

# **UNIT I - INTRODUCTION**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation

# Definition of Quality

- Quality is also defined as **excellence** in the product or service that **fulfills or exceeds the expectations of the customer**.
- There are **9 dimensions of quality** that may be found in products that produce customer-satisfaction.
- Though quality is an abstract perception, it has a quantitative measure-  $Q = (P / E)$  , where **Q=quality**, **P= performance(as measured by the Mfgr.)**, and **E = expectations(of the customer)**.

# Definition of Quality

- Quality is **not fine-tuning your product at the final stage** of manufacturing, before packaging and shipping .
- **Quality is in-built into the product at every stage** from conceiving –specification & design stages to prototyping –testing and manufacturing stages.

# Attributes / Dimensions of Quality

- *Performance* - main characteristics of the product/service
- *Aesthetics* - appearance, feel, smell, taste
- *Special Features* - extra characteristics
- *Conformance* - how well product/service conforms to customer's expectations
- *Reliability* - consistency of performance

## Attributes / Dimensions of Quality(Cont'd)

- *Durability* - useful life of the product/service
- *Perceived Quality* - indirect evaluation of quality (e.g. reputation)
- *Serviceability* - service after sale

# Quality Planning

- Implies the ability to anticipate situations and prepare actions to bring about the desired outcome



- Important to prevent defects by:
  - Selecting proper materials
  - Training and indoctrinating people in quality
  - Planning a process that ensures the appropriate outcome

# Cost of Quality

## Three Views of quality Costs

### **Higher quality means higher cost.**

- Quality attributes such as performance and features cost more in terms of labor, material, design and other costly resources.
- The additional benefits from improved quality do not compensate for additional expense.

### **The cost of improving quality is less than the resulting savings.**

- The saving result from less rework, scrap and other direct expenses related defects.
- This is said to account for the focus on continuous improvement of processes in Japanese firms.

# Three Views of quality Costs

**Quality costs are those incurred in excess of those that would have been incurred if the product were built or the service performed exactly right the first time.**

- ❑ This view is held by adherents of TQM philosophy.

Costs include not only those that are direct, but also those resulting from lost customers, lost market share and the many hidden costs and foregone opportunities not identified by modern cost accounting systems.



# **Types of Quality Costs**

The cost of quality is generally classified into four categories

1. Cost of Prevention
2. Cost of Appraisal
3. Cost of Internal Failure
4. Cost of External Failure

# Quality Costs

## **Cost of Prevention**

- Prevention costs include those activities which remove and prevent defects from occurring in the production process.
- Included are such activities as quality planning, production reviews, training, and engineering analysis, which are incurred to ensure that poor quality is not produced.

## **Appraisal**

- Those costs incurred to identify poor quality products after they occur but before shipment to customers. e.g. Inspection activity.

# Quality Costs

## **Internal Failure**

- Those incurred during the production process.
- Include such items as machine downtime, poor quality materials, scrap, and rework.

## **External Failure**

- Those incurred after the product is shipped.
- External failure costs include returns and allowances, warranty costs, and hidden costs of customer dissatisfaction and lost market share.

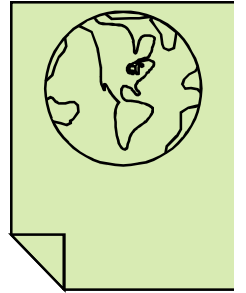
# The Cost of Quality

- The **cost of quality** is the cost of conformance plus the cost of nonconformance
  - **Conformance** means delivering products that meet requirements and fitness for use
  - **Cost of nonconformance** means taking responsibility for failures or not meeting quality expectations
- A 2002 study reported that software bugs cost the U.S. economy \$59.6 billion (6% of GDP) each year and that one-third of the bugs could be eliminated by an improved testing infrastructure
- Gartner Research estimated that the cost of downtime for computer networks is about \$42,000/hour.
  - A worse than average system with a downtime of 30 minutes per day can cost more than \$7 million per year.

# Five Cost Categories Related to Quality

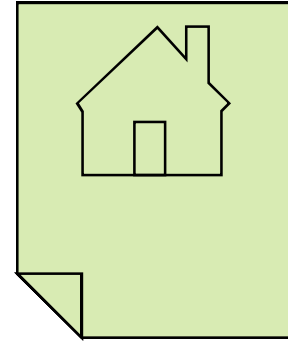
- **Prevention cost:** cost of planning and executing a project so it is error-free or within an acceptable error range
- **Appraisal cost:** cost of evaluating processes and their outputs to ensure that a project is either error-free or within an acceptable error range
- **Internal failure cost:** cost incurred to correct an identified defect before the customer receives the product (rework, inventory costs due to defects, premature failure of products)
- **External failure cost:** cost that relates to all errors not detected and corrected before delivery to the customer (warranty costs, product liability suits, future business losses)
- **Measurement and test equipment costs:** capital cost of equipment used to perform prevention and appraisal activities

# Historical Review of Quality Control



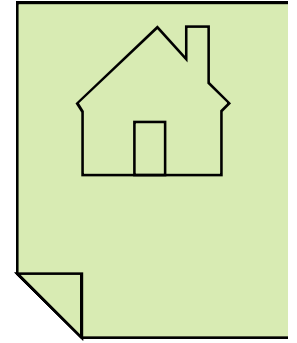
- In 1954, Joseph M. Juran taught Japanese managements their responsibility to achieve quality .
- In 1960, the first quality control circles were formed. SQC techniques were being applied by Japanese workers.
- 1970's US managers were learning from Japan Quality implementation miracles.
- In 1980's TQM principles and methods became popular.(also in auto industry)
- In 1990's ,the ISO 9000 model became the world-wide standard for QMS.

# EVOLUTION of TQM



- **CRAFTSMEN & ARTISANS**(eg. Artists, Sculptors, working with metals & other materials who were very Quality-conscious.
- **TRADESMEN** (eg.Masons,Carpenters etc.)
- **ENGINEERING TRADES & PRACTICES**  
(eg.Foundry,Smithy, Die-making,Mould-making,Stamping,Forging,Turning,Milling, Drilling etc. )

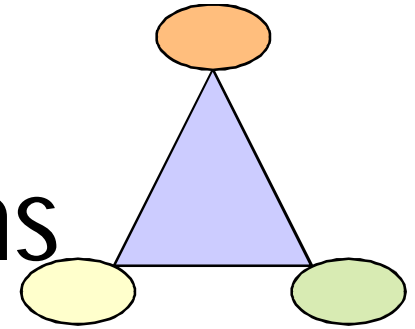
# TQM Evolution



- **Custom-built** Articles/Products having considerable control over Quality.  
↓
- **Mass- Produced** Products with less control over Quality  
↓
- **Quality control** Department in Factories.  
↓
- **TQM-based Production** facility – enhancing the Organization through Quality techniques to better achieve organization's goals-eg. Productivity and Profitability with min.wastage.  
↓
- **ISO** Quality Management Systems.

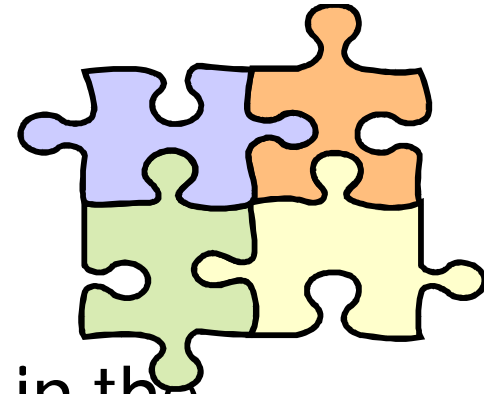


# Quality - Definitions



- Quality is *excellence that is better than a minimum standard.*  
*It is **conformance to standards** and **'fitness of purpose'***
- ISO 9000:2000 definition of quality-  
***It is the degree to which a set of inherent characteristics fulfills requirements.***
- *Quality is ' **fitness for use** ' of the product – Joseph Juran.*

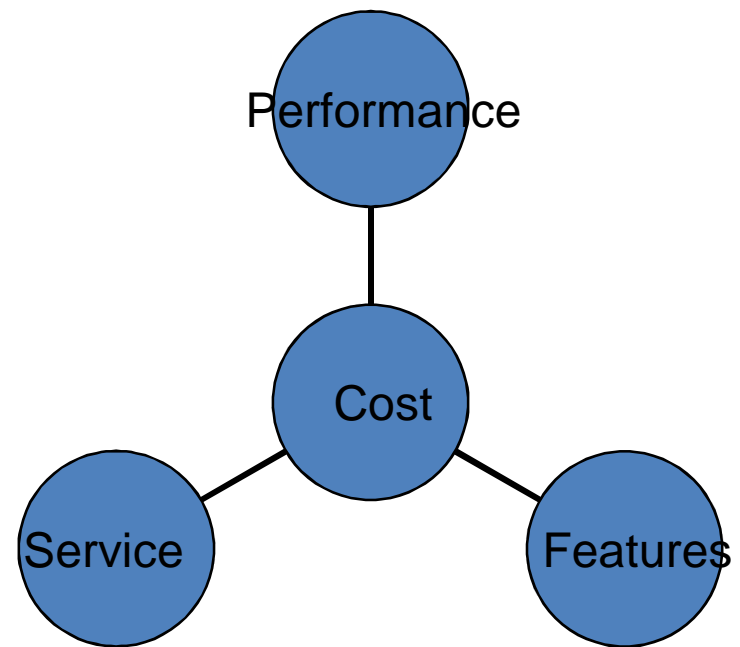
## Quality and customer expectations



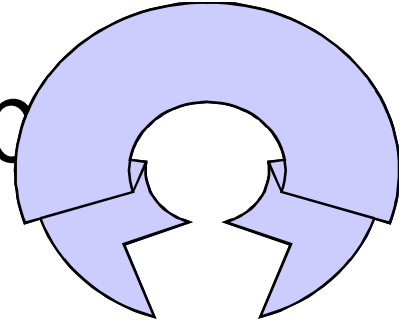
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# The 9 Dimensions of Quality

