

# Total Quality Management

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## **Module I**

# INTRODUCTION

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- ❑ Competition is getting harder and becoming global.
- ❑ Companies may now have to be more responsive, offer a better product and keep improving.
- ❑ TQM increases customer satisfaction by boosting quality. It does this by motivating the workforce and by improving the way the company operates.
- ❑ In an increasingly competitive market, firms with a continuous improvement culture and external focus are more likely to survive and prosper.
- ❑ TQM is considered as an important catalyst in this context.

# Quality-Definition

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- Dependent on the people defining it
- No single, universal definition of quality

# Few Definitions

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1. **Conformance to specifications**
  - Does product/service meet targets and tolerances defined by designers?
2. **Fitness for use**
  - Evaluates performance for intended use
3. **Value for price paid**
  - Evaluation of usefulness vs. price paid
4. **Support services**
  - Quality of support after sale
5. **Psychological**
  - Ambiance, prestige, friendly staff

# Why Quality?

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Reasons for quality becoming a cardinal priority for most organizations:

- ❑ **Competition** – Today's market demand high quality products at low cost. Having 'high quality' reputation is not enough! Internal cost of maintaining the reputation should be less.
- ❑ **Changing customer** – The new customer is not only commanding priority based on volume but is more demanding about the "quality system."
- ❑ **Changing product mix** – The shift from low volume, high price to high volume, low price have resulted in a need to reduce the internal cost of poor quality.

# Why Quality?

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- **Product complexity** – As systems have become more complex, the reliability requirements for suppliers of components have become more stringent.
- **Higher levels of customer satisfaction** – Higher customers expectations are getting spawned by increasing competition.

Relatively simpler approaches to quality viz. product inspection for quality control and incorporation of internal cost of poor quality into the selling price, might not work for today's complex market environment.

# Manufacturing Quality vs. Service Quality

- Manufacturing quality focuses on tangible product features
  - Conformance, performance, reliability, features
- Service organizations produce intangible products that must be experienced
  - Quality often defined by perceptual factors like courtesy, friendliness, promptness, waiting time, consistency

# Need for Quality

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- **Quality** is critical to satisfying your customers and retaining their loyalty so they continue to buy from you in the future.
- **Quality** products make an **important** contribution to long-term revenue and profitability. They also enable you to charge and maintain higher prices.



# What is TQM

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- A comprehensive, organization-wide effort to improve the quality of products and services, applicable to *all* organizations.
- Total Quality Management is an extensive and **structured organization management approach** that focuses on **continuous quality improvement** of products and services by using **continuous feedback**.

# History of quality management

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- When top managers in USA focused on marketing, production quantity and financial performance, *Japanese managers improved quality* at an unprecedented rate.
- Market started preferring Japanese products and American companies suffered immensely.
- America woke up to the quality revolution in early 1980s. *Ford Motor Company consulted Dr. Deming* to help transform its operations.

(By then, 80-year-old Deming was virtually unknown in USA. Whereas Japanese government had instituted The Deming Prize for Quality in 1950.)

- Managers started to realize that “quality of management” is more important than “management of quality.” Birth of the term *Total Quality Management (TQM)*.
- *TQM – Integration of quality principles into organization’s management systems.*

# Modern History of Quality Management

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- Frederick W. Taylor wrote Principles of Scientific Management in 1911.
- Walter A. Shewhart used statistics in quality control and inspection, and showed that productivity improves when variation is reduced (1924); wrote Economic Control of Manufactured Product in 1931.
- W. Edwards Deming and Joseph M. Juran, students of Shewhart, went to Japan in 1950; began transformation from “shoddy” to “world class” goods.
- In 1960, Dr. K. Ishikawa formalized “quality circles” - the use of small groups to eliminate variation and improve processes.
- In the late ‘70’s and early ‘80’s:
  - Deming returned from Japan to write Out of the Crisis, and began his famous 4-day seminars in the United States
  - Phil Crosby wrote Quality is Free
  - NBC ran “If Japan can do it, why can’t we?”
  - Motorola began 6 Sigma

# Quality Gurus

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Quality Guru	Main Contribution
Walter A. Shewhart	<ul style="list-style-type: none"><li>- Contributed to understanding of process variability.</li><li>- Developed concept of statistical control charts.</li></ul>
W. Edwards Deming	<ul style="list-style-type: none"><li>- Stressed management's responsibility for quality.</li><li>- Developed "14 Points" to guide companies in quality improvement.</li></ul>
Joseph M. Juran	<ul style="list-style-type: none"><li>- Defined quality as "fitness for use."</li><li>- Developed concept of cost of quality.</li></ul>
Armand V. Feigenbaum	<ul style="list-style-type: none"><li>- Introduced concept of total quality control.</li></ul>
Philip B. Crosby	<ul style="list-style-type: none"><li>- Coined phrase "quality is free."</li><li>- Introduced concept of zero defects.</li></ul>
Kaoru Ishikawa	<ul style="list-style-type: none"><li>- Developed cause-and-effect diagrams.</li><li>- Identified concept of "internal customer."</li></ul>
Genichi Taguchi	<ul style="list-style-type: none"><li>- Focused on product design quality.</li><li>- Developed Taguchi loss function.</li></ul>

# The Quality Gurus (cont'd)

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- W. Edwards Deming
  - Advocated Statistical Process Control (SPC)
    - Methods which signal shifts in a process that will likely lead to products and/or services not meeting customer requirements.
    - Emphasized an overall organizational approach to managing quality.
    - Demonstrated that quality products are less costly than poor quality products.
    - Identified **14 points critical for improving quality**.
  - The Deming Prize
    - Highest award for industrial excellence in Japan.



# Deming's 14-Point Program for Improving Quality

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1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on mass inspection.
4. End the practice of awarding business on the price tag alone.
5. Improve constantly and forever the system of production and training.
6. Institute training.
7. Institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations, and targets for the workforce.
11. Eliminate numerical quotas.
12. Remove barriers to pride in workmanship.
13. Institute a vigorous program of education and retraining.
14. Take action to accomplish the program.

# The Deming philosophy

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- “A System of Profound Knowledge”
  1. **Appreciation for a system** - A system is a set of functions or activities within an organization that work together to achieve organizational goals. Management’s job is to *optimize the system*. (not parts of system, but the whole!). System requires *co-operation*.
  2. **Psychology** – The designers and implementers of decisions are *people*. Hence understanding their psychology is important.

# The Deming philosophy

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3. **Understanding process variation** – A production process contains many sources of variation. *Reduction in variation improves quality*. Two types of variations- *common causes and special causes*. Focus on the special causes. Common causes can be reduced only by change of technology.
4. **Theory of knowledge** – Management decisions should be driven by *facts, data and justifiable theories*. Don't follow the managements fads!



# The Quality Gurus (cont'd)

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## □ Joseph M. Juran

- Emphasized the importance of producing quality products through an approach focused on quality planning, control, and improvement.
- Defined product quality as “**fitness for use**” as viewed by the customer in:
  - Quality of design                      • Quality of conformance
  - Availability                      • Safety                      • Field use
- Categorized the cost of quality as:
  - Cost of prevention
  - Cost of detection/appraisal
  - Cost of failure

# The Juran philosophy

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- Pursue quality on two levels:
  1. The *mission of the firm* as a whole is to achieve high *product quality*.
  2. The *mission of each individual department* is to achieve high *production quality*.
  
- Quality should be talked about in a language senior management understands: **money (cost of poor quality)**.
  
- At operational level, focus should be on conformance to specifications through elimination of defects- use of statistical methods.

# The Juran philosophy

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## Quality Trilogy –

1. *Quality planning*: Process of preparing to meet quality goals. Involves understanding customer needs and developing product features.
2. *Quality control*: Process of meeting quality goals during operations. Control parameters. Measuring the deviation and taking action.
3. *Quality improvement*: Process for breaking through to unprecedented levels of performance. Identify areas of improvement and get the right people to bring about the change.

# The Quality Gurus (cont'd)

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## □ Philip Crosby

- Preached that “quality is free.”
- Believed that an organization can reduce overall costs by improving the overall quality of its processes.

# The Crosby philosophy

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## Absolute's of Management

- ❑ Quality means *conformance to requirements* not elegance.
- ❑ There is no such thing as *quality problem*.
- ❑ There is no such thing as economics of quality: it is always cheaper to do the *job right the first time*.
- ❑ The only performance measurement is the *cost of quality*: the cost of non-conformance.

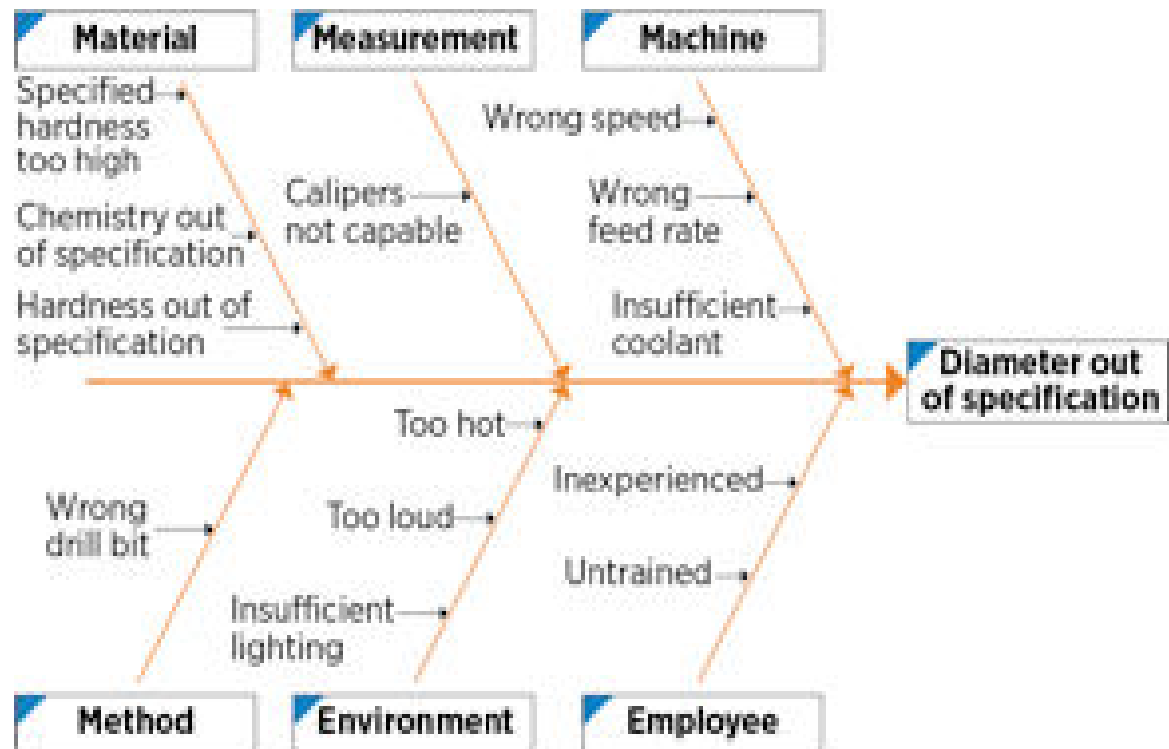
## Basic Elements of Improvement

- ❑ *Determination* (commitment by the top management)
- ❑ *Education* (of the employees towards Zero Defects (ZD))
- ❑ *Implementation* (of the organizational processes towards ZD)

# The Quality Gurus (cont'd)

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- Genichi Taguchi
  - Emphasized the minimization of variation.
    - Concerned with the cost of quality to society.
    - Extended Juran's concept of external failure.
  
- Kaoru Ishikawa
  - Developed problem-solving tools such as the cause-and-effect (*fishbone*) diagram.
  - Called the father of quality circles.



# Defining the Dimensions of Quality

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## □ Quality in Goods

- Performance
- Features
- Reliability
- Durability
- Conformance
- Serviceability
- Aesthetics
- Perceived quality

## □ Quality in Services

- Reliability
- Tangibles
- Responsiveness
- Assurance
- Empathy



# Three of the Quality Gurus Compared

	Crosby	Deming	Juran
Definition of quality	Conformance to specifications	A predictable degree of uniformity and dependability at low cost and suited to the market	Fitness for use
Degree of senior management responsibility	Responsible for quality	Responsible for 85% of quality problems	Less than 20% of quality problems are due to workers
Performance standard/motivation	Zero defects	Quality has many "scales": use statistics to measure performance in all areas; critical of zero defects	Avoid campaigns to do perfect work
General approach	Prevention, not inspection	Reduce variability by continuous improvement; cease mass inspection	General management approach to quality, especially human elements
Structure	14 steps to quality improvement	14 points for management	10 steps to quality improvement

Source: Modified from John S. Oakland, Total Quality Management (London: Heinemann Professional Publishing Ltd., 1989), pp. 291–92.

## Three of the Quality Gurus Compared (cont'd)

	Crosby	Deming	Juran
Statistical process control (SPC)	Rejects statistically acceptable levels of quality	Statistical methods of quality control must be used	Recommends SPC but warns that it can lead to tool-driven approach
Improvement basis	A process, not a program; improvement goals	Continuous to reduce variation; eliminate goals without methods	Project-by-project team approach; set goals
Teamwork	Quality improvement teams; quality councils	Employee participation in decision making; break down barriers between departments	Team and quality circle approach
Costs of quality	Cost of nonconformance; quality is free	No optimum; continuous improvement	Quality is not free; there is an optimum

Source: Modified from John S. Oakland, Total Quality Management (London: Heinemann Professional Publishing Ltd., 1989), pp. 291–92.

## Three of the Quality Gurus Compared (cont'd)

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	Crosby	Deming	Juran
Purchasing and goods received	State requirements; supplier is extension of business; most faults due to purchasers themselves	Inspection too late; allows defects to enter system through AQLs; statistical evidence and control charts required	Problems are complex; carry out formal surveys
Vendor rating	Yes and buyers' quality audits useless	No, critical of most systems	Yes, but help supplier improve
Single sourcing of supply		Yes	No, can neglect to sharpen competitive edge

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Source: Modified from John S. Oakland, Total Quality Management (London: Heinemann Professional Publishing Ltd., 1989), pp. 291–92.



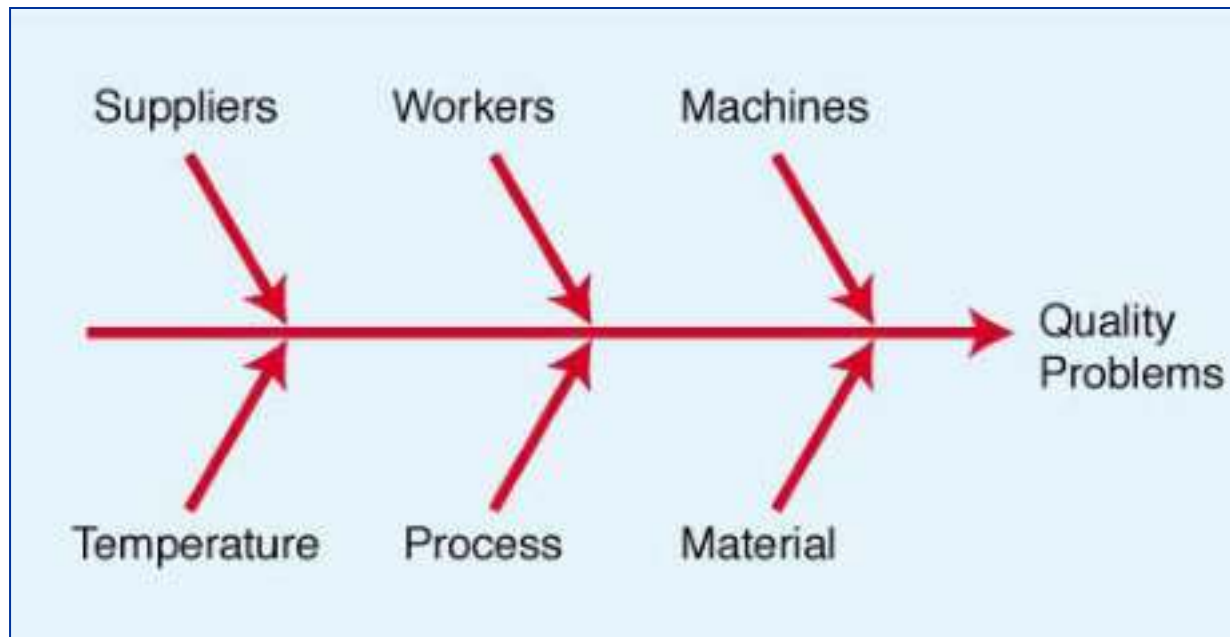
# Seven Tools of Quality Control

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1. Cause-and-Effect Diagrams
2. Flowcharts
3. Checklists
4. Control Charts
5. Run Charts
6. Scatter Diagrams
7. Pareto Analysis
8. Histograms

