fundamentals.

There are two types of random variables – discrete and continuous.

A random variable has either an associated probability distribution (discrete random variable) or probability density function (continuous random variable).

The outcome of an experiment need not be a number, for example, the outcome when a coin is tossed can be 'heads' or 'tails'. However, we often want to represent outcomes as numbers. A random variable is a function that associates a unique numerical value with every outcome of an experiment. The value of the random variable will vary from trial to trial as the experiment is repeated.

Discrete Random Variables

A discrete random variable is one which may take on only a countable number of distinct values such as 0, 1, 2, 3, 4,..... Discrete random variables are usually (but not necessarily) counts. If a random variable can take only a finite number of distinct values, then it must be discrete. Examples of discrete random variables include the number of children in a family, the Friday night attendance at a cinema, the number of patients in a doctor's surgery, the number of defective light bulbs in a box of ten.

The probability distribution of a discrete random variable is a list of probabilities associated Notes with each of its possible values. It is also sometimes called the probability function or the probability mass function.

Continuous Random Variables

A continuous random variable is one which takes an infinite number of possible values. Continuous random variables are usually measurements. Examples include height, weight, the amount of sugar in an orange, the time required to run a mile.

A continuous random variable is not defined at specific values. Instead, it is defined over an interval of values, and is represented by the area under a curve (in advanced mathematics, this is known as an integral). The probability of observing any single value is equal to 0, since the number of values which may be assumed by the random variable is infinite.

Suppose a random variable X may take all values over an interval of real numbers. Then the probability that X is in the set of outcomes A, P(A), is defined to be the area above A and under a curve. The curve, which represents a function p(x), must satisfy the following:

1. The curve has no negative values, ($p(x) > 0$ for all x)

2. The total area under the curve is equal to 1. A curve meeting these requirements is known as a density curve

Probability Distribution

A probability distribution describes the values and probabilities associated with a random event. The values must cover all of the possible outcomes of the event, while the total probabilities must sum to exactly 1, or 100%. For example, a single coin flip can take values Heads or Tails with a probability of exactly 1/2 for each; these two values and two probabilities make up the probability distribution of the single coin flipping event. This distribution is called a discrete distribution because there are a countable number of discrete outcomes with positive probabilities.

A continuous distribution describes events over a continuous range, where the probability of a specific outcome is zero. For example, a dart thrown at a dartboard has essentially zero probability of landing at a specific point, since a point is vanishingly small, but it has some probability of landing within a given area. The probability of landing within the small area of the bulls eye would (hopefully) be greater than landing on an equivalent area elsewhere on the board. A smooth function that describes the probability of landing anywhere on the dartboard is the probability distribution of the dart throwing event. The integral of the probability density function (pdf) over the entire area of the dartboard (and, perhaps, the wall surrounding it) must be equal to 1, since each dart must land somewhere.

The concept of the probability distribution and the random variables which they describe underlies the mathematical discipline of probability theory, and the science of statistics. There is spread or variability in almost any value that can be measured in a population (e.g. height of people, durability of a metal, etc.); almost all measurements are made with some intrinsic error; in physics many processes are described probabilistically, from the kinetic properties of gases to the quantum mechanical description of fundamental particles. For these and many other reasons, simple numbers are often inadequate for describing a quantity, while probability distributions are often more appropriate models. There are, however, considerable mathematical complications in manipulating probability distributions, since most standard arithmetic and algebraic manipulations cannot be applied.

Process Capability:

Process capability can be defined as the ability of a process to produce more uniform products with little variations. Process capability compares the output of an in-control process to the specification limits by using capability indices. The comparison is made by forming the ratio of the spread between the process specifications (the specification "width") to the spread of the process values, as measured by 6 process standard deviation units (the process "width").

Six Sigma:

The Concept 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

1. A clear focus on achieving measurable and quantifiable financial returns from any project.

2. An increased emphasis on strong and passionate management leadership and support.

3. A special infrastructure of "Champions," "Master Black Belts," "Black Belts," etc. to lead and implement the Six Sigma approach.

4. A clear commitment to making decisions on the basis of verifiable data, rather than assumptions and guesswork.

At Motorola University, we think about Six Sigma at three different levels:

1. As a metric

2. As a methodology

3. As a management system

DMAIC is commonly used by Six Sigma project teams and is an acronym for:

DMAIC - The basic methodology consists of the following five steps:

- Define process improvement goals that are consistent with customer demands and the enterprise strategy. Measure key aspects of the current process and collect relevant data.
- Analyze the data to verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered.
- Improve or optimize the process based upon data analysis using techniques like Design of Experiments.
- Control 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:

- Define design goals that are consistent with customer demands and the enterprise strategy.
- Measure and identify CTQs (characteristics that are Critical To Quality), product capabilities, production process capability, and risks.
- Analyze to develop and design alternatives, create a high-level design and evaluate design capability to select the best design.
- Design 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 identifies several key roles for its successful implementation.

- 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.
- 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.
- 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.
- 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.
- 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.

Total Productive Maintenance

Total = Overall features for production Productive = production of goods and services that meet expectation Maintenance = Keeping the equipments and plant as good as new and working condition Goals of TPM Maintaining and Improving equipment capacity.

Maintaining equipment for longer life Using support from all areas of operation Encouraging input from all employees Continuous improvement Improve ment needs Machines expected to fail at one point or another – minimize that risk Employees who use and work that machine give the first hand information.

Six major loss areas in terms of time Downtime loss

1. Planned – i) start ups ii) Shift change iii) tea / lunch breaks iv) planned maintenance

2. Unplanned – i) Equipment breakdown ii) changeovers iii) lack of materials

3. Idling and minor stoppages

4. Slow downs

5. Process change

6. Scraps Calculating Equipment Effectiveness

Downtime loss measured by equipment availability

$A = (T/P) X 100$ A – availability,

T – operating time (P – D),

P – Planned operation time

D- Downtime Performance efficiency

E = (CXN/T) X 100

E – Performance efficiency,

C – Theoretical cycle time,

N – Processed amount (qty) Rate of quality products

R = (N-Q/N)X 100 R – Rate of quality products,

N = Processed amount

Q – nonconformities