- Performance
- Features
- Conformance
- -----
- Reliability
- Durability
- Service
- -----
- Response- of Dealer/ Mfgr. to Customer
- Aesthetics – of product
- Reputation- of Mfgr./Dealer



# TQM six basic Concepts



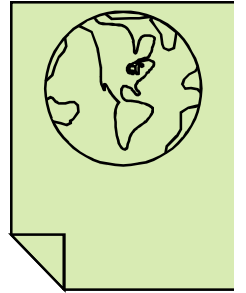
- **Management commitment to TQM principles and methods & long term Quality plans for the Organisation**
- **Focus on customers – internal & external**
- **Quality at all levels of the work force.**
- **Continuous improvement of the production/business process.**
- **Treating suppliers as partners**
- **Establish performance measures for the processes.**

# Benefits of Quality



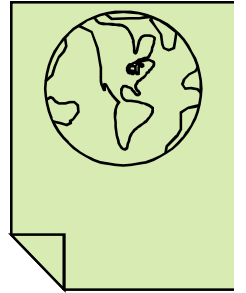
- Higher customer satisfaction
- Reliable products/services
- Better efficiency of operations
- More productivity & profit
- Better morale of work force
- Less wastage costs
- Less Inspection costs
- Improved process
- More market share
- Spread of happiness & prosperity
- Better quality of life for all.

# Historical Review of Quality Control



- **Quality in articles and artefacts produced by skilled craftsmen and artisans from the B.C. era eg. goldsmiths, silversmiths, blacksmiths, potters, etc.**
- **Artists & Artisans Guilds in the Middle ages spent years imparting quality skills and the worksmen had pride in making quality products.**
- **Industrial Revolution brought factory manufacturing where articles were mass-produced and each worker made only a part of the product, and did not sense the importance of his contribution to the quality of the product .**

# Historical Review of Quality Control



- In 1924, W.A.Shewhart of Bell Telephone Labs developed a statistical chart for the control of product variables – the beginning of SQC and SPC.
- In the same decade, H.F.Dodge and H.G.Romig of Bell Telephone Labs developed statistical acceptance sampling instead of 100% inspection.
- In 1946, the American Society for Quality Control was formed.
- In 1950, W. Edwards Deming, who learnt SQC from Shewhart, taught SPC & SQC to Japanese engineers and CEO's

# Leadership

- As Joseph M. Juran said in 1945, “It is most important that top management be quality-minded. In the absence of sincere manifestation of interest at the top, little will happen below.” \*
- A large percentage of quality problems are associated with management, not technical issues
- As globalization increases and customers become more demanding, creating quality products quickly at a reasonable price is essential for staying in business
  - In 1988, Motorola Corp. became one of the first companies to receive the Malcolm Baldrige National Quality Award.
  - One of Motorola's innovations that attracted a great deal of attention was its Six Sigma program.
  - Top management stressed the need to develop and use quality standards and provided resources (training, staff, customer input) to help improve quality

\*American Society for Quality (ASQ), ([www.asqc.org/about/history/juran.html](http://www.asqc.org/about/history/juran.html)).



# Leadership

Leadership is the ability to develop a vision that motivates others to move with a passion toward a common goal. So leadership is a process by which a person influences others to accomplish an objective and directs the organization in a way that makes it more cohesive and coherent.

## Styles of leadership

The three major styles of leadership are **(U.S. Army Handbook, 1973)** :



- Authoritarian or autocratic
- Participative or democratic
- Delegative or Free Reign

# Leadership

Autocratic – The authoritarian leader makes decisions alone as power is centralized in one person. Decisions are enforced using rewards and the fear of punishment. it is an abusive, unprofessional style called “**bossing people around.**”

Democratic- The participative leader include one or more employees in the decision making process. Communication flow freely; suggestions are made in both directions. The participation encourages member commitment to the final decision

Laissez-faire- The free-rein leader gives power to subordinates to make the decisions. However, the leader is still responsible for the decisions that are made. This is used when employees are able to analyze the situation. Delegative style is generally not useful.

# The Role of Management

- The EMS model is built on the premise that senior management is consistently participating or otherwise involved.
- There are key points where senior management has a defined role (e.g., Policy, management review).
- Ongoing support is critical.



# Specific Expectations of Management

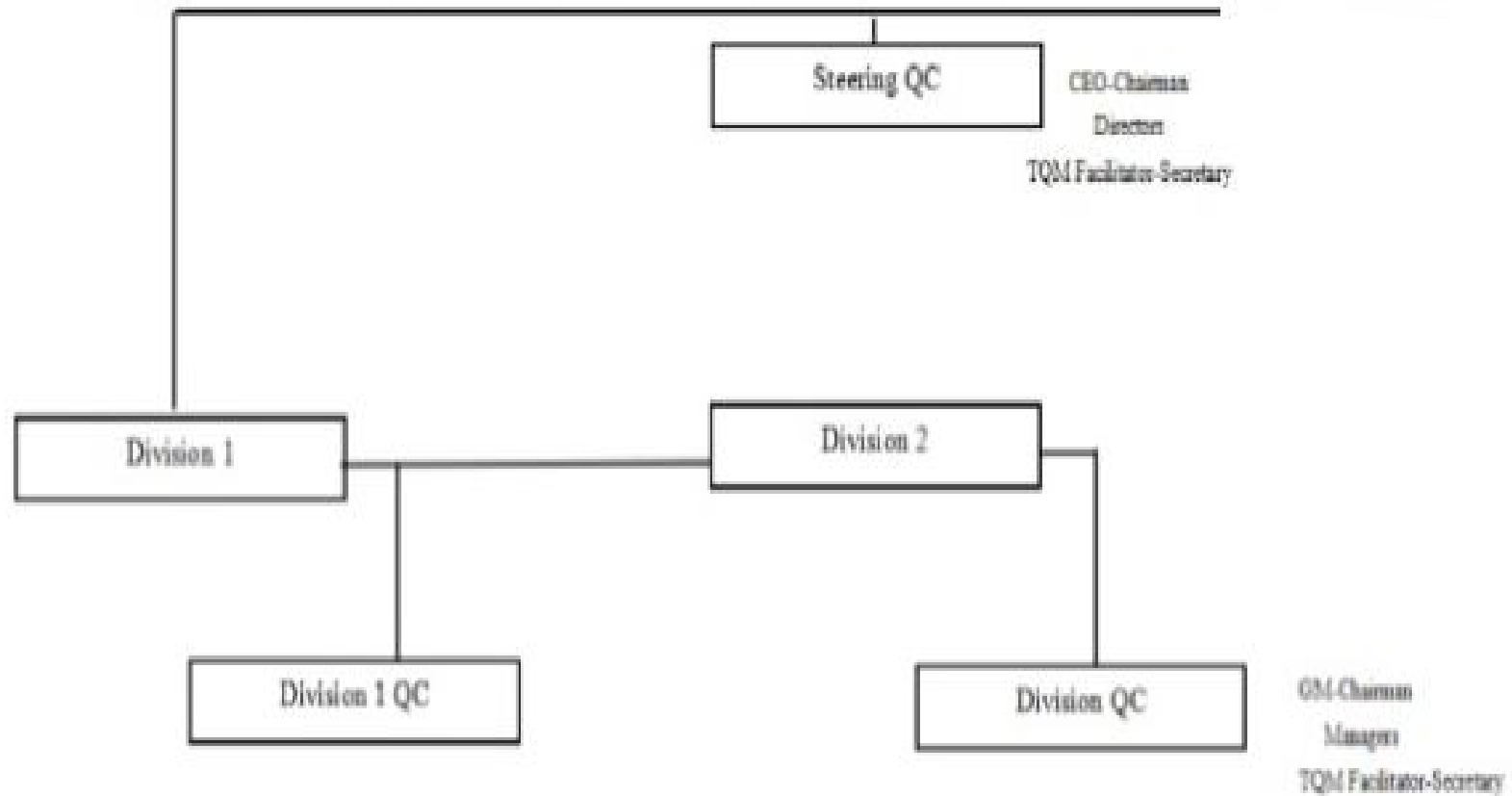
- \* Be visible and positive about the message.
- \* Show your support through organizational policy, as well as “walk the talk” by your words and actions.
- \* Discuss the benefits of using the EMS tool; Most importantly, verbalize how it supports the mission.
- \* Be up front and honest about the effort needed for successful implementation.
- \* Provide resources (financial, staff, external).