# Cause-and-Effect Diagrams

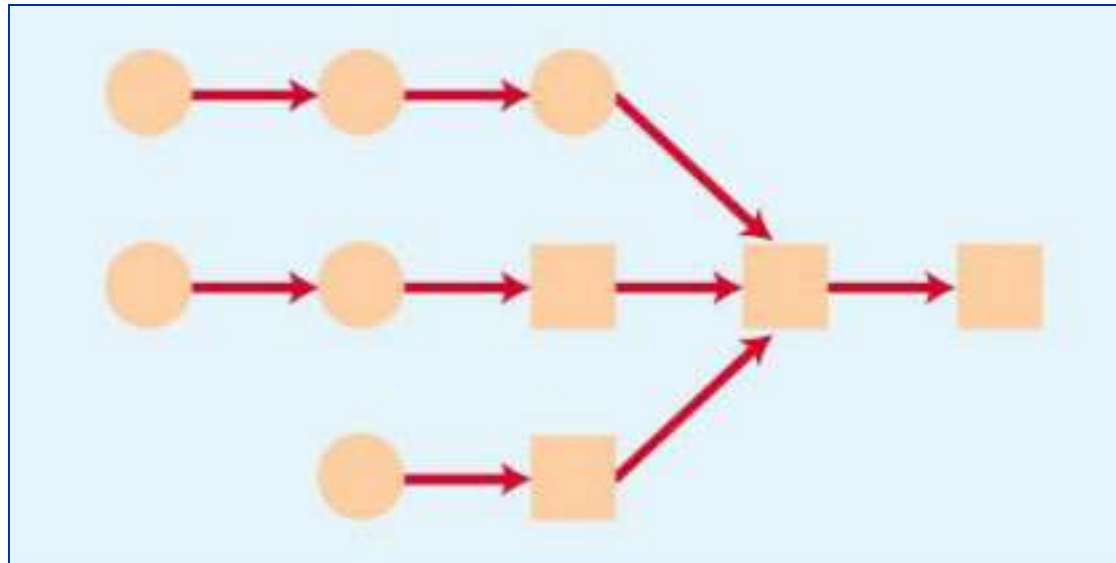
- Called **Fishbone Diagram**
- Focused on solving identified quality problem



# Flowcharts

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- Used to document the detailed steps in a process
- Often the first step in Process Re-Engineering



# Checklist

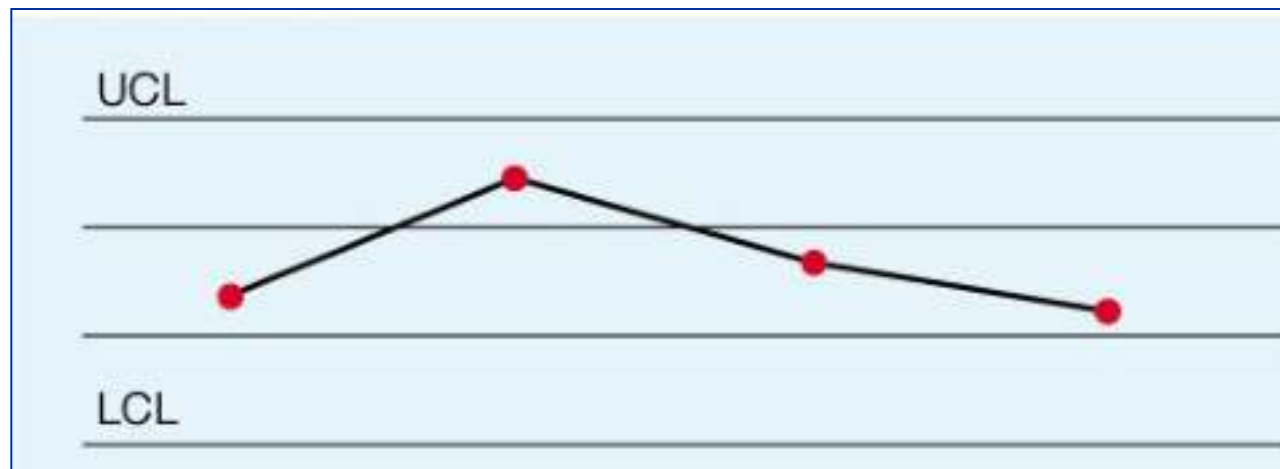
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**Simple data check-off sheet designed to identify type of quality problems at each work station; per shift, per machine, per operator**

Defect Type	No. of Defects	Total
Broken zipper	✓✓✓	3
Ripped material	✓✓✓✓✓✓✓	7
Missing buttons	✓✓✓	3
Faded color	✓✓	2

# Control Charts

- Important tool used in **Statistical Process Control**
- The UCL and LCL are calculated limits used to show when process is in or out of control

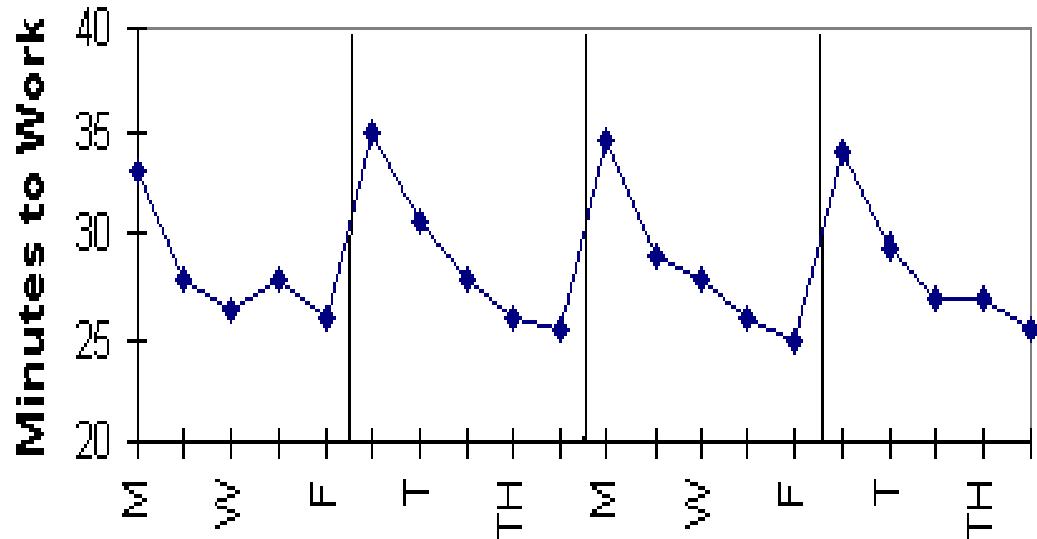




# Run Charts

**Run Charts** are similar in some regards to Control Charts, but do not show the control limits of the process.

They are therefore simpler to produce, but do not allow for the full range of analytic techniques supported by Control Charts.

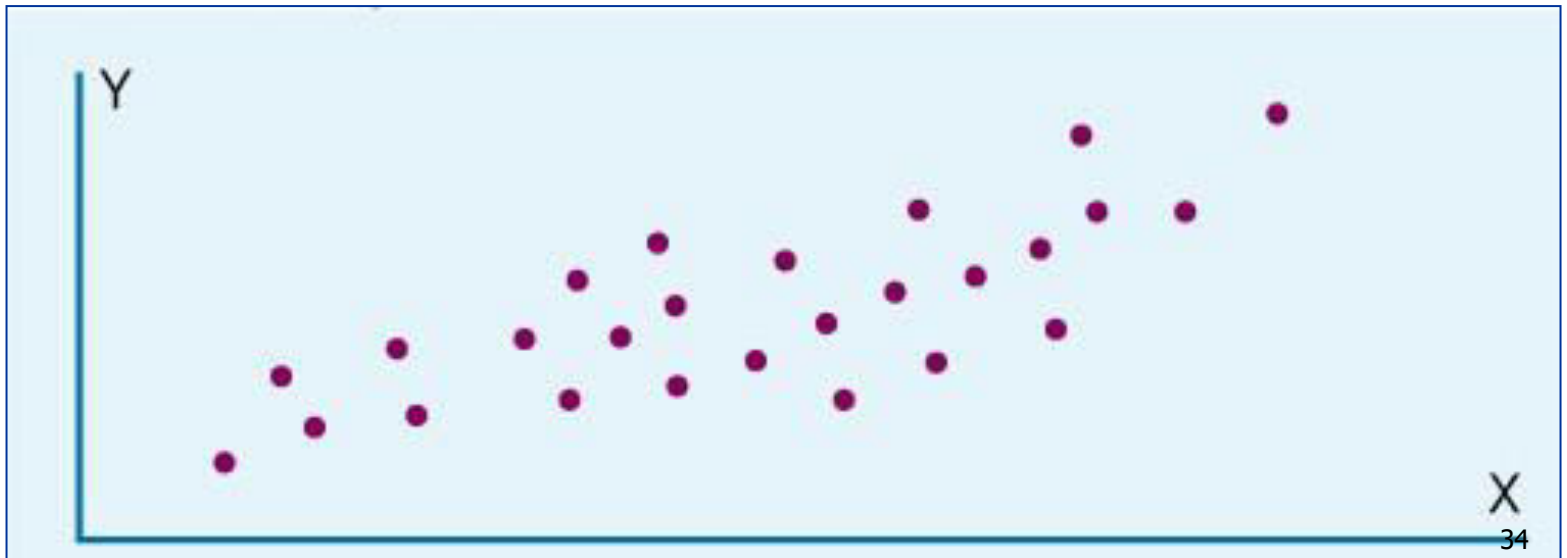


- Run chart: Measurement against progression of time.
- Control chart: Add Upper Control Limit and Lower Control Limit to the run chart.

# Scatter Diagrams

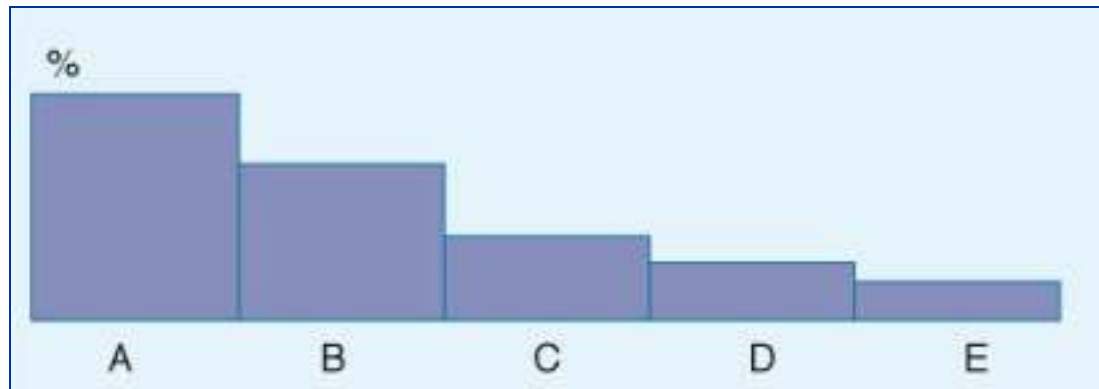
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- **A graph that shows how two variables are related to one another**
- **Data can be used in a regression analysis to establish equation for the relationship**

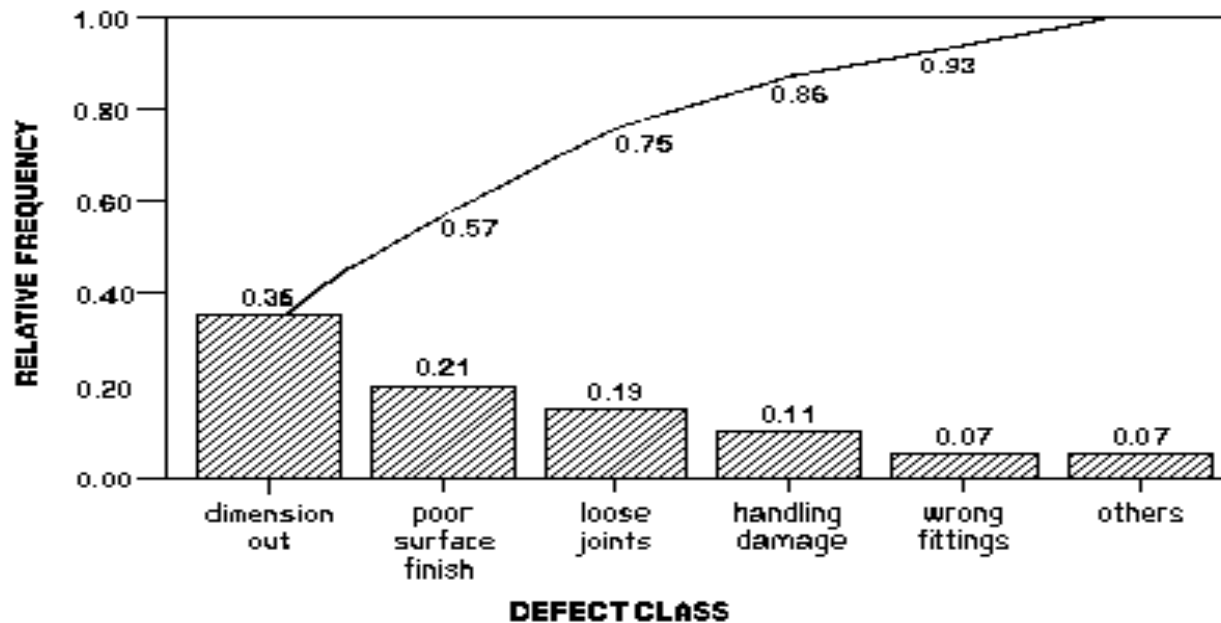


# Pareto Analysis

- Technique that displays the degree of importance for each element
- Named after the 19<sup>th</sup> century Italian economist; often called the 80-20 Rule
- Principle is that quality problems are the result of only a few problems e.g. 80% of the problems caused by 20% of causes



# Pareto Diagram

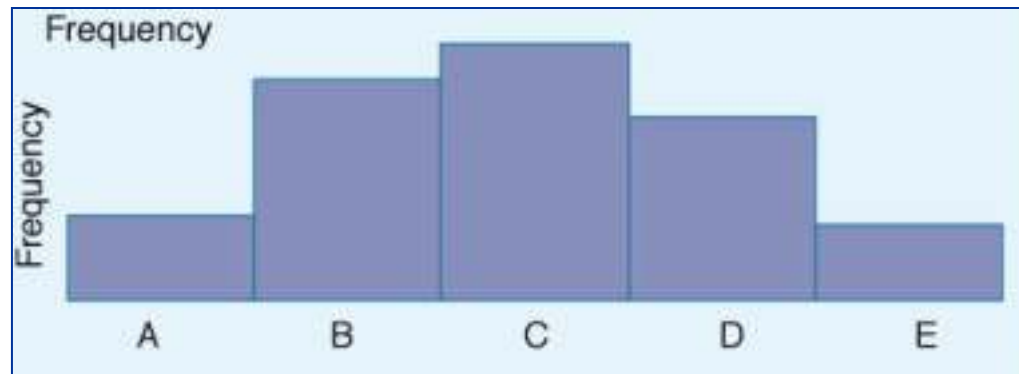


It can be noted that the 3 defects of out-of-dimension, poor surface finish and loose joints account for 75% of the rejections.

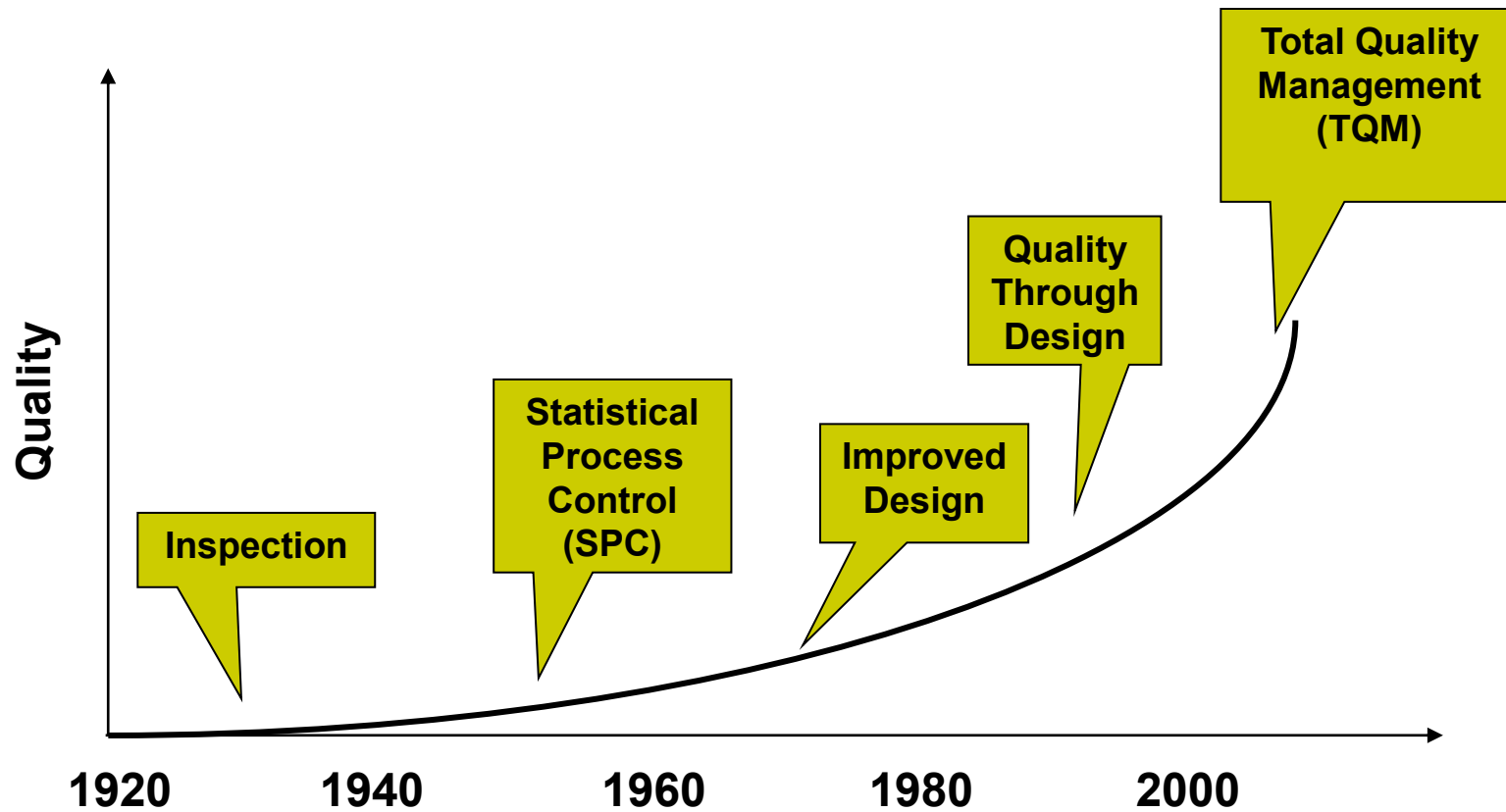
# Histograms

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- A chart that shows the frequency distribution of observed values of a variable like **service time** at a bank drive-up window
- Displays whether the distribution is symmetrical (normal) or skewed



# Quality as a Function of Time and Methods



# Cost of Quality

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# The Cost of Quality

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Framework for identifying components of quality that are related to producing both high quality products and low quality components, with the goal of minimizing the total cost of quality

- Quality control costs
  - Prevention costs
  - Appraisal costs
- Quality failure costs
  - Internal failure costs
  - External failure costs



# Cost of Quality – 4 Categories

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<b>Prevention costs.</b>	Costs of preparing and implementing a quality plan.
<b>Appraisal costs.</b>	Costs of testing, evaluating, and inspecting quality.
<b>Internal failure costs.</b>	Costs of scrap, rework, and material losses.
<b>External failure costs.</b>	Costs of failure at customer site, including returns, repairs, and recalls.

Early detection/prevention is less costly

- (Maybe by a factor of 10)

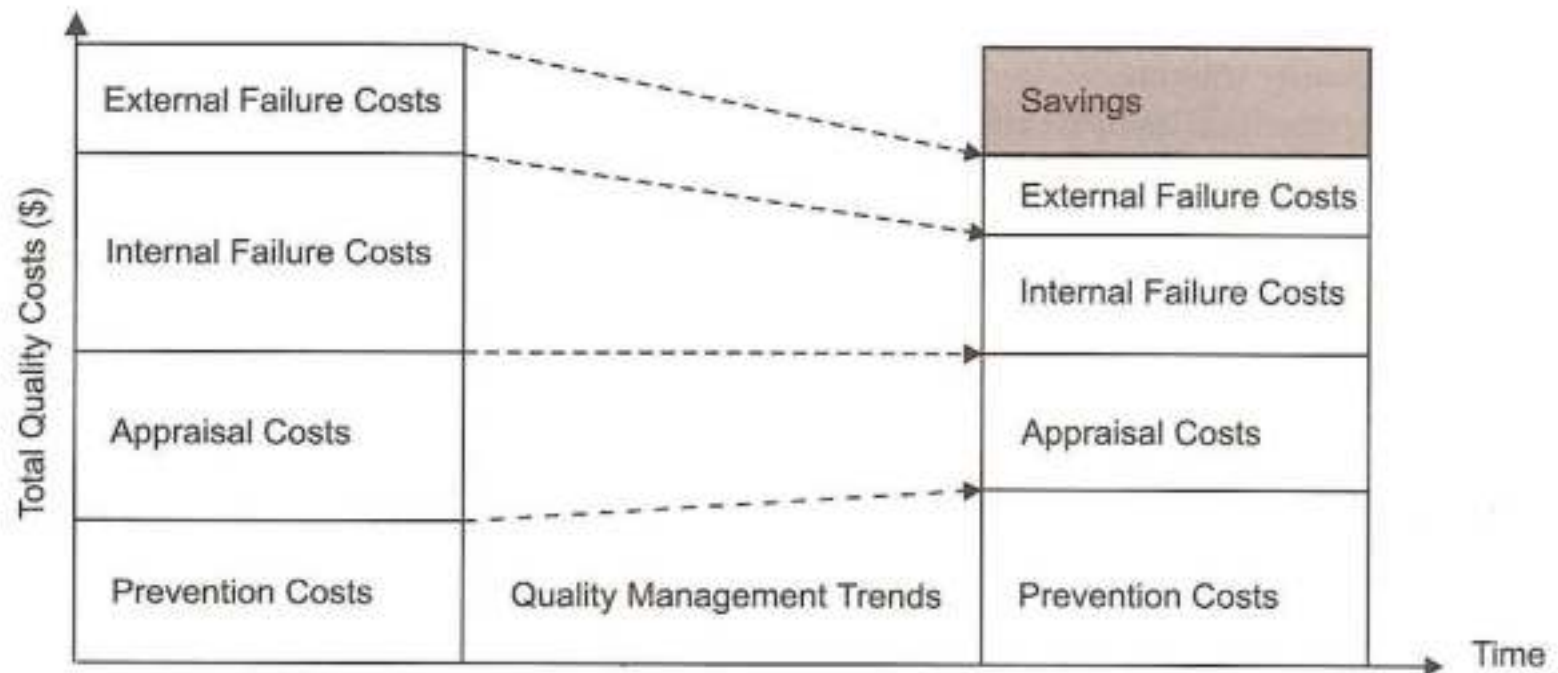
# “Costs” of Quality

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Category	Definition	Example
Prevention	Costs associated with preventing defects.	Training, early reviews, quality planning, tools, process improvement initiatives.
Appraisal	Costs associated with analyzing and testing the product to ensure it conforms to specifications.	Inspections, testing, audits, quality control.
Internal Failure	Costs associated with fixing defects found prior to release.	Repair, retesting, updating documentation.
External Failure	Costs associated with fixing defects found after release.	Technical support, defect reporting and tracking, field updates, loss of future sales.

# “Costs” of Quality

Quality Cost Management shows how increased Prevention Costs reduce the Total Quality Costs.



# “Costs” of Quality

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- The equation “Cost of Quality” (COQ) allows to quantify the impact of POOR quality.
- It is used as a monitoring tool to track costs for inspection, internal errors, external errors, and prevention.
- As the prevention efforts are increased, the costs for inspection, internal failures and external failures drop.

$$\text{COQ} = \frac{\sum (E + I + A + P)}{S} \times 100\%$$

E: External Failure Costs

I: Internal Failure Costs

A: Appraisal Costs

P: Prevention Costs

S: Sales

# Typical Quality Cost Ratios

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Category	Feigenbaum	Juran and Gryna
Prevention costs	5%–10%	0.5%–5%
Detection/appraisal costs	20%–25%	10%–50%
Failure costs	65%–70%	Internal: 25%–40%
		External: 20%–40%
Total cost of quality	<hr/> 100%	<hr/> 100%

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# The Cost of Quality (Juran's Model)

<b>Cost Category</b>	
<b>Cost of prevention</b>	<b>Costs associated with the development of programs to prevent defectives from occurring in the first place</b>
<b>Cost of detection/ appraisal</b>	<b>Costs associated with the test and inspection of subassemblies and products after they have been made.</b>
<b>Cost of failure</b>	<b>Costs associated with the failure of a defective product.</b>  <b><i>Internal failure costs</i>—producing defective products that are identified before shipment.</b>  <b><i>External failure costs</i>—producing defective products that are delivered to the customer.</b>

# Taguchi Loss Function

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- a statistical method developed by Genichi Taguchi, a Japanese business statistician that shows how manufacture of each non-perfect part results in a loss for the company
- an increase in variation within specification limits leads to an exponential increase in customer dissatisfaction.

Figure 5

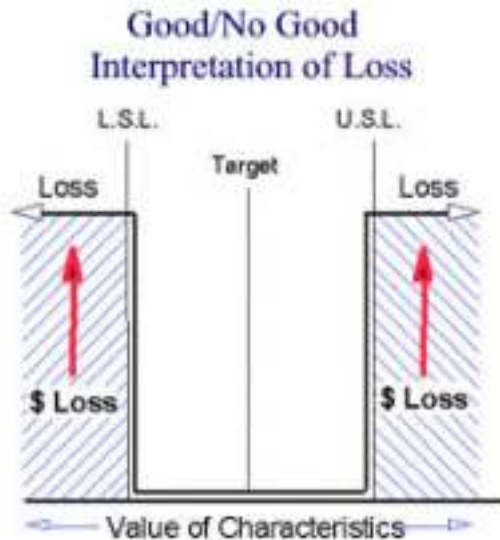
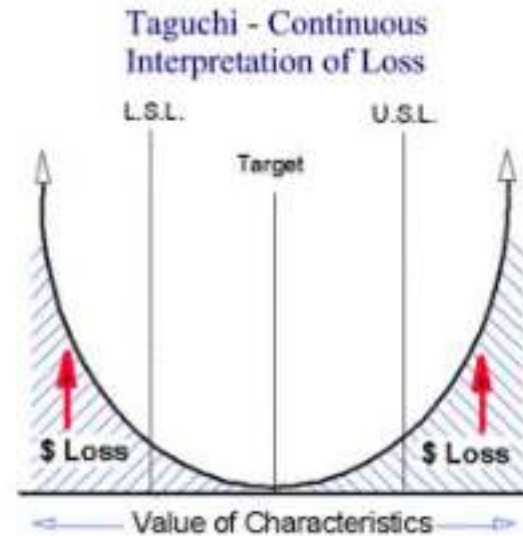
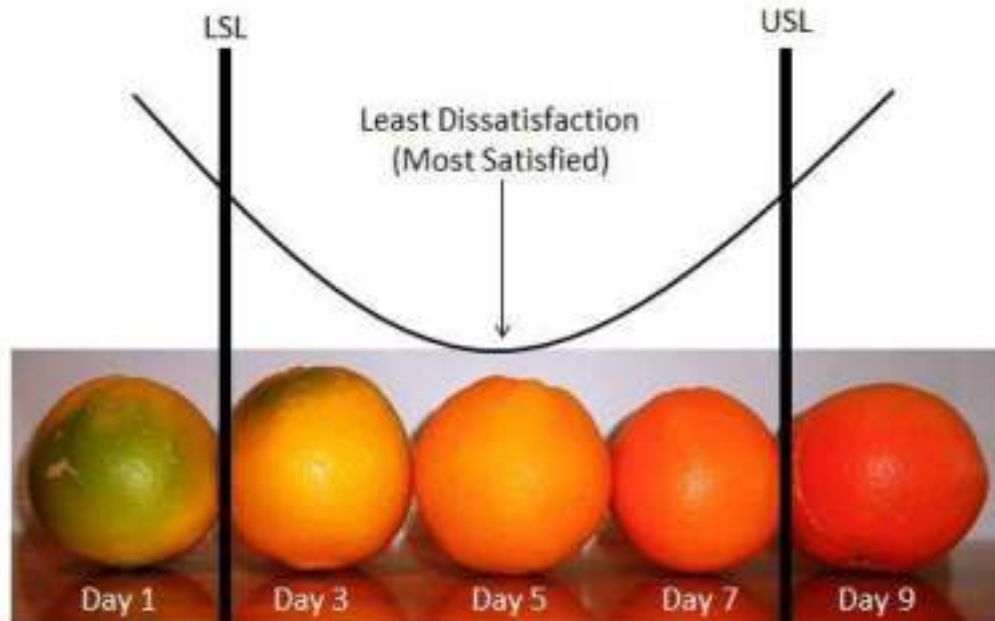


Figure 6



if the lower limit is 10, and the upper limit is 20, then a measurement of 19.9 will lead to customer satisfaction, while a measurement of 20.1 will lead to customer dissatisfaction. **XXXX wrong**



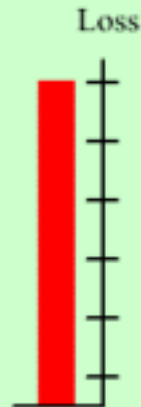
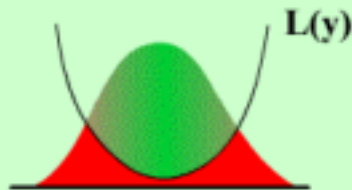


## TAGUCHI LOSS FUNCTION

- ▶ play
- stop
- ▶ step
- ▶ rew

$$L(y) = k(y-m)^2$$

The loss due to performance variation is proportional to the square of the deviation of the performance characteristic from its nominal value.



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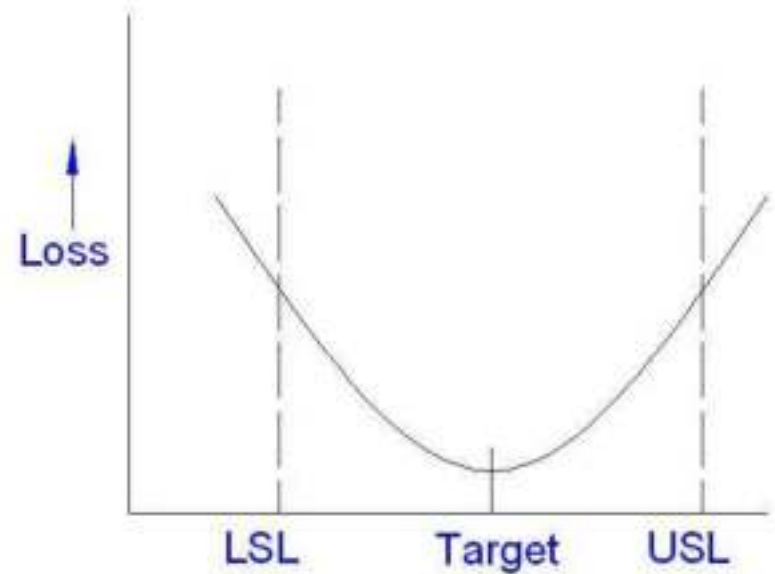


Fig.1.1- Taguchi Loss Function

$m$  is the theoretical 'target value' or 'mean value'  
 $y$  is the actual size of the product  
 $k$  is a constant and  $L$  is the loss



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**END**

# TQM

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## MODULE-II

# TOTAL QUALITY MANAGEMENT

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- **Total** – Made up of the whole
- **Quality** – Degree of excellence a product or service provides
- **Management** – Act, art or manner of handling, controlling, directing etc.

*TQM is the art of managing the whole to achieve excellence*

# Basic Concepts of TQM



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1. A committed management providing top to bottom organizational support
2. A unwavering focus on the customer, both internally and externally
3. Effective involvement and utilization of the entire workforce
4. Continuous improvement of the business and the production process
5. Treating suppliers as partners
6. Establish performance measures for the processes

# NEW AND OLD CULTURES

SL NO	QUALITY ELEMENT	PREVIOUS STATE	TQM
1	Definition	Product-oriented	Customer-oriented
2	Priorities	Second to service and cost	First among equals of service and cost
3	Decisions	Short-term	Long-term
4	Emphasis	Detection	Prevention
5	Errors	Operations	System
6	Responsibility	Quality control	Everyone
7	Problem solving	Managers	Teams
8	Procurement	Price	Life-cycle costs, partnership
9	Manager's role	Plan, assign, control and enforce	Delegate, coach, facilitate and monitor

# Evolution of TQM – New Focus

<b>TIME:</b>	Early 1900s	1940s	1960s	1980s and Beyond
<b>FOCUS:</b>	Inspection	Statistical sampling	Organizational quality focus	Customer driven quality
	 <p>Old Concept of Quality: Inspect for quality after production.</p>			 <p>New Concept of Quality: Build quality into the process. Identify and correct causes of quality problems.</p>



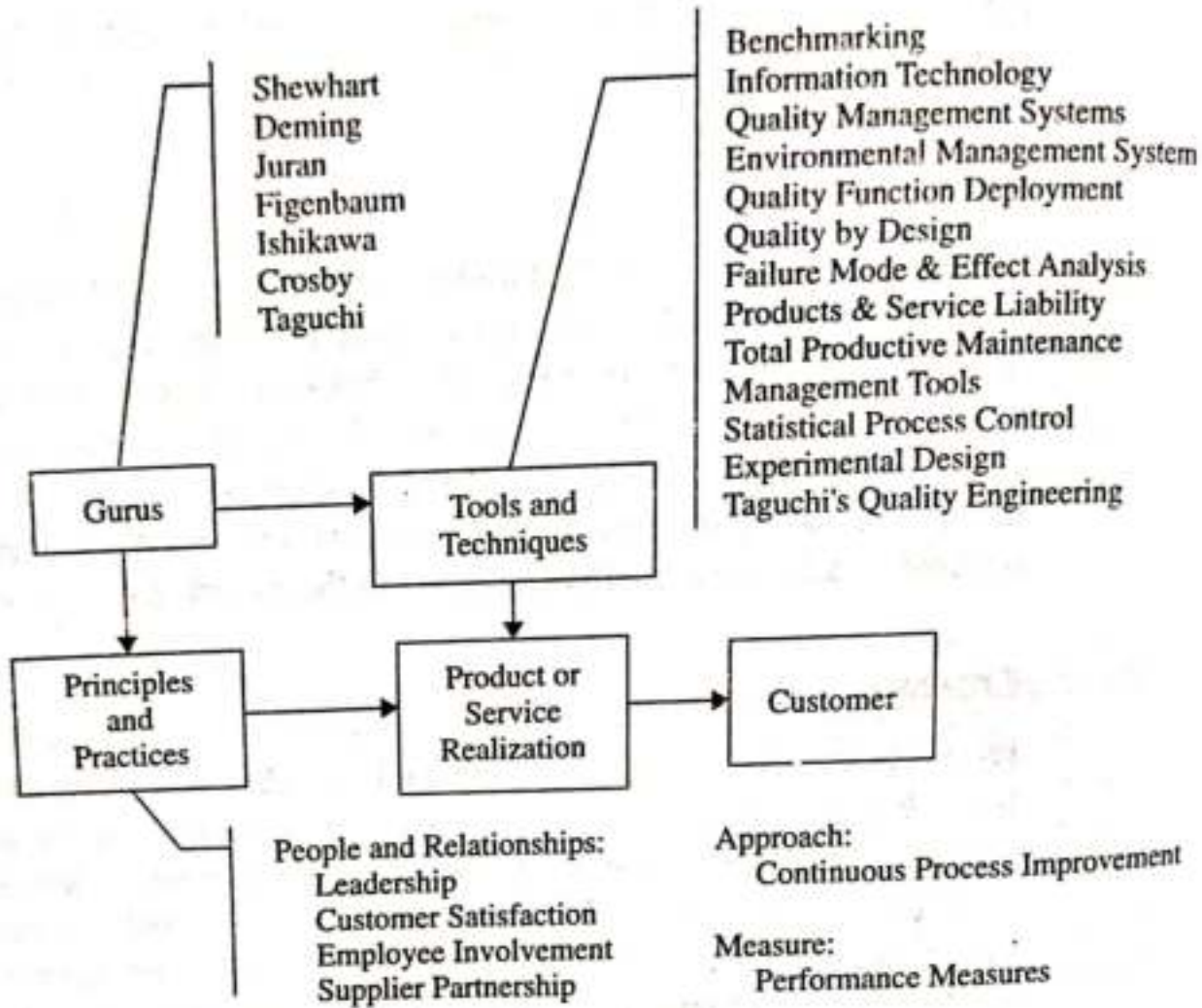


Figure 1-1 TQM Framework

# Barriers to TQM

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- ❑ Lack of management commitment
- ❑ Inability to change organizational culture
- ❑ Improper planning
- ❑ Lack of continuous training and education
- ❑ Incompatible organizational structure and isolated individuals and departments
- ❑ Ineffective measurement technique and lack of access to data and results
- ❑ Paying inadequate attention to internal and external customers
- ❑ Inadequate use of empowerment and teamwork
- ❑ Failure to continually improve



# Total Quality Management Principles

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1. Focus on customer
2. Employee Involvement
3. Continual Improvement
4. Strategic Approach to Improvement
5. Integrated System
6. Decision Making
7. Communications

# Focus on customer

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- Consumers are the ultimate judge to determine whether products or services are of superior quality or not.
- No matter how many resources are pooled in training employees, upgrading machines and computers, incorporating quality design process and standards, bringing new technology, etc.; at the end of the day, it is the customers who have the final say in judging your company.