# Specific Expectations (cont.)

- \* Provide moral support, encourage your team, and create a leadership environment that ensures success. The staff should feel that you are in it with them and committed to success.
- \* Encourage dialogue among the various offices, units and/or facilities. Try to break down the silos!
- \* Share performance results with the workforce.
- \* Communicate outside the agency to share experiences and to learn from others.



# Quality council



QUALITY COUNCIL IN A LARGE ORGANIZATION

# The Quality Statements



- **Vision Statement** :The vision statement is a short declaration what an organization aspires to be tomorrow
- A vision statement, on the other hand, describes how the future will look if the organization achieves its mission.
- Successful visions are timeless, inspirational, and become deeply shared within the organization, such as:
  - IBM's *Service*
  - Apple's *Computing for the masses*
  - Disney theme park's *the happiest place on the earth*, and
  - Polaroid's *instant photography*

# The Quality Statements

- **Mission Statement:** A mission statement concerns what an organization is all about. The statement answers the questions such as: who we are, who are our customers, what do we do and how do we do it.
- This statement is usually one paragraph or less in length, easy to understand, and describes the function of the organization.
- It provides clear statement of purpose for employees, customers, and suppliers.
- An example of mission statement is:
  - Ford Motor Company is a worldwide leader in automatic and automotive related products and services as well as the newer industries such as aerospace, communications, and financial services. Our mission is to improve continually our products and services to meet our customers' needs, allowing us to prosper as a business and to provide a reasonable return on to our shareholders, the owners of our business.



# Strategic Planning

## What is Strategic Planning?

- Strategic planning is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy.
- What do we want to do?
- How do we best excel?
- Where do we want the company to be?

# Strategic Planning



## **Gather Inputs**

- From all Stakeholders
- Customer analysis
- Competitor analysis
- Industry analysis
- Environmental
- Company performance
- Company strategies

## **SWOT Analysis**

- External Analysis
  - Opportunities
  - Threats
- Internal Analysis
  - Strengths
  - Weaknesses
- Strategic Questions
- Strategic Issues

## **Review Inputs**

- All Stakeholders
- Review Inputs
- Review SWOT Analysis
- Define 3-4 key statements

## **Strategic Matrix**

- All Stakeholders
- Define Strategies to address SWOT combinations:
  - Opportunities vs Strengths
  - Opportunities vs Weaknesses
  - Threats vs Strengths
  - Threats vs Weaknesses

## **Define Strategies**

- Objectives
- Key Strategies
- Short and Long Term Goals
- Operational Plans

## **Final Reviews**

- All Stakeholders
- Review Strategies
- Review Goals
- Review Plans
- Adjust as necessary

# Deming Philosophy

14 points for management:

1. Create and publish to all employees a *statement of the aims and purposes* of the company. The management must demonstrate their commitment to this statement.
2. *Learn* the new philosophy.
3. Understand the *purpose of inspection* – to reduce the cost and improve the processes.
4. *End* the practice of awarding business on the *basis of price tag* alone.
5. *Improve constantly* and forever the system of production and service.

# Deming Philosophy

6. Institute training
7. Teach and institute *leadership*.
8. Drive out fear. Create an *environment of innovation*.
9. *Optimize the team efforts* towards the aims and purposes of the company.
10. Eliminate exhortations for the workforce.
11. Eliminate *numerical quotas* for production.
12. Remove the barriers that rob *pride of workmanship*.
13. Encourage *learning and self-improvement*.
14. Take action to accomplish the transformation.

# Barriers to TQM Implementation

1. Competitive markets
2. Bad attitudes/abdication of responsibility/management infallibility
3. Lack of leadership for quality
4. Deficiency of cultural dynamism
5. Inadequate resources for total quality management
6. Lack of customer focus.
7. Lack of effective measurement of quality improvement
8. Poor Planning
9. Lack of management commitment
10. Resistance of the workforce
11. Lack of proper training/Inadequate Human Resource Development

# UNIT II - TQM PRINCIPLES

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

# CUSTOMER SATISFACTION

- The most important asset of any organization is its customers
- Satisfied customers pay their bills promptly which greatly improves cash flow – the lifeblood of any organization

# CUSTOMER SATISFACTION

- CUSTOMERS EXPERIENCE OF A PRODUCT OR A SERVICE IS MULTIFACETED SO HARD TO DETERMINE
- IT NEEDS TO BE MEASURED INDIVIDUALLY TO GET AN ACCURATE TOTAL PICTURE OF CUSTOMER SATISFACTION



# CUSTOMER SATISFACTION

- Customer satisfaction should not be viewed in a vacuum.
- For example, a customer may be satisfied with a product or service and therefore rate the product or service highly in a survey and yet same customer may buy another product.

# CUSTOMER SATISFACTION

- Similarly customer's view about a product or service are useless if customer's view about competitors products are not understood.
- The value customers places on the product compared to another may be a better indication of customer loyalty.

# Customer Perception of Quality

One of the basic concepts of the TQM philosophy is continuous process improvement. This concept implies that there is no acceptable quality level because the customer's needs, values and expectations are constantly changing and becoming more demanding.

Before making a major purchase, some people check consumer magazines that rate product quality. During the period 1980 to 1988, the quality of the product and its performance ranked first, the price was second and service was third. During the period 1989 to 1992, product quality remained the most important factor, but service ranked above the price in importance.

An American Society for Quality (ASQ) survey on end user perceptions of important factors that influenced purchases showed the following ranking:

Performance

Features

Service

Warranty

Price

Reputation

The factors of performance, features, service and warranty are the parts of a product or service quality. Therefore, it is evident that product quality and service are more important than price. Although this information is based on the retail customer, it appears, to some extent, to be true to the commercial customer also.

# Customer complaints

- An expression of dissatisfaction with a product/service, either orally or in writing, from an internal or external customer.
- A customer may have a genuine causes for complaint, although some complaints may be made as a result of a misunderstanding or an unreasonable expectation of a product or services.

# Why customer FEEDBACK/COMPLAINT necessary

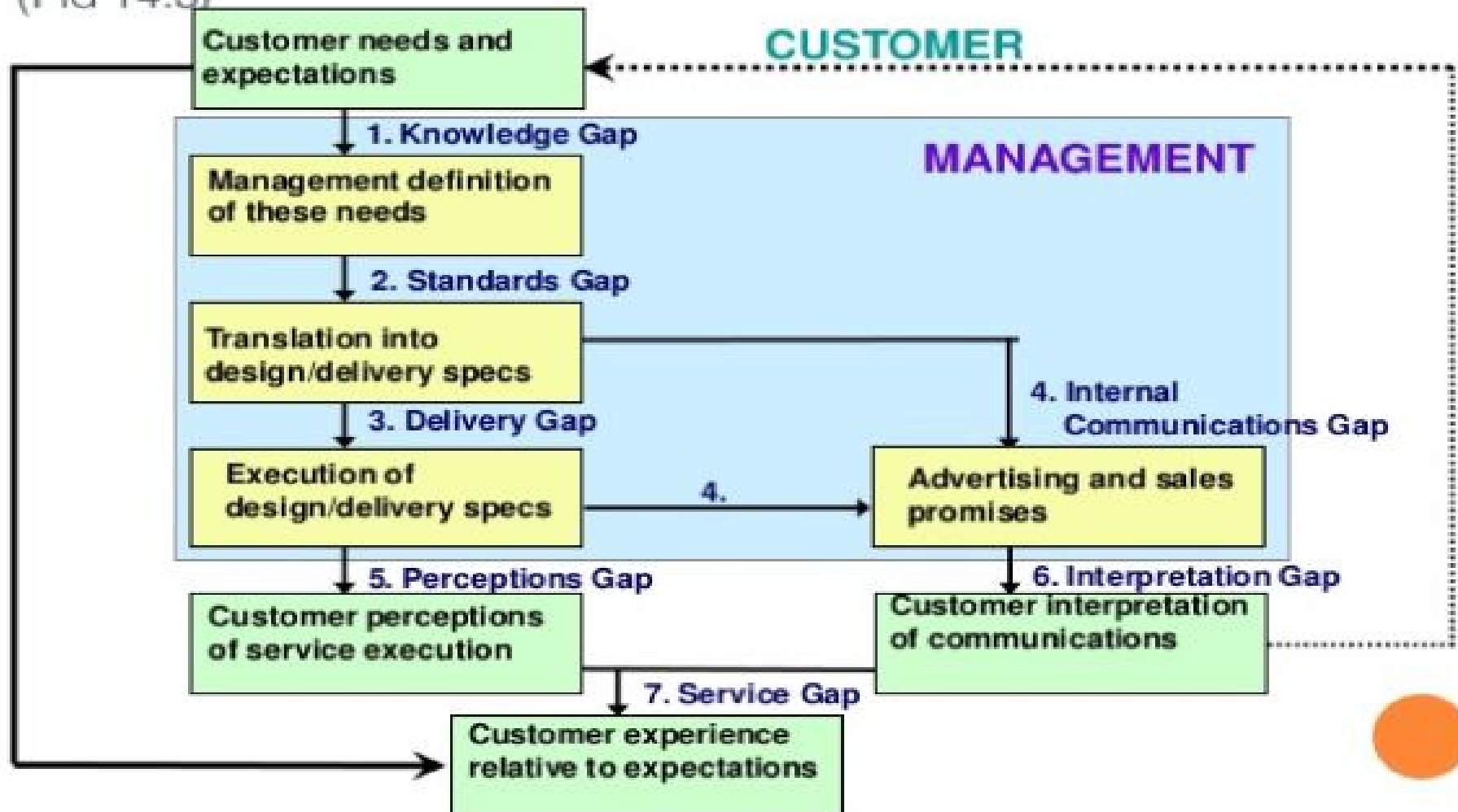
- To discover customer dissatisfaction
- To identify the customer needs
- To discover relative priorities of quality
- To compare performance with the competition
- To determine opportunities, for improvement