# Employee Involvement

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- Ensuring total employee involvement in achieving goals and business objectives will lead to employee empowerment and active participation from the employees in decision making and addressing quality related problems.
- Employee empowerment and involvement can be increased by making the workspace more open and devoid of fear.

# Continual Improvement

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- Continual improvement will lead to improved and higher quality processes.
- Continual improvement will ensure companies will find new ways and techniques in producing better quality products, production, be more competitive, as well as exceed customer expectations.

# Strategic Approach to Improvement

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- Businesses must adopt a strategic approach towards quality improvement to achieve their goals, vision, and mission.
- A strategic plan is very necessary to ensure quality- becomes the core aspect of all business processes.

# Integrated System

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- Businesses comprise of various departments with different functionality purposes. These functionalities are interconnected with various horizontal processes TQM focuses on.
- Everyone in the company should have a thorough understanding of the quality policies, standards, objectives, and important processes. It is very important to promote a quality work culture as it helps to achieve excellence and surpass customer expectations.
- An integrated system ensures continual improvement and helps companies achieve a competitive edge.



# Decision Making

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- ❑ Data from the performance measurement of processes indicates the current health of the company.
- ❑ For efficient TQM, companies must collect and analyze data to improve quality, decision making accuracy, and forecasts.
- ❑ The decision making must be statistically and situational based in order to avoid any room for emotional based decisions.

# Communications

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- ❑ Communication plays a crucial role in TQM as it helps to motivate employees and improve their morale during routine daily operations.
- ❑ Employees need to be involved as much as possible in the day to day operations and decision making process to really give them a sense of empowerment.
- ❑ This creates the environment of success and unity and helps drive the results the TQM process can achieve.

# QUALITY STATEMENTS

- ▶ Vision Statement
- ▶ Mission Statement
- ▶ Policy Statement

## SUMMARISED KEY DEFINITIONS

- ▶ Vision : Desired future state of organization.
- ▶ Mission : What business we are in.
- ▶ Policy : Commitment to customer.

# Vision Statement

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- ▶ Vision is a desired future state of the organization.
- ▶ Imagination and inspiration are the important components of a vision.
- ▶ Typically, a vision can be viewed as the ultimate goal of the organization, one that may take 5 or even 10 years to achieve.

It is the ideal state that might never be reached,  
but which you continually strive to achieve

e.g., Apple's "Computing for the masses"

# Examples

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- ▶ To be the leading consumer battery company in the world.

– Duracell International

- ▶ To engineer, produce, and market the world's finest automobiles.

– Cadillac Motor Car Division

Mentoring to ensure excellence

-MED, MACE

# Mission

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Mission is the purpose or reason for the organization's existence, i.e., what we do and whom we serve.

- Basically, this describes the function of the organization
  - ▶ We exist to create, make, and market useful products and services to satisfy the needs of our customers throughout the world.  
– Texas Instruments
- The institution is committed to transform itself into a centre of excellence in Technical Education upholding the motto "Knowledge is Power". This is to be achieved by imparting quality education to mould technically competent professionals with moral integrity, ethical values and social commitment, and by promoting innovative activities in the thrust areas emerging from time to time  
-MACE

# POLICY

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A quality policy is a guide for everyone in the organization as to how they should provide products and services to customers

- ▶ Policies are a guide to managerial action.
- ▶ An organization may have policies in a number of areas : quality, environment, safety, human resources, etc.
- ▶ These policies guide day-to-day decision making.

# POLICY

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Xerox is a quality company. Quality is the basic business principle for Xerox. Quality means providing our external and internal customers with innovative products and services that fully satisfy their requirements. Quality is the job of every employee.

– Xerox Corporation

To be the best. This policy requires that every individual and operating unit fully understand the requirements of their customers, and deliver products and services that satisfy these requirements at a defect-free level.

– Chrysler Corporation



# Customer

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- External and
- Internal

## External customer

Current, Prospective and Lost

## Internal customer

Different sections inside a firm

# Customer Perception of Quality

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- In TQM- continuous process improvement
- Means- no acceptable quality level, bcoz of changing customer expectations
  - Important factors that influences purchases- according to American society for quality
    - Performance
    - Features
    - Service
    - Warranty
    - Price
    - Reputation



# CUSTOMER FOCUS

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- The orientation of an organization towards serving its clients' needs

# Customer service

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- **Customer service** is a series of activities designed to deliver customer satisfaction.
  - The process of providing customer satisfaction is based on an understanding of what customers want and need.

# Customer Orientation

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- **Customer orientation** is defined as an approach to sales and **customer-**relations in which staff focus on helping **customers** to meet their long-term needs and wants.
- A **customer-oriented** organization places **customer** satisfaction at the core of each of its business decisions.

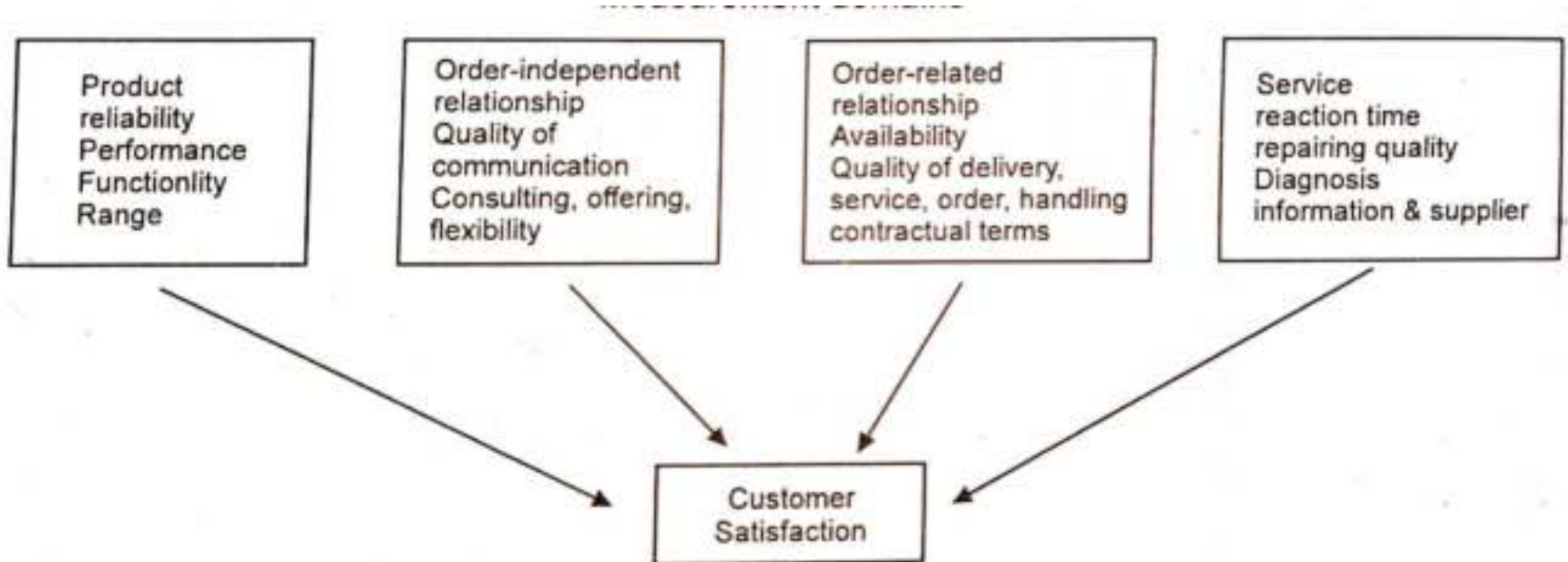
# Customer Satisfaction

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- Customers derive satisfaction from a product or a service based on whether their need is met effortlessly, in a convenient way that makes them loyal to the firm.
- In other words, it's how happy the customers are with their transaction and overall experience with the company.

# Customer Satisfaction...

measurement domains



# TO IMPROVE CUSTOMER RELATIONSHIP

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- ❑ Upto date customer support centres with competent people and equipment
- ❑ Upto date with the newest developments in industry
- ❑ Meetings with potential and current key customers to discuss the suitability of existing/new products
- ❑ Permanent technical support staff, customer visits, telephone contact, toll free nos..etc.



# Customer Complaints

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## CUSTOMER COMPLAINT/FEEDBACK

- 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.



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## 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

# SOURCES OF CUSTOMER COMPLAINT

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## □ Related to Product

- Product is defective/non-functioning
- Product did not meet the basic requirements
- Customer expectation is higher than what the product could deliver
- Frequent breakdown of product
- Product has defective parts

## □ Related to after-sales service

- Service department responding to the problem
- Product complaint not resolved even after repair
- Basic behavior and courteousness of the service personnel
- Speed of response to a complaint call



# Customer feedback collection tools

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- **Comment Card.**
- **Customer Questionnaire.**
- **Focus Groups.**
- **Toll Free Telephone No.**
- **Customer Visits.**
- **Report Card.**
- **Internet & Computer.**
- **Employee Feedback.**
- **Customer complaints**

# Steps to handle customer complaints

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- 1. Provide customers with the opportunity to complain.**
- 2. Give customers your full and undivided attention.**
- 3. Listen carefully.**
- 4. Ask key questions to fully understand the complaint**
- 5. Agree that a problem exists; never argue.**
- 6. Apologize for the problem.**
- 7. Resolve the complaint.**
- 8. Thank the customer for bringing the complaint to your attention.**

# Service Quality

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- Company: Standard operating procedures
- Customer: Personal expectations
- **Misalignment of company and customer specifications can lead to dissatisfaction, even if the service is delivered as designed**
  - Effective communication is key in eliminating misalignment

# Measuring service quality

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- **Reliability:** Perform promised service dependably and accurately. Example: receive mail at same time each day.
- **Responsiveness:** Willingness to help customers promptly. Example: avoid keeping customers waiting for no apparent reason.



# Measuring service quality....

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- **Assurance:** Ability to convey trust and confidence. Example: being polite and showing respect for customer.
- **Empathy:** Ability to be approachable. Example: being a good listener.
- **Tangibles:** Physical facilities and facilitating goods. Example: cleanliness.



# Customer Retention

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- Refers to the activities and actions companies and organizations take to reduce the number of customer defections.
- The goal is to help companies retain as many customers as possible, often through customer loyalty and brand loyalty initiatives.
- Customer retention begins with the first contact a customer has with a company and continues throughout the entire lifetime of the relationship.

# Retention Benefits

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- Most companies traditionally spend more money on customer acquisition because they view it as a quick and effective way of increasing revenue
- But customer retention often is faster and, on average, costs up to seven times less than customer acquisition.
- Selling to customers with whom you already have a relationship is often a more effective way of growing revenue because companies don't need to attract, educate, and convert new ones.

# How to Improve Customer Retention

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1. **Set customer expectations** – Set customer expectations early and a little lower than you can provide to eliminate uncertainty about the level of your service and ensure you always deliver on your promises.
2. **Become the customers' trusted advisor** – You need to be the expert in your particular field, so that you can gain customers' trust and build customer loyalty.
3. **Use relationships to build trust** – Build relationships with customers in a way that fosters trust. Do this through shared values and fostering customer relationships.
4. **Take a proactive approach to customer service** – Implement anticipatory service so that you can eliminate problems before they occur.

# How to Improve Customer Retention....

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5. **Use social media to build relationships** – Use LinkedIn, Twitter, and Facebook to connect and communicate with customers and give them a space for sharing experiences with your company, so they can become brand ambassadors.
6. **Go the extra mile** – Going above and beyond will build strong relationships with customers and build long-term loyalty by paying attention to their needs and issues.
7. **Make it personal** – Personalized service improves customer experience and is something customers are expecting and demanding. Make their experience personal to strengthen the bond with your brand.

# Retention Rates

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- Attrition rate compliments retention rate.
- If a company has a 20% attrition rate, it has an 80% retention rate.
- Companies' attrition rates can be defined by the percentage of customers the company has lost over a given period.

# Total Quality Control

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- TQM is a continuous process of increasing the quality of the output.
- A quality product comes within a quality process, which means that quality should be built into the process.
- TQM comprises of some key elements such as continuous improvement, customer focus, employee empowerment, use of quality tools, product design, process management, managing supplier quality etc.
- TQC (Total Quality Control) TQC is about application of the quality management principles to the business processes from the designing stage to delivery of goods to the end users. It includes various Japanese techniques related with quality management such as Kaizen, 5S etc.
- TQM expresses about continuous improvement in the processes while TQC is about maintaining the quality standards throughout the process.

# Total Waste Elimination

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- Waste elimination is one of the most effective ways to increase the profitability of any business.
- Anything that is unproductive, or doesn't add value that a customer will pay for is considered waste.

# 7 areas (W's or Muda's) of waste reduction

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## 1. Overproduction

- ❑ To manufacture an item before it is actually required
- ❑ Overproduction is highly costly to a manufacturing plant because it prohibits the smooth flow of materials
- ❑ The Toyota Production System is also referred to as “Just in Time” (JIT) because every item is made just as it is needed.
- ❑ Overproduction creates excessive lead times, high storage costs, and makes it difficult to detect defects.
- ❑ The concept is to schedule and produce only what can be immediately sold/shipped



## 2. Waiting

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- Whenever goods are not moving or being processed, the waste of waiting occurs.
  - Much of a product's lead time is tied up in waiting for the next operation
  - E.g., distances between work centers are too much
  - One hour lost in a bottleneck process is one hour lost to the entire factory's output
  - Linking processes together so that one feeds directly into the next can dramatically reduce waiting.
- Waste that results from customer orders, inventory, or completed products waiting in queue for a process to begin.
  - High inventory encourages higher product waiting time
  - Operator waiting time implies under-utilization and poor control of workflow
  - Reduces value for customers
  - Increases delay to obtain financial return on the product

# 3. Transporting

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- ❑ Transporting product between processes is a cost incursion which adds no value to the product.
- ❑ Excessive movement and handling cause damage and are an opportunity for quality to deteriorate.
- ❑ Material handlers must be used to transport the materials, resulting in another organizational cost that adds no customer value.
- ❑ Mapping product flows is a solution to reduce transportation
  - Extra carts, fork lifts, dollies
  - Multiple Storage Locations
  - Extra Material Racks
  - Complex Inventory Management
  - Extra Facility Space
  - Incorrect Inventory Counts
  - Damaged Material

# 4. Inappropriate Processing

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- ❑ Many organizations use expensive high precision equipment where simpler tools would be sufficient.
- ❑ This often results in poor plant layout because preceding or subsequent operations are located far apart.
- ❑ Toyota is famous for investing in smaller, more flexible equipment where possible; creating manufacturing cells; and combining steps will greatly reduce the waste of inappropriate processing.

# 5. Unnecessary Inventory

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- Raw materials, Work in Progress (WIP) and finished goods are the three major forms of inventory.
- Work in Progress is a direct result of overproduction and waiting.
- Excess inventory increases lead times, consumes productive floor space, delays the identification of problems, and inhibits communication.

# 6. Unnecessary / Excess Motion

- This waste is related to ergonomics and is seen in all instances of bending, stretching, walking, lifting, and reaching.
  - These are also health and safety issues, which in today's litigious society are becoming more of a problem for organizations.
  - Jobs with excessive motion should be analyzed and redesigned for improvement with the involvement of plant personnel.
- Looking for Tools
  - Excessive Reaching or Bending
  - Material Too Far Apart (Walk Time)
  - Equipment for Moving Parts
  - Extra "Busy" Movements While Waiting

# 7. Defects

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- ❑ Defects resulting in rework or scrap are tremendous cost to organizations.
- ❑ Associated costs include quarantining inventory, re-inspecting, rescheduling, and capacity loss.
- ❑ In many organizations the total cost of defects is often a significant percentage of total manufacturing cost.
- ❑ Through employee involvement and Continuous Process Improvement (CPI), we can reduce defects at many facilities.



# Total Employee Involvement

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Total employee involvement is a system for direct participation of employees to organizational success, by letting them take responsibilities. It enables everyone deeply involved, using own brain power, in problem solving, learning, continuous improvement activities, & systematic search for opportunities.

# Behavioral pattern of employees in an Organization

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# TQM Principles & strategies pertaining to employee involvement

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- Motivation
- Team work
- Training & mentoring
- Recognition & Rewards
- Performance appraisal & feed back
- Empowerment

# 1. Motivation

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Internal and external forces and influences that drive an individual to achieve certain goals.

## Motivation Theories

1. Maslow Theory
2. Herzberg Theory
3. Douglas McGregor theory

# Maslow's Theory

- **Maslow's hierarchy of needs** is a theory in psychology proposed by Abraham **Maslow** in his 1943 paper "A Theory of Human Motivation" in Psychological Review. ... This means that in order for motivation to occur at the next level, each level must be satisfied within the individual themselves.



# Maslow's Hierarchy of Needs



# Herzberg's -Two Factor Theory

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- there are two factors that an organization can adjust to influence motivation in the workplace.
  - **Motivators:** Which can encourage employees to work harder.
  - **Hygiene factors:** These won't encourage employees to work harder but they will cause them to become unmotivated if they are not present.

# Two Factor Theory of Motivation

## Motivators

Achievement  
Recognition  
The work itself  
Responsibility  
Advancement  
Growth

## Hygiene Factors

Company policies  
Supervision  
Relationships  
Work conditions  
Remuneration  
Salary  
Security

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# McGregor Theory X and Theory Y

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- Theory X and Theory Y are theories of human work motivation and management.
- Created by Douglas McGregor while he was working at the MIT Sloan School of Management in the 1950s

# Theory X

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This theory assumes that the employees can not be trusted and they have to be supervised all the time. Theory X characterizes employees as follow:

- Avoid work
  - No ambition
  - No initiative
  - Do not take responsibilities
  - Needs security
- 
- If you believe that your team members dislike their work and have little motivation, then, according to McGregor, you'll likely use an authoritarian style of management.



# Theory Y

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According to this theory employees seek freedom to do difficult and challenging jobs, all by themselves. Theory Y characterizes employees as follow:

- Want to learn
  - Work is a natural activity
  - Have self discipline
  - Develop themselves
  - Have self confidence
- 
- Theory Y managers have an optimistic, positive opinion of their people, and they use a decentralized, participative management style.

# Theory Z

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- Propagated by William Ouchi's
- focused on increasing employee loyalty to the company by providing a job for life with a strong focus on the well-being of the employee, both on and off the job.

# 2. Team Work

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- “Together every one achieves more”
- Team work is not a natural human function
- Management role in enabling team work
- Use of Quality circles



# 3. Training and Development

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- Necessity for orientation training:  
Training enables employees in understanding;
  - o Objectives of the organization
  - o His role
  - o His responsibilities
  - o His authority
  - o Familiarity in understanding nature of job
- Experienced recruits need more orientation
- Training is not a one time activity

# 4. Recognition and Reward

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- Recognition of achievement is important
- Select a few best performers
- Reward teams, rather than individual



# 5. Performance Appraisal

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- Used for the development of employees
- Each dept. head should prepare a action plan for each individual for whole year.
- Performance of each employee should be reviewed on quarterly basis & reports submitted to mgnt.
- Appraisals are used for several purposes as
  - o Promotion
  - o Granting of additional increments
  - o Transfers
  - o Training



# 6. Empowerment

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The process of displacing decision making downwards to the workforce, or lower levels of management, to enable them to use their skills more effectively and flexibly. The emphasis is often on better engagement with customers.





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**END**



# MODULE III

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## Quality Assurance



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□ Quality Assurance:

- Total quality assurance,
- Management principles in quality assurance,
- Objectives of quality assurance system,
- Hierarchical planning for Quality Assurance
- Vendor rating, Methods

□ Quality improvement:

- elements,
- programmes –
- KAIZEN, PDCA cycle, 5S, Quality circles.

# Quality assurance (QA)

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- QA is any systematic process of determining whether a product or service meets specified requirements.
- QA is a way of preventing mistakes and defects in manufactured products and avoiding problems when delivering products or services to customers
- Often used interchangeably with quality control (QC)

# QA Vs QC

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- QA is a wider concept that covers all policies and systematic activities implemented within a quality system
- QA focuses on preventing defect.
- QA ensures that the approaches, techniques, methods and processes designed for the projects are implemented correctly.
- Quality Assurance is a proactive process and is Prevention in nature. It recognizes flaws in the process.
- Quality Assurance has to complete before Quality Control.

# QA Vs QC

---

- QC focuses on identifying a defect.
- Quality Control is a reactive process and is detection in nature.
- Quality Control has to complete after Quality Assurance.

Quality Assurance	Quality Control
QA aim is to prevent the defect.	QC aim is to identify and improve the defects.
QA is the technique of managing quality.	QC is a method to verify quality.
All team members are responsible for QA.	Testing team is responsible for QC.
QA Example: Verification	QC Example: Validation.
QA means Planning for doing a process.	QC Means Action for executing the planned process.
Statistical Technique used on QA is known as Statistical Process Control (SPC.)	Statistical Technique used on QC is known as Statistical Quality Control (SQC.)
QA makes sure you are doing the right things.	QC makes sure the results of what you've done are what you expected.
QA Defines standards and methodologies to followed in order to meet the customer requirements.	QC ensures that the standards are followed while working on the product.
QA is the process to create the deliverables.	QC is the process to verify that deliverables.
QA is responsible for full software development life cycle.	QC is responsible for software testing life cycle.

In the  
context of  
software

# Advantages of QA

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- ❑ Lowers unit cost
- ❑ Helps to produce better quality product/service
- ❑ Beneficial to all/helps to raise the morale of employees
- ❑ Helps to raise productivity

# Total Quality Assurance

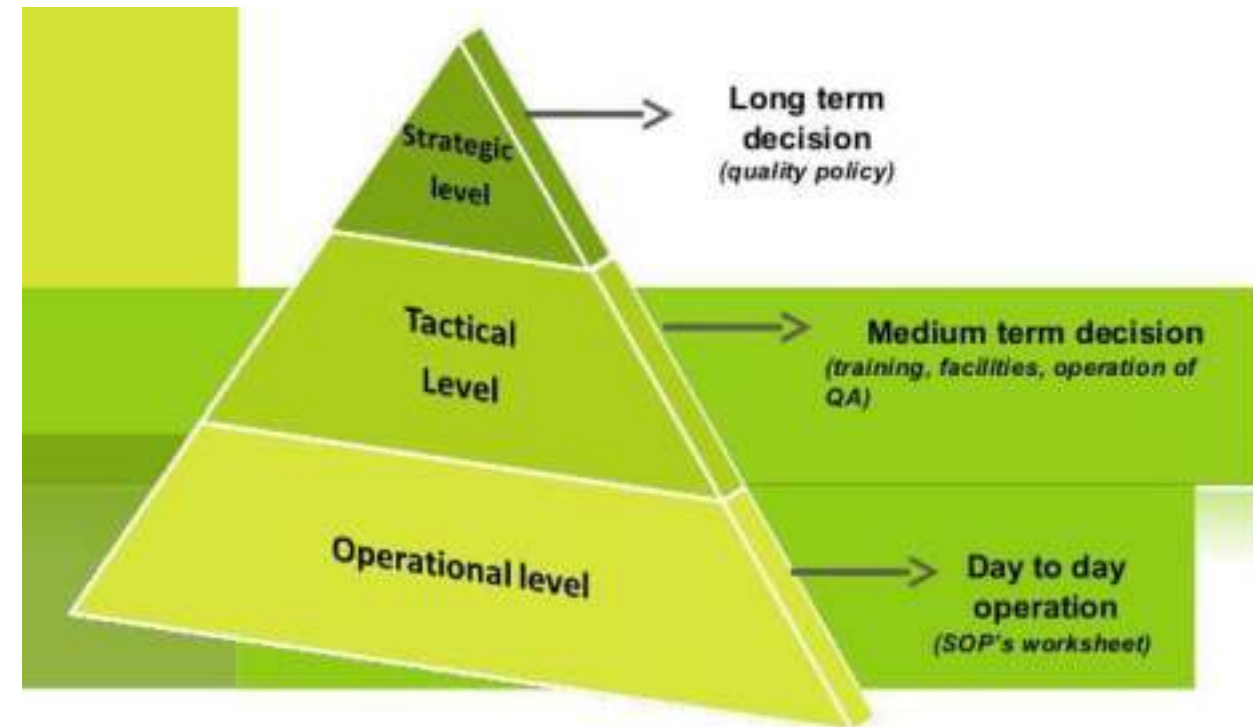
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- ❑ An organizational undertaking to improve the quality of manufacturing and service.
- ❑ It focuses on obtaining continuous feedback for making improvements and refining existing processes over the long term.
- ❑ TQA is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering, and production, customer service, etc.) to focus on meeting customer needs and organizational objectives.
- ❑ TQA views organization as a collection of processes. It maintains that organizations must strive to continuously improve these processes by incorporating the knowledge and experiences of workers.
- ❑ The simple objective of TQA is "Do the right things, right the first time, every time".



# Management Principles in Quality Assurance

1. Determination of goals on long, medium and short term basis
2. Correlating QA objectives with goals
3. Ensuring that goals are valid and realistic with regard to company's need for QA



# Management Principles in Quality Assurance

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4. Assigning proper people with sufficient training and experience to implement QA procedures and programmes
5. Seeking the broadest possible participation of staff in design and implementation of QA programme
6. Designing systems and programmes so as to create better quality in products and services
7. Communicating objectives, plans as widely and clearly as possible

# Quality Assurance

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## □ Internal Quality Assurance

- Quality in procurement
- Receiving inspection
- Product specifications
- Product design
- Product development
- Stage inspection
- Manufacturing process control
- Final inspection
- Performance testing
- Life and reliability testing
- Surveys and audits of shop practices and QC problems
- Control of tools gauges and measuring instruments
- Jigs and fixtures
- Quality related costs
- Analysis of rejection and reworks
- Personal training

## • External quality Assurance

- Field complaints
- Quality of after sales service
- Quality in sales and marketing

# Objectives of QA system

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- It is for both customer and organization
- It provides confidence to its own management
- Provisions of confidence may involve agreed upon demonstrative requirements



# SOURCING

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- MAKE OR BUY

# QUALITY IN PROCUREMENT

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## □ Procurement

- Direct materials- raw mats, semi-finished components, bought out components, sub assemblies, assemblies
- In-direct materials- consumables etc

# Quality requirements in purchasing

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- ❑ Set down policy concerning the quality of purchased goods
- ❑ Identify suitable suppliers
- ❑ Pass on relevant product information to supplier (design etc)
- ❑ Monitor vendor performance

# Vendor selection

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- Partner role
- Design supplied



# Vendor Rating

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- is a process where the suppliers are provided a status or a title based on several factors such as credibility, delivery time, price, quality of the goods supplied etc.
- The ratings are based on the vendor's performance and can have several levels from good, average to best or anything that the firm decides on.
- is a by-product of the just-in-time approach.
- One of the important objective of this system is that it helps the buyers to carefully choose the suppliers for future transactions

# Advantages

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1. It helps the buyer to understand the vendor from every important aspect and will help in knowing if the vendor is suitable to deal with or not. It does not plainly deal with prejudices and word-of-mouth. It is more dependent on data.
2. It helps the buyers to strike the right kind of communication required.
3. Ensuring constant standard of vendor performance with updated reviews of their performance.

# Disadvantages

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1. The vendor might feel insecure as all their details are out in the open and anybody can access it including other vendors.
2. It standardizes the whole group of buyers in one slot and may not consider the inexperience of new start-ups.

# Methods used for vendor rating

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1. Categorical plan: managers from various verticals make a list of factors which are crucial for a vendor to own based on their personal experiences and vendors are compared based on the same.
2. Weighted point plan: factors are categorised and weight is assigned to each factor based on vendor performance.

# Methods used for vendor rating

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3. Cost ratio plan: here the rating is done on the basis of various costs incurred for procuring the materials from various suppliers
- the ratios are computed for various rating variables and the same are compared to provide a rating.

# QUALITY IMPROVEMENT

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- Quality improvement (QI) is a systematic approach to reduction/elimination of waste, rework, and losses in production process.
- AIM: to produce a better quality product than its predecessor

# ELEMENTS OF QUALITY IMPROVEMENT

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## 1. Management Commitment

- Continuous quality improvement requires an explicit commitment from management and a continuous effort to improve company processes and output.
- All employees should be aware of the importance of quality.

## 2. Documentation Control

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- a key component of quality.
- Any business owner has to know who approves documents, who receives them and which versions are valid.
- For continuous quality improvement, such controls are even more critical because procedures change as problems are identified and company processes become more efficient.



# 3. Employee Qualifications and Training

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- Monitoring employee qualifications and assigning training as necessary is an important feature of quality assurance.
- When you want to continuously improve quality, the required qualifications may change as work becomes more demanding.
- Documenting what qualifications are needed to perform each job helps keep track of training requirements and lets you develop a training program that supports improved quality.

## 4. Supplier Evaluation

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- Your suppliers have to deliver material of increasing quality as your own output improves.
- Evaluate suppliers to make sure they have their own quality program in place.
- Inspect your inventory as it arrives to ensure parts and materials satisfy the specified characteristics and the deliveries correspond to what you ordered.
- Incoming inspections allow to evaluate whether your suppliers are performing to the level of quality you need and whether their quality programs are effective.

# 5. Testing and Verification

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- Level of quality of the output improves continuously by adjusting the test procedures and verifying how your products improve.
- As you increase the relevant test parameters, such as robustness, finish durability, component tolerances and time to failure, the quality of your products changes.
- Customer surveys verify to what extent your products have improved.

## 6. Identification of Non-Conformities

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- When employees don't follow procedures, incoming material fails inspection, the exact nature of the problem has to be documented with non-conformity reports.
- The idea behind this process is to document in a neutral manner, what aspect of the quality program was ineffective, which helps track problem areas and improve quality.

# 7. Corrective Action

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- Non-conformity reports identify the root cause of problems and corrective action changes procedures, training and testing to eliminate those causes.
- For example, if an employee makes a mistake, it could be because he lacked training, the procedure wasn't clear or the process was badly designed. Corrective action addresses such issues in a positive, proactive fashion.



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# **Quality Improvement Models and Tools**

# I. 5S

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- **5S** is a workplace organization method that uses a list of five Japanese words:
- *seiri*
- *seiton*
- *seisō*
- *Seiketsu*
- *shitsuke*

Translated into English, they  
stand for:

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



- 
- The 5-S practice is a well-recognised methodology used by the Japanese for improving the work environment.
  - It was found to be key to quality and productivity.
  - The 5-S practice helps everyone in the organisation to live a better life.

## Sorting (*Seiri*)

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- Eliminate all unnecessary tools, parts, and instructions.
- Keep only essential items and eliminate what is not required
- Prioritizing things per requirements and keeping them in easily-accessible places.
- Everything else is stored or discarded.



## **Straightening or setting in order / stabilize (*Seiton*)**

- There should be a place for everything and everything should be in its place.
- The place for each item should be clearly labelled or demarcated.
- Items should be arranged in a manner that promotes efficient work flow, with equipment used most often being the most easily accessible.





## shining or systematic cleaning (*Seiso*)

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- Clean the workspace and all equipment, and keep it clean, tidy and organized.
- At the end of each shift, clean the work area and be sure everything is restored to its place.
- Maintaining cleanliness should be part of the daily work – not an occasional activity initiated when things get too messy.

## Standardizing (*Seiketsu*)

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- All work stations for a particular job should be identical.
- All employees doing the same job should be able to work in any station with the same tools that are in the same location in every station.
- Everyone should know exactly what his or her responsibilities are for adhering to the first 3 S's.

## **Sustaining the discipline or self-discipline (*Shitsuke*)**

- Maintain and review standards.
- Maintain focus on this new way and do not allow a gradual decline back to the old ways.
- While thinking about the new way, also be thinking about yet better ways.