# Service Quality

## SEVEN SERVICE QUALITY GAPS

(FIG 14.3)



# Service Quality

## PRESCRIPTIONS FOR CLOSING THE SEVEN SERVICE QUALITY GAPS

1. *Knowledge gap*: Learn what customers expect
2. *Standards gap*: Specify SQ standards that reflect expectations
3. *Delivery gap*: Ensure service performance meets standards
4. *Internal communications gap*: Ensure that communications promises are realistic
5. *Perceptions gap*: Educate customers to see reality of service quality delivered
6. *Interpretation gap*: Pretest communications to make sure message is clear and unambiguous
7. *Service gap*: Close gaps 1 to 6 to meet customer expectations consistently

# Customer Retention

- The process of retaining the existing customers. It is obvious that customer retention is more powerful and effective than customer satisfaction



# Employee Involvement

- A participative process that uses the input of employees to increase their commitment to the organization's success.
- The direct participation of staff to help an organization fulfil its mission and meet its objectives by applying their own ideas, expertise, and efforts towards solving problems and making decisions.
- Regular participation of employee in deciding how work is done, making suggestion for improvement, goal setting, planning and monitoring of their performance.

# Employee Involvement

- Improved organizational decision-making capability
- Improved attitude regarding work
- Substantially improved employee well-being
- Reduced costs through elimination of waste and reduced product cycle times
- Empowerment, job satisfaction, creativity, commitment and motivation, as well as intent to stay
- Increased employee productivity across industries

# What is motivation

## ➤ Basic motivational concepts

- Motivation—the forces within the individual that account for the level, direction, and persistence of effort expended at work.
- Reward—a work outcome of positive value to the individual
- Extrinsic rewards—valued outcomes given to someone by another person.
- Intrinsic rewards—valued outcomes that occur naturally as a person works on a task.

# Employee Empowerment

*A primary goal of employee empowerment is to give workers a greater voice in decisions about work-related matters.*

*Their decision-making authority can range from offering suggestions to exercising veto power over management decisions.*

*Possible areas include: how jobs are to be performed, working conditions, company policies, work hours, peer review, and how supervisors are evaluated*



# Employee Empowerment

## *Benefits of Empowerment*

- *All ees view themselves as 'Owners' of the business*
- *Improved productivity*
- *Creativity & Innovation*
- *Customer-focus*
- *Faster decision-making*
- *Organizational learning*
- *Making full use of Human resources-*
- *"Engaging the mind of every employee"*



# Teams

Type of Team	
Top-management team	A group composed of the CEO, the president, and the heads of the most important departments
Research and development team	A team whose members have the expertise and experience needed to develop new products
Command groups	A group composed of subordinates who report to the same supervisor, also called a department or unit.
Task forces	A committee of managers or nonmanagerial employees from various departments or divisions who meet to solve a specific, mutual problem; also called an “ad hoc” committee

# Teams

<b>Type of Team</b>	
<b>Self-managed work team</b>	<b>A group of employees who supervise their own activities and monitor the quality of the goods and services they provide.</b>
<b>Virtual team</b>	<b>A team whose members rarely or never meet face to face and interact by using various forms of information technology such as email, computer networks, telephone, fax and video conferences.</b>
<b>Friendship group</b>	<b>An informal group composed of employees who enjoy each other's company and socialize with each other.</b>
<b>Interest group</b>	<b>An informal group composed of employees seeking to achieve a common goal related to their membership in an organization.</b>

# Recognition and Rewards

- ❖ the acknowledgement of an individual or team's behavior, effort and accomplishments that support the organization's goals and values.

- ❖ is an ongoing communications activity by which appreciation is declared for the contributions of individuals or groups.

- ❖ prize that the head of an organization gives to employee/group for doing an exceptional job at work. It can be monetary or not, and the idea is encourage employee to continue achieving.



# Two kinds of Rewards

## Extrinsic rewards

- concrete rewards that employee receive.

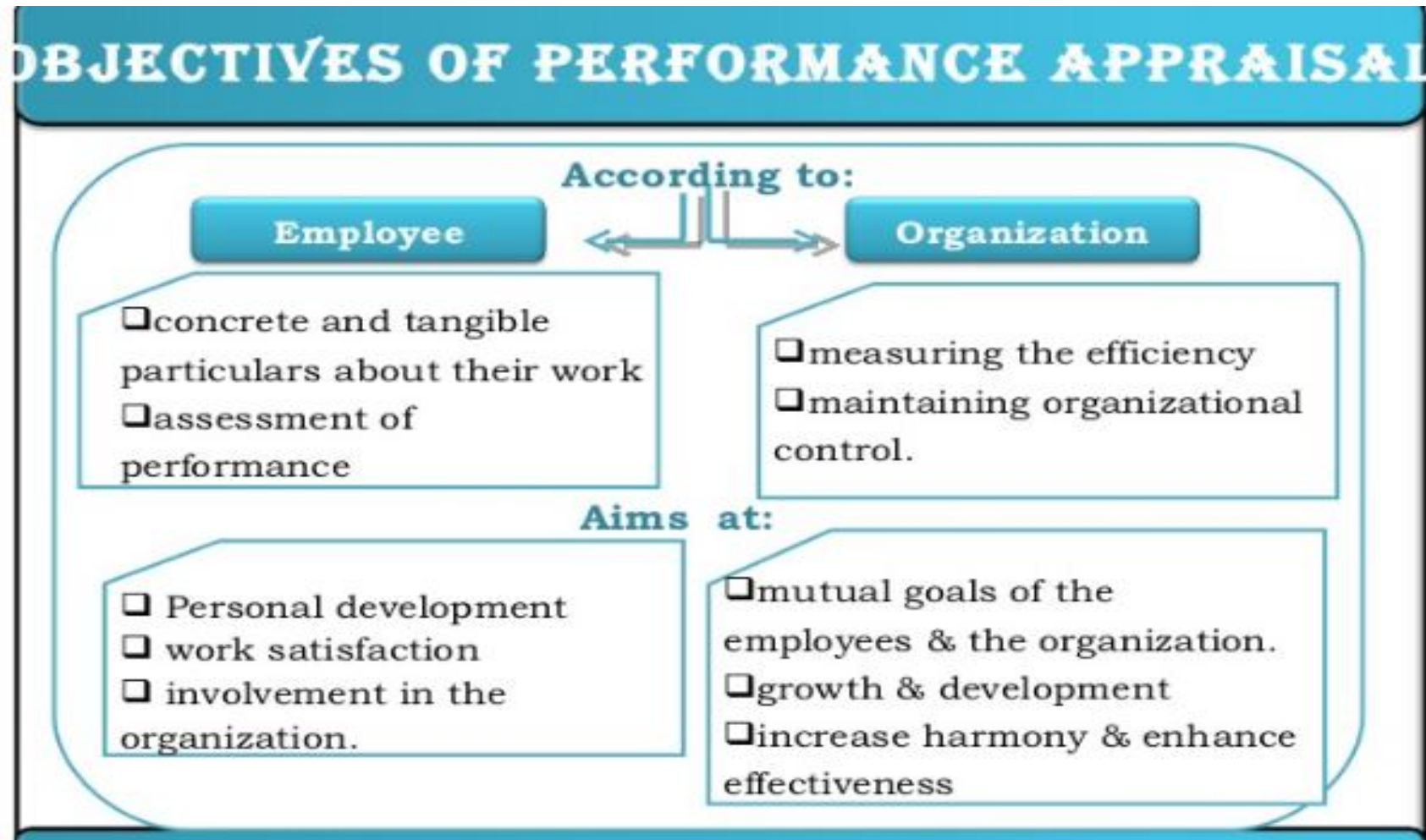
Ex.: Bonuses, Salary Raise,  
Gifts, Promotion, etc.