**1. Sort**



**2. Stabilize**

# 5 S's



**5. Sustain**



**3. Shine**



**4. Standardize**

## BENEFITS OF 5S

- improves organizational efficiency
- reduces waste in all forms
- cuts down employee frustration when "the system doesn't work"
- improves speed and quality of work performance
- improves safety
- creates a visually attractive environment

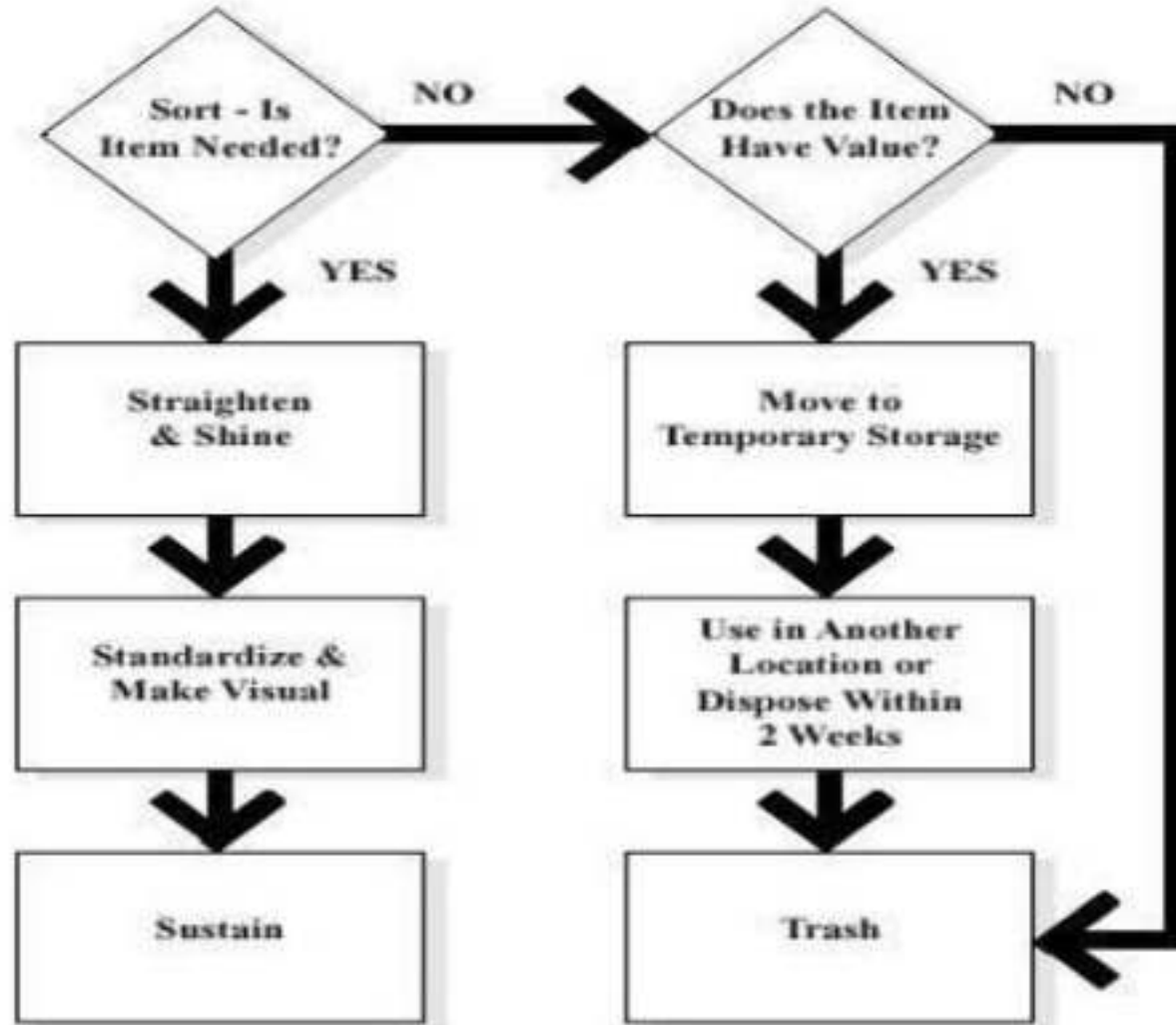


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## OBJECTIVES OF 5S

- Productivity
- Safety
- Reduced Waste
- Worker Commitment

5S Flow Chart



## II. KAIZEN

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- Kaizen is the Japanese word for "improvement".
- Kaizen has its origins in post-World War II Japanese quality circles.
- refers to activities that continuously improve all functions and involve all employees from the CEO to the assembly line workers.

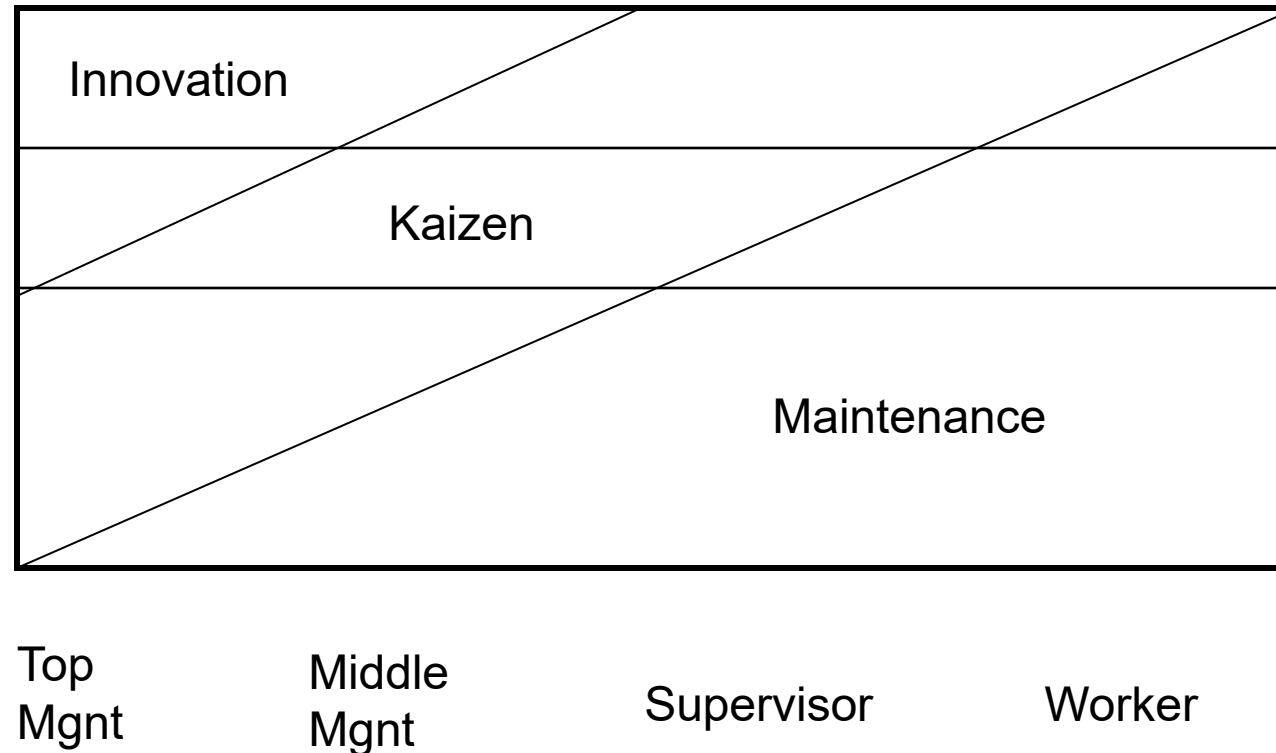
# What Kaizen means?

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- Kaizen is for small improvements, but carried out on a continual basis and involves all people in the organization
- The principle is a very large number of small improvements are more effective in an organization than few improvements of large value
- Requires no or little investment

# Kaizen and management

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# Three basic principles of Kaizen

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## 1. Work place effectiveness

- Achieved through application of 5S tools

Mu's

## 2. Elimination of waste strain and discrepancy

- Elimination of three MU's
  1. Muri- strain
  2. Muda- waste
  3. Mura- Discrepancy

Muda- Waste (non valuing adding),

Mura- Variation -deviation from a set standard or expected outcome.

Muri -Excess Physical Burden.

Means avoidable physical strain/ burden on people and machines/ equipment's at work. when the strain becomes excessive, it results in accidents, injury, leading to poor output or quality errors.

## 3. Standardization

- Proposes standardization of processes, materials, machinery etc.



# Muda is classically seen in eight forms

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1. unnecessary material transportation,
2. unnecessary motion of people... hands, feet, eyes!
3. rework/ inspection due to defects,
4. people, material or machines waiting for each other
5. unnecessary processing – over kill!
6. unnecessary production – producing more or faster than required
7. unnecessary inventory – in any form raw, work in progress or finished goods
8. finally the killer – unused human skills/ potential

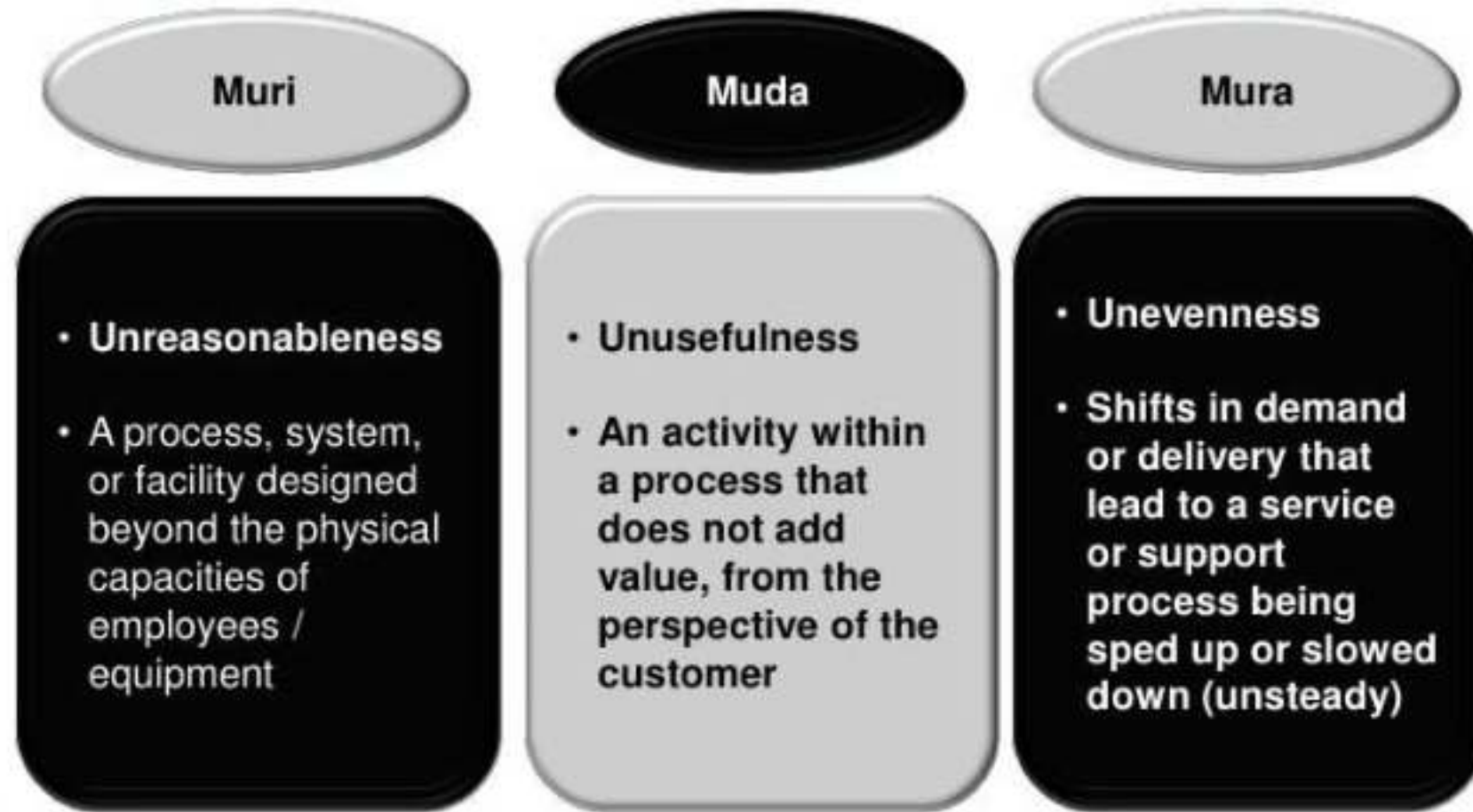
# Symptom and Cure

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- 1) Unnecessary material transportation – layout redesign, FLOW / cellular production,
- 2) Unnecessary motion of people – apply principles of work station design and motion economy
- 3) Rework/ inspection due to defects – eliminate causes for defects at the root
- 4) People, material or machines waiting for each other – needs multi pronged treatment – use TPM, SMED, FLOW, Internal Logistics etc
- 5) Unnecessary processing – define customer needs, stick to it!
- 6) Unnecessary production – Line balancing, follow Pull production, Levelling etc
- 7) Unnecessary inventory – this automatically reduces, as other symptoms are treated! However KANBAN, Pull planning etc can help
- 8) Unused human skills/ potential – TEE – Total Employee Engagement, TWI – Training Within Industry and DWM Daily Work Management are proven cures in this case.

# 3 MU's

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# Goal of Kaizen

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- Kaizen is implemented not for profit but for quality. Unless an organization improves quality, it cannot prosper.
- The success of *Kaizen* should be measurable through its impact on the customer satisfaction
- Kaizen will be successful only when it is process oriented
- It is important to recognize that any organization will have problems and hence the employees should be encouraged to admit when there is a problem

# Goal of Kaizen.....

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- A suggestion system is an integral part of *Kaizen*. The management should encourage the employees to give suggestions and their involvement in improvement process
- *Kaizen* should be prioritized based on the impact on the customers. Thus, *Kaizen* is a customer driven strategy for improvement
- *Kaizen* is a problem-solving tool based on cross-functional team and collaborative approach



# Goal of Kaizen.....

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- Kaizen is basically for improving the processes in the organization
- Collaboration between the cross-functional team, the process owners (those who carry out the job regularly) and the management is essential for success of *Kaizen*
- Quality Circles can become part of *Kaizen* since it is a group oriented suggestion system

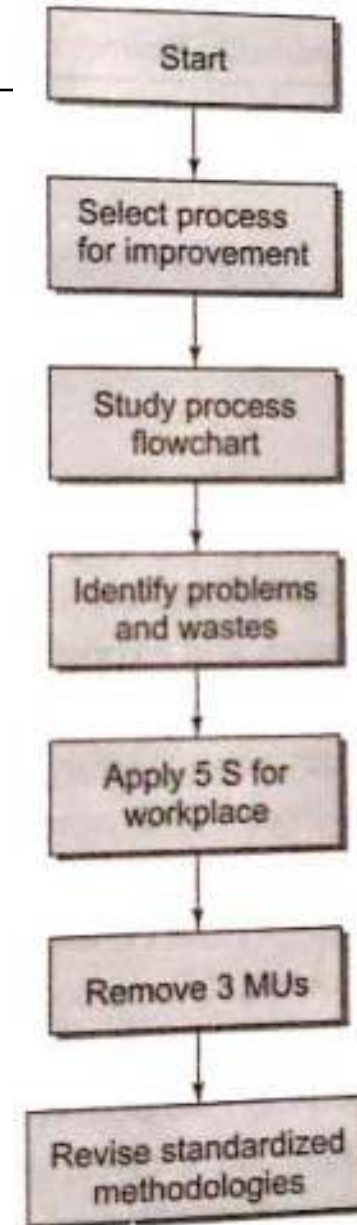
# Kaizen Implementation

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- Can be implemented in two ways
  1. Gradual Improvement Process
    - The management constitutes an apex quality council which oversees the gradual improvement process. They use 5S tools for reorganizing work places and eliminate/ reduce 3 MU's
  2. Kaizen blitz
    - A quick improvement technology
    - Usually completed in a week
    - Generally lasts for a week

# Applying Kaizen

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# PDCA CYCLE

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- **PDCA (plan–do–check–act or plan–do–check–adjust)** is an iterative four-step management method used in business for the control and continuous improvement of processes and products.
- Developed by **Shewhart** and also known as **shewart cycle**
- **Deming** modified it as **plan–do–study–act (PDSA)**.
- So also known as **Deming circle/cycle/wheel**.



- The Plan–Do–Check–Act cycle is a four-step model for carrying out change.
- Just as a circle has no end, the PDCA cycle should be repeated again and again for continuous improvement.

# The Plan–Do–Check–Act Procedure

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**1. Plan:** Establish objectives and processes

Establish a plan that will facilitate achieving the goal

**2. Do:** The do phase allows the plan from the previous step to be enacted. Carry out a small-scale study (pilot study).

# 3. Check/study

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- The data and results gathered from the do phase are evaluated.
- Data is compared to the expected outcomes to see any similarities and differences.
- During this phase one has to find out which plan worked and which didn't

# 4. Act

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- This act phase is where a process is improved.
- Records from the "do" and "check" phases help identify issues with the process. These issues may include problems, non-conformities, opportunities for improvement, inefficiencies etc.
- Root causes of such issues are investigated, found and eliminated by modifying the process.
- Work in the next "do" phase should not create recurrence of the identified issues; if it does, then the action was not effective.

# PDSA of TQM

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- Planning phase
  - Announcement by CEO regarding implementation of TQM
  - Select consultant
  - Corporate strategic planning
    - Planning the strategy of how organization is going to get TQM
  - Vision statement
    - Vision of CEO about where the organization should be in long run
  - Quality Policy
    - aimed at improving the customers perception about the company and thereby improving image of the company
  - Plan for quality council
    - TQM project should be steered by a quality council
  - Employee involvement etc.

# Do Phase

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- Starts after planning phase
- First task is meeting of QC
- Various plans given in planning phase should be authorized by QC

# Study Phase

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- In every meeting of QC, the results achieved through the implementation of TQM should be studied
- What ever plans to be changed should be discussed

## **Act Phase**

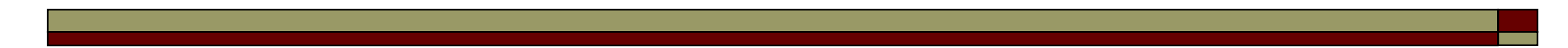
- Here the plans for implementing TQM should be confirmed



# QUALITY CIRCLES

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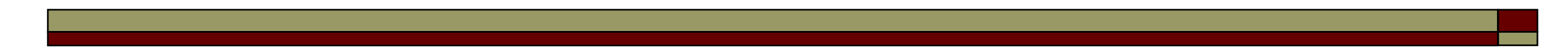
- A **quality circle** or **quality control circle** is a group of workers who do the same or similar work, who meet voluntarily and regularly to identify, analyze and solve work-related problems.
- Normally small in size, the group is usually led by a supervisor or manager and presents its solutions to management;
- where possible, workers implement the solutions themselves in order to improve the performance of the organization and motivate employees.
- Quality circles built mutual trust and create greater understanding between the management and the workers

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- Quality circles started in 1950-60s and were most popular during 1980s, but later on replaced by Kaizen groups and similar worker participation schemes.

# Characteristics of Effective Quality Circles

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1. The atmosphere should be informal, comfortable and relaxed. The members should feel involved and interested.
2. Everyone should participate.
3. The objectives should be clear to the members.
4. The members should listen to each other.
5. The group should feel comfortable even when there are disagreements.

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6. The decisions should generally be taken by a kind of consensus and voting should be minimum.
  7. When an action is required to be taken, clear assignments should be made and accepted by all the members.
  8. The leader should not dominate the group. The main idea should not be as to who controls but how to get the job done.
  9. Until a final solution is found and results are attained, feedback is necessary.

# Objectives of Quality Circles

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- ❑ To improve quality, productivity, safety and cost reduction.
- ❑ To give chance to the employees to use their wisdom and creativity.
- ❑ To encourage team spirit, cohesive culture among different levels and sections of the employees.
- ❑ To promote self and mutual development including leadership quality,
- ❑ To fulfill the self-esteem and motivational needs of employees.
- ❑ To improve the quality of work-life of employees.

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## SWOT ANALYSIS

The term SWOT is an acronym of Strength, Weakness, Opportunities and Threat. SWOT analysis involves the examination of a firm's Strengths, Weaknesses, Opportunities and Threats. Strengths and Weaknesses are internal to the firm where as Opportunities and Threats are external to the firm. A firm should continuously build upon its strength [like, R&D, Brand Power, Good Customer Service etc.] and mitigate the weaknesses. Similarly, a firm must grab the opportunity like entering a new market and be ahead of its competitors. Threats need to be mitigated so that the goals are achieved as expected. The analysis of the macro-environment tells us about the opportunities and threats present in the environment for our company. Analysis of the micro-environment tells us about the strengths and weaknesses of our company.

SWOT analysis is a technique that enables a group or individual to move from everyday problems and traditional strategies to a fresh prospective. SWOT Analysis is the most renowned tool for audit and analysis of the overall strategic position of the business and its environment. Its key purpose is to identify the strategies that will create a firm specific business model that will best align an organization's resources and capabilities to the requirements of the environment in which the firm operates. It is the foundation for evaluating the internal potential and limitations and the probable/likely opportunities and threats from the external environment. It views all positive and negative factors inside and outside the firm that affect the success. A consistent study of the environment in which the firm operates helps in forecasting/predicting the changing trends and also helps in including them in the decision-making process of the organization.

- **Strength:**

Strengths are the qualities that enable us to accomplish the organization's mission. These are the basis on which continued success can be made and continued/sustained. Strengths can be either tangible or intangible. These are what you are well-versed in or what you have expertise in, the traits and qualities your employees possess (individually and as a team) and the distinct features that give your organization its consistency. Strengths are the beneficial aspects of the organization or the capabilities of an organization, which includes human competencies, process capabilities, financial resources, products and services, customer goodwill and brand loyalty.

- **Weakness:**

Weaknesses are the qualities that prevent us from accomplishing our mission and achieving our full potential. These weaknesses deteriorate influences on the organizational success and growth. Weaknesses are the factors which do not meet the standards we feel they should meet. Weaknesses in an organization may be depreciating machinery, insufficient research and development facilities, narrow product range, poor decision-making, etc. Weaknesses are controllable. They must be minimized and eliminated.

- **Opportunities:**

Opportunities are presented by the environment within which our organization operates. These arise when an organization can take benefit of conditions in its environment to plan and execute strategies that enable it to become more profitable. Organizations can gain competitive advantage by making use of opportunities. Organization should be careful and recognize the opportunities and grasp them whenever they arise. Selecting the targets

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that will best serve the clients while getting desired results is a difficult task. Opportunities may arise from market, competition, industry/government and technology.

- **Threats:**

Threats arise when conditions in external environment jeopardize the reliability and profitability of the organization's business. They compound the vulnerability when they relate to the weaknesses. Threats are uncontrollable. When a threat comes, the stability and survival can be at stake.

### SWOT Analysis

<b>External Environment</b>	Threats (T)	Confront	Avoid
	Opportunities (O)	Exploit	Search
		Strengths (S)	Weakness (W)

### Internal Environment

#### Advantages of SWOT analysis

- It is a source of information for strategic planning.
- Builds organization's strengths.
- Reverse its weaknesses.
- Maximize its response to opportunities.
- Overcome organization's threats.
- It helps in identifying core competencies of the firm.
- It helps in setting of objectives for strategic planning.
- It helps in knowing past, present and future so that by using past and current data, future plans can be chalked out.

#### Limitations of SWOT Analysis

- Price increase
- Inputs/raw materials
- Government legislation
- Economic environment
- Searching a new market for the product which is not having overseas market due to import restrictions; etc.
- Insufficient research and development facilities;
- Faulty products due to poor quality control;
- Poor industrial relations;
- Lack of skilled and efficient labour

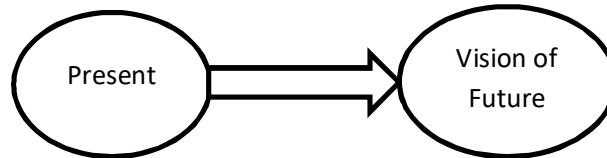


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## STRATEGIC PLANNING

Strategic planning sets the long – term direction of the organization in which it wants to proceed in future.



Strategic planning is the process of envisioning the organizations future and developing the necessary goals, objectives and action plans to achieve that future. Strategic planning is an organizations process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy. The objective is to build a posture that is so strong in selective ways that the organization can achieve its goals despite unforeseeable external forces.

Strategic planning can be defined as the process of deciding on objectives of the organization, on changes on these objectives, on the resource used to attain these objectives and on the policies that are to govern the acquisition, use and disposition of these resources.

### Strategic Planning Process:

**Step 1: Identification of customer needs:** The basic step is the identification of customers and their wants and needs. An organization must seek its customers requirements, expectations and assess future trends before developing a strategic plan.

**Step 2: Determination of customer positioning:** The second step requires the planners to determine its positioning with regards to its customers. Various alternatives such as whether the organization should give up, maintain or expand market position should be considered. In order to become successful, the organization should concentrate and consolidate its position in its area of excellence.

**Step 3: Predict the future:** In this step, the planners should predict future conditions that will effect their product or service.

**Step 4: Gap Analysis:** In this step the planners should identify the gaps between the current state and future state of organization. For identifying the gaps, an analysis of core values and concepts and othertechniques must be used.

**Step 5: Closing of gap:** In this step the planners should develop a specific plan to close the gap. By assessing the relative importance and relative difficulty the planners can close the gap. This process is also termed as process improvement.

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**Step 6: Align the plan with Mission and Vision:** In this step the revised plan should be aligned with mission, vision and core values and concepts of the organization. Organization should embrace quality as an essential ingredient in their mission, vision and objectives.

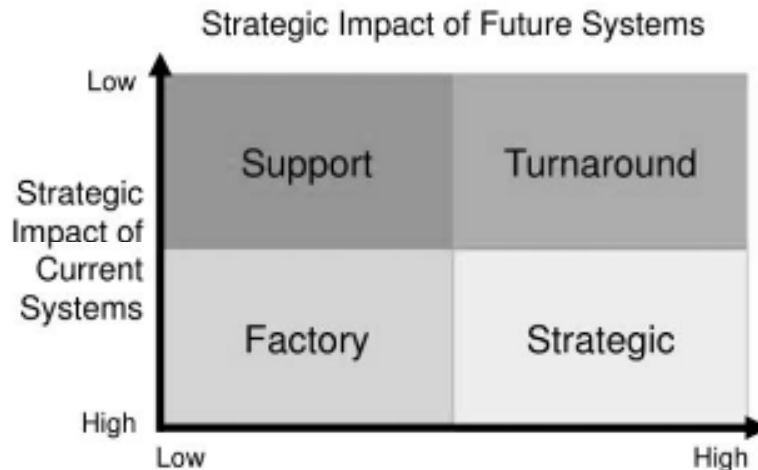
**Step 7: Implementation of plan:** In order to implement the action plan, resources must be allocated to collecting data, designing changes and overcoming resistance to changes. Also the planners should monitor and assess the result of strategic plan.

Since quality is a continuous improvement process, one has to reassess and renew the strategic plans periodically. So it is cyclic process.

### STRATEGIC GRID

McFarlan proposed the strategic grid that allows the visualization of the relationship between IT strategy and business strategy and operations. This model analyses the impacts of IT existent applications (present) and of applications portfolio (future), defining four boxes, with each representing one possible role for IT in the enterprise: “Support,” “Factory,” “Turnaround,” and “Strategic”

The strategic grid model is an IT specific model that can be used to assess the nature of the projects that the IT organization has in its portfolio with the aim of seeing how well that portfolio supports the operational and strategic interests of the firm.



The X-axis:

- The X axis represents impact of the project on IT strategy. One way of expressing what we mean by this is: what options does this project offer the firm by way of affecting one of Porter's five forces in our favour?
- Does it change the nature of competition in our market.
- Does it enable us to offer completely new products and services, or enable us to substitute one of ours for one of someone else's in the eyes of their customers?

The Y-axis:

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- The Y axis represents the impact of the project on IT operations. One way of expressing this is to say that projects that are high on this axis improve the efficiency or quality of our existing systems and business processes, or lower their costs.

McFarlan divided the grid into 4 quadrants

- **Support**  
Low operational impact, low strategic impact. This quadrant is about local process improvements for individual users.
- **Factory**  
High operational impact, low strategic impact. This quadrant is about operational improvements that affect large portions of the firm, and are aimed at improving performance or decreasing cost.
- **Turnaround**  
Low operational impact, high strategic impact. This quadrant is about exploiting new technologies to provide strategic opportunities.
- **Strategic**  
High operational impact, high strategic impact. IT organizations that have most projects in this quadrant understand that IT can both improve core operations of the firm while simultaneously generating strategic options.

### ORGANIZATIONAL CULTURE

Organizational culture is a system of shared beliefs & attitudes that develop within an organization & guides the behaviour of its members. It is also known as "corporate culture", & has a major impact on the performance of organization & especially on the quality of work life experienced by the employees. Organizational culture "consists of the norms, values & rules of conduct of an organization as well as management styles, priorities, beliefs & inter-personal behaviours. Together they create a climate that influences how well people communicate, plan & make decisions".

#### Concept of Organizational Culture

Culture consists of beliefs & behaviour. It is cultivated behaviour in the sense that it is learnt from the other members of the society. Organizational culture is the totality of beliefs, customs, traditions & values shared by the members of the organization. Organizational culture stress on sharing of norms & values that guide the organizational members' behaviour. These norms and values are clear guidelines as to how employees are to behave within the organization and their expected code of conduct outside the organization.

The simplest definition of culture is '**the way we do things round here**' (Deal and Kennedy, 1982). It is a combination of values and beliefs, norms of behaviour that are acceptable or otherwise, written policies, pressures, and expectations coming down from the top, formal and informal systems, processes and procedures, and networks.

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Smircich (1983) defines organizational culture as a **fairly stable set of taken-for-- granted assumptions, shared beliefs, meanings, and values that bring forth a new way of understanding of organisational life**. According to Denison (1984), organizational culture refers to the **set of values, beliefs, and behaviour patterns that form the core identity of an organisation**.

### Role of Organization Culture

The role of culture in an organization is to

- Specify the goals and objectives of the organization
- Specify the relations that exist within the organization
- Specify what qualities are valued within organizations such as loyalty, confidentiality, dynamism, hard work, and so on
- Specify the wider context within which the organization operates.

The success of any organization is linked to an organization culture in which people are encouraged to work together and share resources as needed. Organization culture exerts many effect on individuals and organizational processes - some dramatic and others more subtle. If the organization culture stresses the importance of product quality and excellent service, its customers will generally find their complaints handled politely and efficiently.

### Nature of Organizational Culture

The main features of organizational culture are as follows:-

- Like an individual, every organization has its own personality.
- The personality of the organization defines the internal environment of an organization.
- It differentiates an organization from the others.
- It is relatively enduring or stable over time.
- It exercises a significant influence on the attitudes, behaviour & performance of organizational members.

### Functions of Organizational Culture

The main function of organisational culture is to define the way of doing things in order to give meaning to organisational life.

Brown (1998) states the following functions of organisational culture:

- **Conflict reduction.** A common culture promotes consistency of perception, problem definition, evaluation of issues and opinions, and preferences for action.
- **Coordination and control.** Largely because culture promotes consistency of outlook it also facilitates organisational processes of coordination and control.
- **Reduction of uncertainty.** Adopting of the cultural mind frame is an anxiety reducing device which simplifies the world of work, makes choices easier and rational action seem possible.

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- **Motivation.** An appropriate and cohesive culture can offer employees a focus of identification and loyalty, foster beliefs and values that encourage employees to perform.
- **Competitive advantage.** Strong culture improves the organisation's chances of being successful in the marketplace.

### Elements of Organizational Culture

Following are the elements of organizational culture:-

- **Individual Autonomy:** In this the individuals have responsibility, freedom & opportunities of exercising initiative that an individual has in the organization.
- **Structure:** In this the organization creates objectives, performance expectations & authority relationships.
- **Management Support:** In this the managers provide clear communication, assistance, warmth & support to their subordinates.
- **Identity:** In this the members identify with the organization as a whole rather than with their particular work group or field of professional expertise.
- **Performance Reward System:** Reward system of an organization include increase in salary, promotions etc., is based on employee performance rather than on seniority & favouritism.
- **Risk Tolerance:** In this employees are encouraged to be innovative, aggressive & risk taking.

### Types of Organizational Culture

Handy (1985) has analysed the different types of organizational culture and offers a four-fold typology:

- **The Power Culture**  
In this, the organization stresses the role of individuals rather than committees. Individuals are power-oriented and politically aware. Control is exercised at the centre and is characterised by informal webs of influence rather than formal procedures. It is not characterised by bureaucracy.
- **The Role Culture**  
Here the stress is upon formal rules and roles and authority is vested in these roles. It is characterised by formal procedures and offers the individual security, stability and predictability. It is, therefore, characteristic of bureaucracy.
- **The Task Culture**  
This is job-oriented and is concerned with getting the job done. It is concerned with utilising resources to meet the organization's objectives and is characterised by the requirement of efficiency. The culture adapts itself to change and is driven by the need to provide goods and services for the customer.
- **The Person Culture**  
The individual is at the heart of this organization and this culture, according to Handy, is not often found. The organisation serves the individual rather than the other way round. Control mechanisms or hierarchies are virtually impossible and influence the shared.

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Another way of classifying organizational culture is

- **Authoritarian & Participative Culture:**

In the authoritarian culture there is centralization of power with the leader & obedience to orders & discipline are stressed. Any disobedience is punished severely to set an example to others. The basic assumption is that the leader knows what is good for the organization & he always acts in its interests.

- **Mechanistic & Organic Cultures:**

The mechanistic organizational culture has the values of bureaucracy & so is also called "Bureaucratic Culture". Organizational jobs are created around narrow specializations & people think of their careers mainly within these specializations. There is a great deal of departmental loyalty. This sort of culture resists change & innovation. In organic culture formal hierarchy of authority, departmental boundaries, formal rules & regulations & prescribed channels of communications are found. Emphasis is on task accomplishment, team work, and free flow of communication – formal & informal. There is an understanding within the staff like at the of problems, threats & opportunities the organization is facing & willingness to take part in solving the problems. The culture stresses flexibility, consultation, change & innovation.

- **Sub-Culture & Dominant Culture:**

Each department of an organization may have its own culture representing a sub-culture of the system. An organizational culture takes place when there is an integration of all the departments. Within any given unit the tendency for integration & consistency will be assumed to be present, but it is perfectly possible for coexisting units of a larger system to have cultures that are independent & even in conflict with each other.

### **Creation of Culture:**

Organization culture provides the members with a sense of organizational identity & generates a commitment. Though ideas that become part of culture can come from anywhere within the organization, an organization's culture generally begins with the leader who implements particular ideas & values as a vision, philosophy or business strategy. When these ideas & values lead to success, they become institutionalized & give shape to an organizational culture.

Creation of an organization culture is a very lengthy & complicated process. Culture has 3 levels. Namely:-

1. Artifacts.

2. Beliefs & Values.

3. Assumptions.

1. **Observable Artifacts:** These are the symbols of culture in the physical & social work environment & are most visible. Following are the things found in artifacts:-

- **Organizational Heroes:** As a reflection of the organization's philosophy, concerns the behaviour of top executives & their leadership styles. These leaders become the role models of an organization's culture. They represent what the company stands for & reinforce the values of the culture.

- **Ceremonies & Rites:** Ceremonies & rites tell about activities that are done on important occasions. Members of the organization who have achieved success are

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recognized & rewarded on such occasions. Annual convocations at colleges & universities where degrees, diplomas & medals are distributed to the students are reflections of culture in educational institutions. These ceremonies bond organization members together. Such ceremonies as company picnics, retirement dinners, encourage interpersonal communication & togetherness.