## Intrinsic rewards

-tend to give personal satisfaction to individual

Ex.: Information / feedback,  
Recognition,  
Trust/Empowerment

# Performance Appraisal

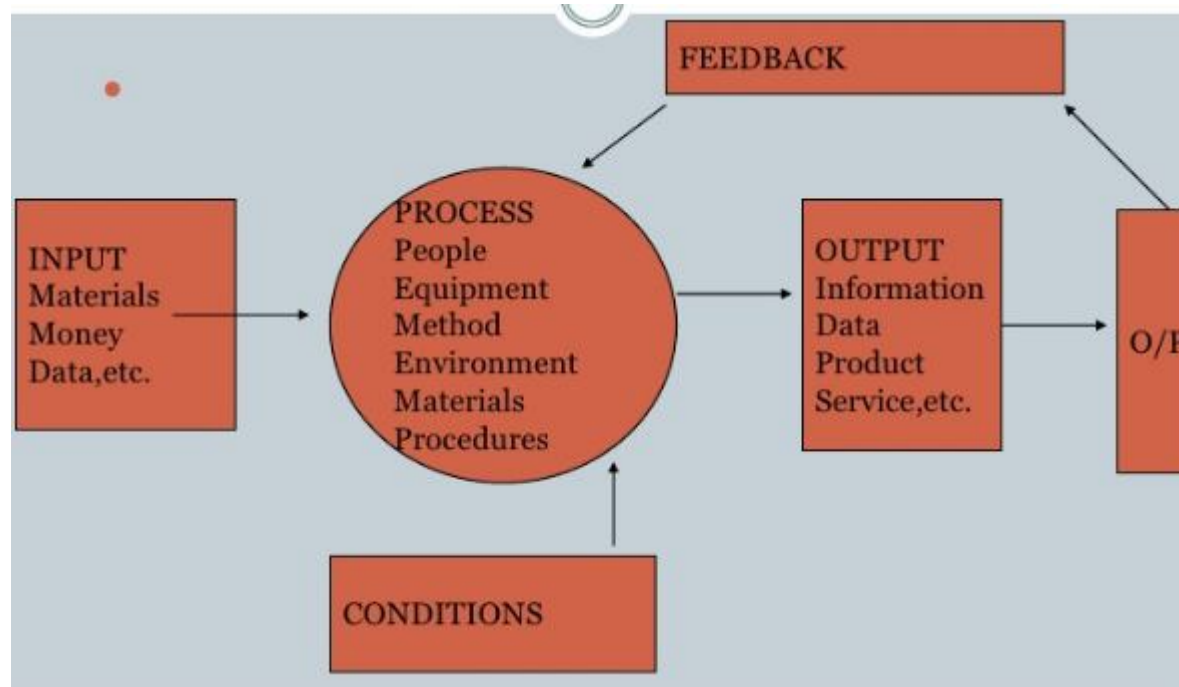


# Benefits of TQM

- Total Quality Management aims to optimize the performance of an organization via continual improvement in the products and services provided, the operation of the internal and external processes, equipment, utilities and most of all the people involved in an organization.  
The net result is a relentless positive improvement in all aspects of an organization's performance, for example, product reliability improvements, greater employee motivation, improved operational efficiency, waste reduction achievements, fewer safety incidents and overall organizational profit increases (where profit is an objective of the organization).

# Continuous Process Improvement

A comprehensive philosophy of operations that is built around the concept that there are always ways in which a process can be improved to better meet the needs of the customer and that an organization should constantly strive to make those improvements.



# Juran Trilogy

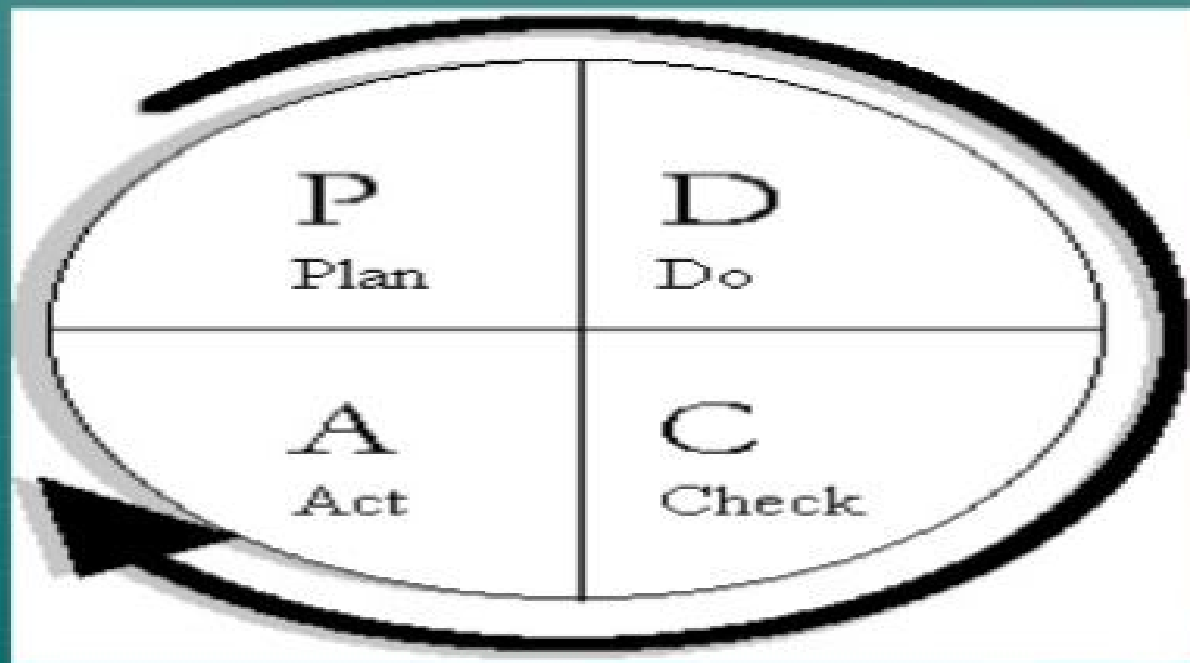
## J.M. Juran's Trilogy

- Developed the idea of trilogy
  - Quality Planning
  - Quality Improvement
  - Quality Control
- Trilogy shows how an organization can improve every aspect by better understanding of the relationship between processes that plan, control and improve quality as well as business results
- In 1951, the first edition of Juran's quality control handbook was published

# PDCA Cycle

## From problem-faced to problem-solved

- ♦ The PDCA Cycle is a checklist of the four stages which you must go through to get from 'problem-faced' to 'problem solved'. The four stages are Plan-Do-Check-Act, and they are carried out in the cycle illustrated below.



# 5S

**5S** is a workplace organization methodology that uses a list of five Japanese words which are *seiri*, *seiton*, *seiso*, *seiketsu* and *shitsuke*.

Translated into English, they stand for:

- Sorting (*seiri*)
- Straightening (*seiton*)
- Systematic cleaning (*seiso*)
- Standardizing (*seiketsu*)
- Sustaining (*shitsuke*)

# Kaizen



**CONTINUOUS  
IMPROVEMENT**



**FOR THE  
BETTER**

**Kaizen aims to eliminate waste ("activities that add cost but do not add value").**

**It is often the case that this means "to take it apart and put back together in a better way."**

**This is then followed by standardisation of this 'better way' with others, through standardized work.**



# Supplier Partnership

## DEFINITION:

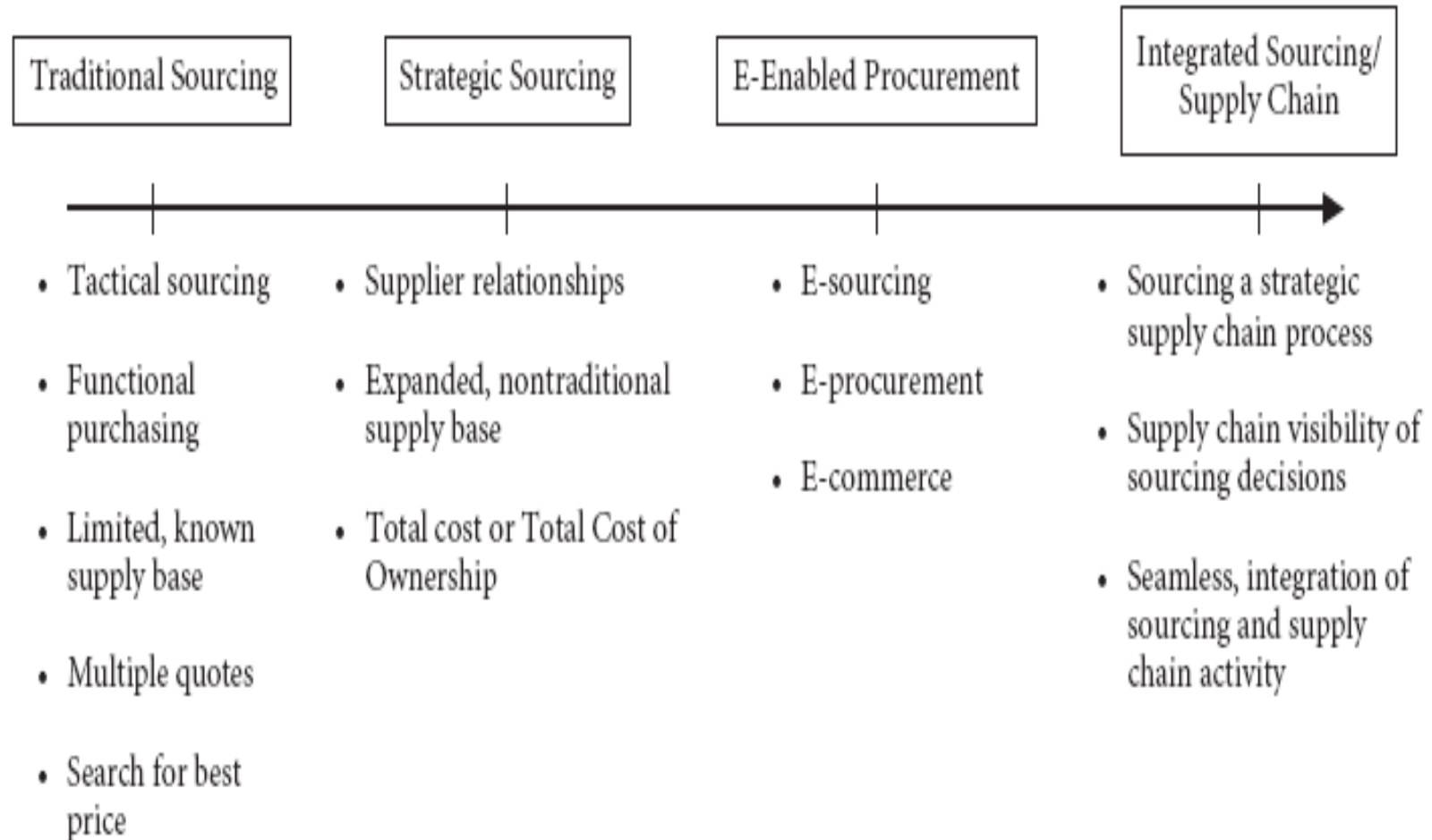
Supplier Partnership is the discipline the strategically planning for, and managing, all interactions with third party organization that supply good and or/ service to your organization, in order to maximize the values of those interactions.

- ▣ An organization (or customer) purchases its requirements, raw materials, components, and services, from supplier.
- ▣ Better supplier's quality → Better product's quality

# PARTNERING

Partnering is a long-term commitment between two or more organizations for the purpose of achieving specific business goals & objectives.

- The relationship is based upon trust, dedication to common goals and objectives.
- Benefits include:
  - o Improved Quality,
  - o Increased efficiency,
  - o Lower cost,
  - o Increased opportunity for innovation, &
  - o Continuous improvement of products and services
- The three key elements of partnering are:
  - o Long-term commitment.
  - o Trust.
  - o Shared vision.

**Figure 13-2****Sourcing Process—Strategic Evolution**

# Supplier Selection

## **SELECTION**

- 3 criteria often considered by firms selecting new suppliers:
  1. Price
  2. Quality
  3. Delivery

## **CERTIFICATION**

- Programs verify that potential suppliers have the capability to provide the services or materials the buying firm requires

# Supplier Selection

**TEN** conditions for selection & evaluation of suppliers:

1. Understand and appreciates the management philosophy of the customer organization
2. Has a stable management system
3. Maintain high technical standards and has the capability of dealing with future technological innovations
4. Can provide those raw materials and parts required and also meet the quality specification
5. Has the capability to produce the amount of production needed



# Supplier Selection

6. There is no danger of the supplier breaching corporate secrets
7. The price is right and the delivery dates can be met – easily accessible in terms of transportation and communication
8. Sincere in implementing contract provisions
9. Has an effective quality system and improvement program such as ISO9000
10. Has a track record of customer satisfaction and organization credibility

# Supplier Rating

The customer rates supplier to:

- Obtain an overall rating of supplier performance
- Ensure complete communications with suppliers concerning their performance
- Provide each supplier with a detailed and factual record of problems for corrective action
- Enhance the relationship between the customer and the supplier
- Requires 3 key factors:
  1. An internal structure to implement and sustain the rating program
  2. A regular and formal review process
  3. A standard measurement system for all the suppliers

# Relationship Development

- Inspection
  - There are 4 phases of inspection
    1. 100% inspection – critical quality characteristics
    2. Sampling – confidence in quality performance
    3. Audit
    4. Identity check – statistical control of the process and continuous improvement; experience in Japan & US has shown that it takes about 5 years to achieve this final level of quality
- Training
- Team Approach
- Recognition



# Performance Measures

- The sixth and final concept of Total Quality Management
- It plays an important part in the overall success or failure of a business organization.
- Performance measures quantitatively tell us something important about our products, services, and the processes that produce them.
- They are a tool to help us understand, manage, and improve what our organizations do.

# **UNIT III - STATISTICAL PROCESS CONTROL (SPC)**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

# The seven tools of quality

- **The seven tools are:**
- Cause-and-effect diagram (also known as the "fishbone" or Ishikawa diagram)
- Check sheet.
- Control chart.
- Histogram.
- Pareto chart.
- Scatter diagram.
- Stratification (alternately, flow chart or run chart)

# Central Tendency

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- This is a method of calculating the **average** of a set of data
- The average represents the **centre** of the distribution
- These types of statistics are **descriptive** which means they seek to summarise the data

- The three common methods of finding the average are:
  1. The **MEAN**
  2. The **MEDIAN**
  3. The **MODE**

# Central Tendency - Mean

- **MEAN =**

sum of all values in the data set

---

total no. of values in the data set

*Write out the formula for calculating the mean, see page 25.*

*Workout the mean of the following data set.*

Depth of water in cm at intervals across a river channel: 45, 36, 36, 28, 24, 19, 16, 16, 12, 7, 3, 3, 3, 1.

- **Advantages:**

- All measures in data set are considered
- Simple to calculate
- Widely understood
- Most reliable when the data set is large with no abnormally extreme values

- **Limitations:**

- Influenced by extreme values in the data set
- Can yield a decimal figure – may be inappropriate e.g. 5.1 persons
- Less reliable the smaller the sample size

# Central Tendency – Median

The median is the **mid-point** in a set of values when they are arranged in order of size.

If there is an even number of values in a data set then you must calculate the average of the two central values when in numerical rank.

## **Advantages:**

The extreme values do not distort your average

Can be more reliable when there is 'bunching, or clustering of values in the data set.

## **Limitations:**

Mathematically less accurate as the actual values do not form part of a calculation

Less reliable when the data set is small or when there are large gaps between the values.

- Calculate the median of the data set below.

- 45
- 36
- 36
- 28
- 24
- 19
- 16
- 16
- 12
- 7
- 3
- 3
- 3
- 1

$$\text{Median} = \frac{7^{\text{th}} + 8^{\text{th}} \text{ value}}{2}$$

$$\text{Median} = \frac{16 + 16}{2}$$

$$\text{Median} = 16$$

- *What is the median group from the data table for channel depth?*

# Central Tendency - Mode

- This is the value which occurs **most frequently** in the data set.
- A data set may have no mode.
- If a data set has one peak it is called UNIMODAL, if it has two it is BIMODAL.
- **Advantages:**
  - Describes the overall shape of the distribution e.g. unimodal or bimodal.
  - Fast and easy as no calculations.
- **Limitations:**
  - Limited mathematical value as modal value may represent extremes in the data set.
  - Does not take into account the spread of values within the data set.

- Calculate the mode of the data set below.

- 45
- 36
- 36
- 28
- 24
- 19
- 16
- 16
- 12
- 7
- 3
- 3
- 3
- 1

Mode = 3

Why is this not a very good method of calculating central tendency in this particular set of data?

- *What is the modal group from the data table for channel depth?*

# Dispersion

- The MEAN summarises the 'centre' of a distribution, but on its own it may not be informative enough.
- **It is often useful to show how far figures differ from the average. This measure is known as DISPERSION.**
- Methods of showing dispersion:
  1. Range
  2. The inter-quartile range
  3. Standard deviation

In your exam you will only have to calculate the range.

- **Range = the difference between the lowest and highest values in the data set.**

- ***Calculate the range for channel depth in cm: 45, 36, 36, 28, 24, 19, 16, 16, 12, 7, 3, 3, 3, 1.***

- Highest – lowest = range
- 45 - 1 = 44cm

- **Advantages:**

- Easy to calculate
- Shows the spread of data
- When used with the mean it shows the distribution of values around the mean – statistically more useful

- **Limitations:**

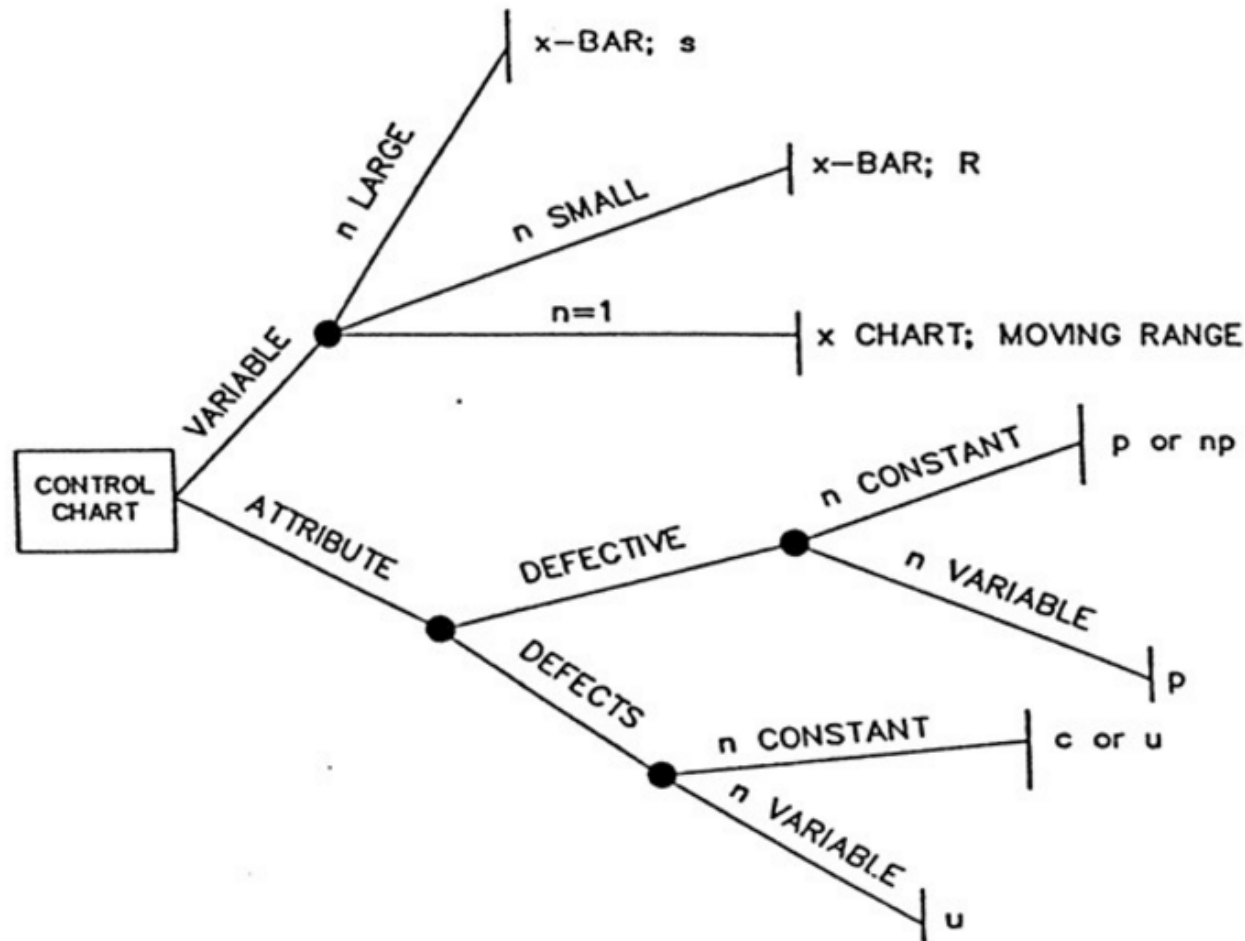
- Depends on only two values and ignores the rest. A particular problem if extreme values are atypical.



# Normal Curve

- It is a graphical presentation of normal distribution
- It is a bell-shaped curve that extends indefinitely on both sides.
- The curve is symmetrical, with the highest point at the center.
- It is asymptotic to the base line or the x-axis.
- The total area under the normal is 1.0 or 100%.
- The mean, median and mode coincide at one point at the center of the curve.
- The mean and the standard deviation are the parameters used to describe the normal curve.

# Control Charts for variables and attributes

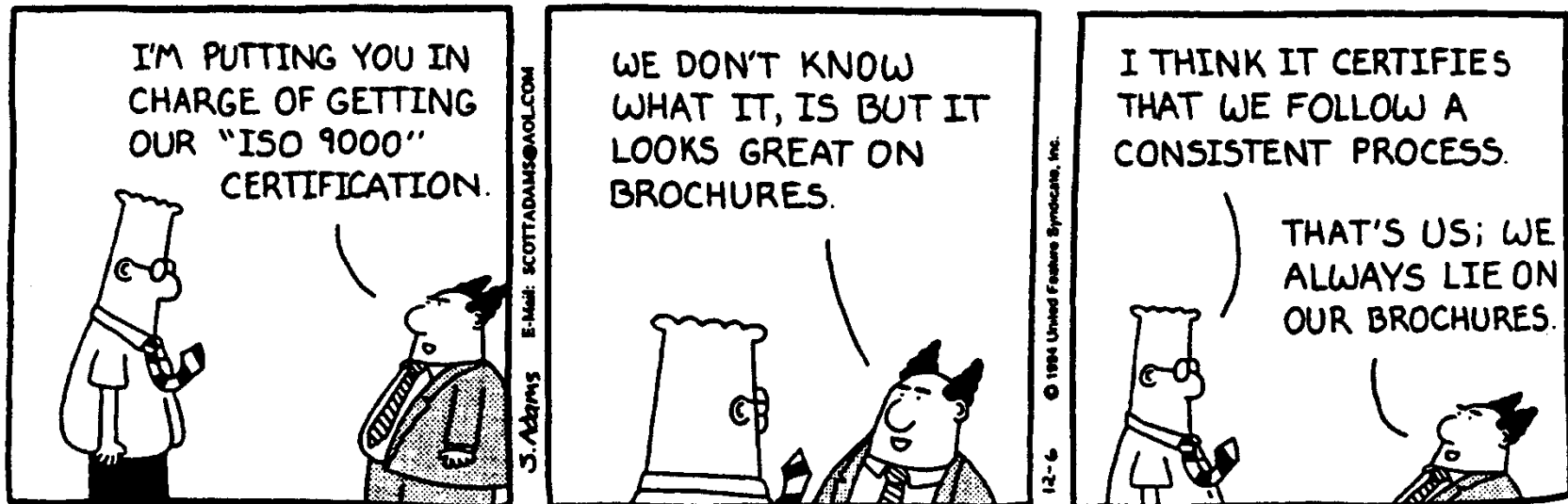


# How do you get to a Six Sigma Process?

## Step 1: Do Things Consistently (ISO 9000)

1. Management Responsibility
2. Quality System
3. Contract review
4. Design control
5. Document control
6. Purchasing / Supplier evaluation
7. Handling of customer supplied material
8. Products must be traceable
9. Process control
10. Inspection and testing
11. Inspection, Measuring, Test Equipment
12. Records of inspections and tests
13. Control of nonconforming products
14. Corrective action
15. Handling, storage, packaging, delivery
16. Quality records
17. Internal quality audits
18. Training
19. Servicing
20. Statistical techniques

*Examples: "The design process shall be planned",  
"production processes shall be defined and planned"*



# Process Capability

- ▶ There are 6 different “measures” that can be used to define how capable a process is of meeting customer requirements
- ▶ These measures are all related to each other and can be mathematically converted from one measure to another measure

## Short and Long Term Capability

- ▶ Data and the six measures of process capability can represent
  - ▶ Short-term capability
  - ▶ Long-term capability
- ▶ The Differences between short and long-term capability will be covered after an explanation of the different measures of process capability

# THE 'SEVEN SIMPLE TOOLS'

- Flowcharts
- Cause and Effect (Ishikawa / fishbone) Diagrams
- Check sheets
- Pareto Charts
- Histograms
- Run Charts and Control Charts
- Scatter plots and Correlation Analysis

# UNIT IV - TQM TOOLS

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, and FMEA – Stages of FMEA.

# Benchmarking

Benchmarking is the process of  
*measuring* an organization's internal processes  
then *identifying*, *understanding*, and *adapting* outstanding practices from other  
organizations considered to be best-in-class.

## Definition

*“**measuring** our performance against that of best-in- class companies,  
**determining** how the best-in-class achieve those performance levels  
and **using** the information as a basis for our own company's targets,  
strategies and implementation .”*

# Benchmarking

## Why Benchmarking?

- To Obtain an External Perspective of What Is Possible
- To Assist in Setting Strategic Targets
- To Promote Improvements in Performance
- To Establish a Competitive Edge
- To Enhance Customer Satisfaction
- To Reduce Costs
- To Improve Employee Morale
- To Achieve Quality Awards
- To Survive



# Benchmarking

## When Benchmarking?

- If the company's QMS is not properly developed, documented and implemented.
- If company's great strength areas are not measured.
- If company's great weakness areas are not measured.
- If company's great opportunities are not measured.
- If customer needs are not assessed and rectified .

# Benchmarking

## Benchmarking in the Context of TQM

*TQM Key principles include:*

- Comparisons with best practice.
- A Strong emphasis on meeting the needs of the customer (internal and external).
- The importance of efficient, effective business processes.
- The need for continuous improvement .
- Enhances a TQM program .

# Quality Function Deployment

- QFD links the needs of the customer (end user) with design, development, engineering, manufacturing, and service functions.
- QFD focuses on customer expectation often referred as VOC.
- Translated Cus expectation into specific requirement into direction, action, engg, tech characteristics and deployed throu product planning, part development, process planning production planning and service industry.
- QFD empowers organizations to exceed normal expectations and provide a level of unanticipated excitement that generates value.

# Quality Function Deployment

❖ Quality Function Deployment (QFD) is a systematic process for motivating a business to focus on its customers.

❖ It is used by cross-functional teams to identify and resolve issues involve in providing products, processes, services and strategies which will more than satisfy their customers.

- 📖 Understanding Customer Requirements
- 📖 Quality Systems Thinking + Psychology + Knowledge
- 📖 Maximizing Positive Quality That Adds Value
- 📖 Comprehensive Quality System for Customer Satisfaction
- 📖 Strategy to Stay Ahead of The Game

# House of Quality

Every successful company has always used data and information to help in its planning processes. In planning a new product, engineers have always examined the manufacturing and performance history of the current product. They look at field test data, comparing their product to that of their competitor's product. They examine any customer satisfaction information that might happen to be available. Unfortunately, much of this information is often incomplete. It is frequently examined as individual data, without comparison to other data that may support or contradict it.

By contrast, Quality Function Deployment (QFD) uses a matrix format to capture a number of issues that are vital to the planning process. The House of Quality Matrix is the most recognized and widely used form of this method. It translates customer requirements, based on marketing research and benchmarking data, into an appropriate number of engineering targets to be met by a new product design. Basically, it is the nerve center and the engine that drives the entire QFD process. According to Hauser and Clausing, it is "a kind of conceptual map that provides the means for interfunctional planning and communication."

There are many different forms of the House of Quality, but its ability to be adapted to the requirements of a particular problem make it a very strong and reliable system to use. Its general format is made up of six major components. These include customer requirements, technical requirements, a planning matrix, an interrelationship matrix, a technical correlation matrix, and a technical priorities/benchmarks and targets section.

# Taguchi Quality Loss Function

- ☐ Taguchi Methods is a statistical methods developed largely by GENICHI TAGUCHI to improve quality of manufactured goods.
  - ☐ The philosophy of off-line quality control.
  - ☐ Innovations in the design of experiments.
- 
- ☐ Quality Loss Occurs when a product's deviates from target or nominal value.
  - ☐ Deviation Grows, then Loss increases.
  - ☐ Taguchi's U-shaped loss Function Curve.

# Total Productive Maintenance

## **TPM TARGETS**

### **2. PRODUCTION**

- i). Obtain Minimum 80% Overall Production Efficiency*
- ii). Obtain Minimum 90% Overall Equipment Effectiveness*
- iii). Run the Machine during lunchtime*

### **3. QUALITY**

*Operate in a manner, so that there are no customer complaint*

### **5. COST**

*Reduce the manufacturing cost by ---- Per Cent*

### **7. DELIVERY**

*Achieve 100% success in delivering the goods as required by the customer*

### **9. SAFETY**

*Maintain an accident free environment*

### **11. MULTYTASK**

*Develop multiskilled & flexible workers.*

# Total Productive Maintenance

## Motives of TPM

- b) Adoption of Life – Cycle approach for improving the overall performance of production equipments
- c) Improving Productivity by highly motivated workers which is achieved by Job – Enlargement
- d) Formation of team of volunteers for activities viz, cause of failure, possible reduction of cycle time; and equipment / process 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.



# Total Productive Maintenance

## Direct Benefits of TPM

2. Increase Productivity and Overall Plant Efficiency by 1.5 to 2 times
3. Rectify customers complaints
4. Reduce manufacturing cost by ....percent
5. Satisfy the customers needs by 100%
6. Reduce accidents
7. Comply with all relevant governmental regulations

## Indirect Benefits of TPM

2. Higher confidence level among the workers
3. Keep the work place clean, neat and attractive
4. Favourable change in the attitude of the operators
5. Achieve goals by working as Team
6. Share knowledge and experience
7. The worker get a feeling of OWNING the machine



# FMEA

## *WHAT IS FMEA?*

### *Analysis of potential failures*

- Classification of failures by severity of the effects, how often they occur and how easily can they be detected
- Definition of controls to prevent failures
- What do we need to do next?

# FMEA

## *FMEA HISTORY*

- Originally developed in the 1940's for the US military
- Utilized in the Apollo space program to minimize failures of expensive prototypes
- Ford formally brought it into the automotive industry in the 1970's after the Pinto "thermal events"

# FMEA

## *BENEFITS OF FMEA*

- Reduces costs
  - Field failure
  - Scrap
- Prioritizes risk
- Engineering / manufacturing knowledge base

# FMEA

## *BENEFITS OF FMEA*

- Prevents failures before they happen
- Identifies critical aspects of designs and processes
- Identifies controls needed
- Identifies where to focus
- Essential to Continuous Improvement
- Essential to Quality

# **UNIT V QUALITY SYSTEMS**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS16949, ISO 14000 – Concept, Requirements and Benefits



# Need for ISO 9000 and Other Quality Systems

- Improved consistency of service and product performance
- Higher customer satisfaction levels
- Improved customer perception
- Improved productivity and efficiency
- Cost reductions
- Improved communications, morale and job satisfaction
- Competitive advantage and increased marketing and sales opportunities

# Need for ISO 9000 and Other Quality Systems

- Enables your organization to become more cost-effective, efficient and resilient to change.
- Requires your organization to monitor and improve key business and customer satisfaction measures.
- Improve internal communications.
- Improves product and process quality.
- Provides a passport to the global market.



# ISO 9000:2000 Quality Management Principles

1. Customer Focus
2. Leadership
3. Involvement of People
4. Process Approach
5. System Approach to Management
6. Continual Improvement
7. Factual Approach to Decision Making
8. Mutually Beneficial Supplier Relationships

# Elements of TQM

*To be successful implementing TQM, an organization must concentrate on the eight key elements:*

- ✓ *Ethics*
- ✓ *Integrity*
- ✓ *Trust*
- ✓ *Training*
- ✓ *Teamwork*
- ✓ *Leadership*
- ✓ *Recognition*
- ✓ *Communication*

# Implementation of TQM

For TQM to be successful, the organization must concentrate on the following key elements:

Integrity

Ethics

Trust

Training

Teamwork

Communication

Recognition

Leadership



# Implementation of TQM

The key elements of TQM can be divided into four groups according to their function:

Foundation: Integrity, Ethics, Trust

Building Bricks: Leadership, Teamwork, Training

Roof: Recognition (Motivation)

Binding Mortar: Communication



# Documentation



**The Documentation Pyramid**

# Quality Auditing

- It is a Periodic, independent, and documented examination and verification of activities, records, processes, and other elements of a quality system to determine their conformity with the requirements of a quality standard such as ISO 9000.

Any failure in their proper implementation may be published publicly and may lead to a revocation of quality certification.

Also called conformity assessment or quality system audit.

# TS16949

📊 Replaced 2002 version

📊 Emphasizes:

- Continuous improvement
- Elimination of variation, defects & waste in production & supply chain

📊 Components of ISO 9001:2008

- Quality system training can vary from operator to operator & includes employee job skills

# ISO 14000

ISO 14000

**ISO 14000** is a family of standards related to **environmental management** that exists to help organizations

- Minimize operations: negatively affect the environment
- Comply with applicable laws, regulations, and other environmentally oriented requirements
- Continually improve in the above.



# Requirements

- Prevention of pollution.
- Continual Environmental Improvement.
- Commitment to comply with Environmental Laws and Regulations
- Applicable in size and scope.
- Establish framework for setting and reviewing objectives and targets
- Documented, implemented, maintained, and communicated to employees.
- Available to the public

# Requirements

Procedures to ensure that the company can identify legal and other environments requirements are required to be established and maintained.

It is also required to know how the organization

- Access and identify legal and other requirements
- Keep track of changes to legal and other requirements
- Communicate relevant information about legal and other requirements to employees

# Benefits

- An organization should implement an effective environmental management system in order to help protect human health and the environment from the potential impacts of its activities, products or services; and to assist in maintaining and improving the quality of the environment.
- Having an EMS can help an organization provide confidence to its interested parties that a management commitment exists to meet the provisions of its policy, objectives, and targets; emphasis is placed on prevention rather than corrective action; evidence of reasonable care and regulatory compliance can be provided; and the systems design incorporates the process of continual improvement.