- **Stories:** Stories about organization's heroes are powerful tools to reinforce cultural values throughout the organization. These stories tell about cultural network & remind employees as to why we do things in a certain way.
  - **Cultural Symbols:** Symbols tell about organizational culture. Certain code of dress or company's logo can reflect its values. Some of the material artifacts created by an organization might also speak of its cultural orientation.
2. **Shared Values:** Values are reflected in the way individuals actually behave. Values reflect an organization's beliefs as to what should be & what should not be. Values are those principles & qualities that shape our thinking & behaviour. Values can be of 2 types. Namely:-
- **Instrumental Values:** Are beliefs that certain behaviours are appropriate at all times irrespective of the objectives or outcomes.
  - **Terminal Values:** Are beliefs that certain more tangible objectives are worth striving for & the objectives become more important than the behaviour in achieving such objectives.
3. **Common Assumptions:** Assumptions are the most fundamental level of an organization's culture. These are deeply held beliefs which are not objectively observed. For example, an organization may establish values based on 3 basic assumptions. Namely:-
- People are basically good. This assumption is reflected in the company's emphasis on trust.
  - People are willing to learn, grow & achieve if they are given proper opportunities. This assumption is reflected in the company's extensive training programs.
  - People are motivated by the challenging work. This assumption is reflected by the process of common goal setting & goal achievement by participation of members.

### Maintaining a Culture:

Following are the practices that help to maintain the culture:-

1. **Selection Process:** The main purpose of selection process is to select right type of person for the right job. When for a given job 2 or more candidates with identical skills & abilities are available then the final selection is influenced by how well the candidate fits into the organization. It is by selecting the candidates who can match the organizational culture, the management can think of maintaining organizational culture.
2. **Actions of Top Management:** Besides managerial vision the actions of the top executives also have a major impact on the organizational culture. Through what they say & how they behave, senior executives establish norms that help the organization to take risks, how much freedom managers should allow their subordinates, what actions will pay off during promotions & other rewards.



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## QUALITY CULTURE

Quality culture encompasses an organization's practices, central values and philosophy and can be defined as the concentration of all people and resources in a never-ending quest for greater quality and service in every dimension of the organization. Quality culture refers to a specific part of the organizational culture related to an organization's quality initiatives, whereas organizational culture refers to the entire culture of an organization.

### Characteristics

- Widely shared philosophy of management
- Emphasis on the importance of human resources to the organization
- Ceremonies to celebrate organizational events
- Recognition and rewards for successful employees
- Effective internal network for communicating the culture
- Informal rules of behaviour
- Strong value system
- High standards for performance
- Definite organizational character

### Foundation of quality culture

Establishing a quality culture is like constructing a building. The process begins with laying a solid foundation. A 10-step model is used to establish a solid foundation for a quality culture in any organization.

- **Understand** – Quality is at its heart a cultural concept. The tone for an organization's culture is set by the CEO and executive managers. Without the buy-in and commitment of executive management, there can be no quality culture. Consequently, the cornerstone of the cultural foundation must be an understanding on the part of executive managers of the concept of a quality culture and their role in establishing and maintaining such a culture.
- **Assess** – In this step, a comprehensive assessment of the existing corporate culture as it relates to quality is completed and the results are compiled.
- **Plan** – Based on the results of the survey in the pre-step, develop a comprehensive plan for establishing a quality culture.
- **Expect** - An organization's corporate culture is one of those phenomena in which you get what you expect. Consequently, it is important for executives, managers, and supervisors to make sure that all personnel know that quality-positive attitudes and behaviour are expected. This can be achieved by
  - including a corporate value relating to quality in the organization's strategic plan
  - including quality in the job descriptions of all personnel
  - including quality in all of the organization's team charters
  - including quality criteria in all of the organization's performance appraisal instruments
  - talking about quality at all levels in the organization
  - recognizing and rewarding quality- positive attitudes and behaviour
  - providing quality-related training for personnel at all levels, and
  - Setting quality- related goals for all teams, units, departments, and divisions in the organization.



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- **Model** – Executives, managers, and supervisors must be consistently positive role models of the quality-related attitudes and behaviours expected of personnel. Employees are more likely to follow the behaviour of management personnel than their words.
- **Orient** – New employee orientations should have a comprehensive quality component. A new employee's first exposure to the organization occurs during his or her initial orientation.
- **Mentor** – Many organizations use mentors to help in the development of employees. Typically, mentors provide technically oriented assistance
- **Train** – Providing quality training at all levels is not a new concept to competitive organizations.
- **Monitor** – it is important that supervisors monitor the quality-related attitudes and behaviours of their direct reports continually. When the quality-positive attitudes and behaviours are observed, they should be reinforced immediately. Correspondingly, when quality-negative attitudes and behaviours are observed, they should be corrected immediately.
- **Reinforce and maintain quality** – In order to maintain a quality culture once it has been established, organizations must reinforce the quality-related attitudes and behaviours they expect of their personnel. This means that recognition and reward systems must factor in quality as a key criterion. Quality-related attitudes and behaviours should be factors in all decisions about raises, promotions, and recognition awards.

### QUALITY FUNCTION DEPLOYMENT (QFD)

Quality function deployment is a planning tool used to fulfil customer expectations. It is a disciplined approach to product design, engineering and production and provides in-depth evaluation of a product. An organization that correctly implements QFD can improve engineering knowledge, productivity and quality, and reduce costs, product development time and engineering changes. QFD focuses on customer expectations or requirements, often referred to as the voice of the customer. It is employed to translate customer expectations, in terms of specific requirements, into directions and actions, in terms of engineering or technical characteristics, that can be deployed through the following:

- Product planning
- Part development
- Process planning
- Production planning
- Service industries

Quality function deployment is a team-based management tool in which customer expectations are used to drive the product development process. Conflicting characteristics or requirements are identified early in the QFD process and can be resolved before production. By implementing QFD, an organization is guaranteed to implement the voice of the customer in the final product or service. QFD helps in identifying new quality technology and job functions to carry out operations. This tool provides a historic reference to enhance future technology and prevent design errors. QFD is primarily a set of graphically oriented planning matrices that are used as the basis for decisions affecting any phase of the product development cycle. Quality function

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deployment enables the design phase to concentrate on the customer requirements, thereby spending less time on redesign and modifications.

QFD may be defined as a system for translating customer requirements into appropriate requirements at every stage, from research through product design and development, to manufacture, distribution, installation and marketing, sales and service.

### **Objectives of Quality Function Deployment**

- Focus on the customer
- Reduce time-to-market
- Reduce cost
- Manage information
- Improve marketing and development collaboration
- Organisational learning

### **Benefits of QFD**

- Improves customer satisfaction
- Reduces implementation time
- Promotes Teamwork
- Provides documentation
- Shorter product development cycle
- Focus on process
- Prevents design errors
- Reduced development cost

### **QFD Team**

QFD team of six to eight persons has to be constituted for every project. It should be a cross functional team consisting of representatives of various functions (Marketing, Design, Production, QA, Testing, Purchasing, etc). The team members should be able to spend the required time for successful completion of project. The QFD task is carried out for design of a new product as well as improvement of an existing product.

### **The Voice of Customer**

QFD concentrates on customer expectations and needs, a considerable amount of effort is put into research to determine customer expectations. This process increases the initial planning stage of the project definition phase in the development cycle. But the result is a total reduction of the overall cycle time in bringing to the market a product that satisfies the customer.

The driving force behind QFD is that the customer dictates the attitude of a product. Customer satisfaction, like quality, is defined as meeting or exceeding customer expectations. Words used by the customers to describe their expectations are often referred to as the voice of the customer. Sources for determining customer expectations are focus groups, surveys, complaints, consultants, standards and federal regulations. Frequently, customer expectations are vague and general in nature. It is the job of the QFD team to analyze these customer expectations into more

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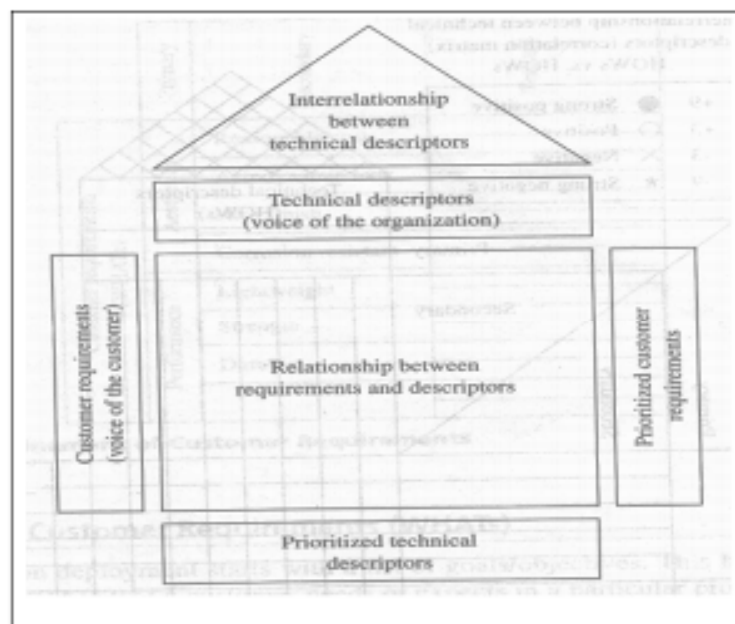
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specific customer requirements. Customer requirements should be taken literally and not incorrectly translated into what organization official's desire. Quality function deployment begins with marketing to determine what exactly the customer desires from a product. During the collection of information, the QFD team should continually ask and answer numerous questions, such as the following:

- What does the customer really want?
- What are the customer's expectations?
- Are the customer's expectations used to drive the design process?
- What can the design team do to achieve customer satisfaction?

### House of Quality

The primary planning tool used in QFD is the house of quality. The house of quality translates the voice of the customer into design requirements that specific values. It also matches those requirements against the ability of the organization to meet them. House of quality is considered to be primary chart in quality planning. The basic structure of QFD can be thought of as a framework of a house, as shown in fig below.



### Building the House of Quality

- **Step 1: List Customer Requirements (WHATs)**  
Quality function deployment starts with a list of goals/objectives. This list is often referred to as the WHATs that a customer needs or expects in a particular product. This list of primary customer requirements is usually vague and very general in nature. The list of customer requirements is divided into a hierarchy of primary, secondary and tertiary customer requirements.
- **Step 2: List Technical Descriptors (HOWs)**

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The goal of the house of quality is to design or change the design of a product in a way that meets or exceeds the customer expectations. The QFD team should come up with engineering characteristics or technical descriptors (HOWs) that will affect one or more of the customer requirements. These technical descriptors make up the ceiling, or second floor, of the house of quality. Each engineering characteristic should directly affect a customer perception and be expressed in measurable terms. Implementation of the customer requirements is difficult until they are translated into counterpart characteristics. Counterpart characteristics are an expression of the voice of the customer in technical language. Each of the customer requirements is broken down into the next level of detail by listing one or more primary technical descriptors for each of the tertiary customer requirements.

- **Step 3: Develop a Relationship Matrix Between WHATs and HOWs**

The next step in building a house of quality is to compare the customer requirements and technical descriptors and determine their respective relationships. Tracing the relationships between the customer requirements and the technical descriptors can become very confusing. This is because each customer requirement may affect more than one technical descriptor and vice versa. The interior walls of the house are the relationships between customer requirements and technical descriptors.

The inside of the house of quality, known as the relationship matrix, is now filled in by the QFD team. The relationship matrix is used to represent graphically the degree of influence between each technical descriptor and each customer requirement. This step may take a long time because the number of evaluations is the product of the number of customer requirements and the number of technical descriptors. Doing this early in the development process will shorten the development cycle and lessen the need for future changes. It is common to use symbols to represent the degree of relationship between the customer requirements and technical descriptors. Examples may include the following:

- o A solid circle represents a strong relationship.
- o A single circle represents a medium relationship.
- o A triangle represents a weak relationship.
- o The box is left blank if no relationship exists.

Each degree of relationship between a customer requirement and a technical descriptor is defined by placing the respective symbol at the intersection of the customer requirement and technical descriptor. This method allows very complex relationships to be depicted and interpreted with very little experience. After the relationship matrix has been completed, it is evaluated for empty rows or columns. An empty row indicates that a customer requirement is not being addressed by any of the technical descriptors. Thus, the customer expectation is not being met. Additional technical descriptors should be considered in order to satisfy that particular customer requirement. An empty column indicates that a particular technical descriptor does not affect any of the customer requirements and, after careful scrutiny, may be removed from the house of quality.

- **Step 4: Develop an Interrelationship Matrix between HOWs**

The roof of the house of quality, called the correlation matrix, is used to identify any interrelationships between each of the technical descriptors. The correlation matrix is a triangular table attached to the technical descriptors. Symbols are used to describe the strength of the interrelationships.

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- o A solid circle represents a strong positive relationship.
- o A circle represents a positive relationship.
- o An X represents a negative relationship.
- o An asterisk represents a strong negative relationship.

The symbols describe the direction of the correlation. In other words, a strong positive interrelationship would be a nearly perfectly positive correlation. A strong negative interrelationship would be a nearly perfectly negative correlation. This diagram allows the user to identify which technical descriptors support one another and which are in conflict.

- **Step 5: Competitive Assessments**

The competitive assessments are a pair of weighted table (or graphs) that depict item for how competitive products compare with current organization products. The competitive assessment tables are separated into two categories: customer assessment and technical assessment.

The customer competitive assessment is the block of columns corresponding to each customer requirement in the house of quality on the right side of the relationship matrix. These rankings can also be plotted across from each customer requirement, using different symbols for each product. The customer competitive assessment is a good way to determine if the customer requirements have been met and identify areas to concentrate on in the next design. The customer competitive assessment also contains an appraisal of where an organization stands relative to its major competitors in terms of each customer requirement.

The technical competitive assessment makes up a block of rows corresponding to each technical descriptor in the house of quality beneath the relationship matrix. These rankings can then be entered below each technical descriptor using the same numbers as used in the customer competitive assessment. The technical competitive assessment is often useful in uncovering gaps in engineering judgment. When a technical descriptor directly relates to a customer requirement, a comparison is made between the customer's competitive evaluation and the objective measure ranking. Customer requirements and technical descriptors that are strongly related should also exhibit a strong relationship in their competitive assessments. Both assessments are very important because they give the organization an understanding where its product stands in relation to the market.

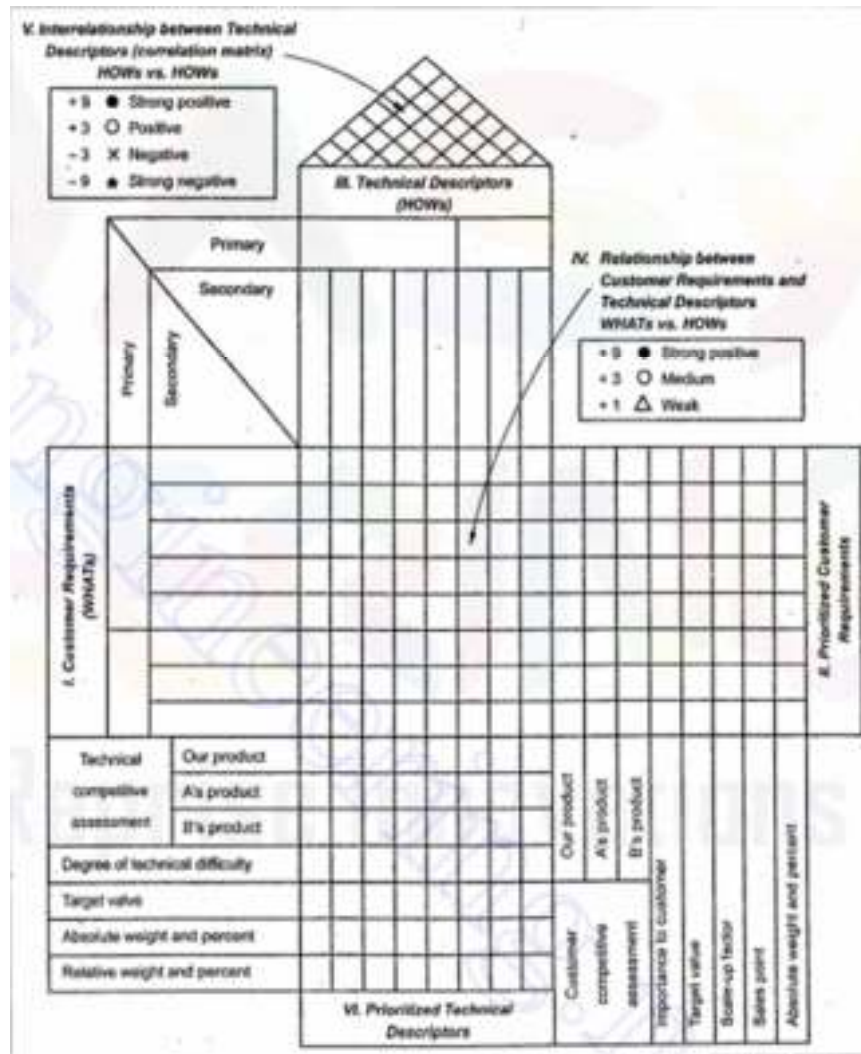
- **Step 6: Develop Prioritized Customer Requirements**

The prioritized customer requirements make up a block of columns corresponding to each customer requirement in the house of quality on the right side of the customer competitive assessment. These prioritized customer requirements contain columns for importance to customer, target value, scale-up factor, sales point and an absolute weight.

- **Step 7: Develop Prioritized Technical Descriptors**

The prioritized technical descriptors make up a block of rows corresponding to each technical descriptor in the house of quality below the technical competitive assessment. These prioritized technical descriptors contain a degree of technical difficulty, target value and absolute and relative weights. The QFD team identifies technical descriptors that are the most needed to fulfil customer requirements and need improvement. These measures provide specific objectives that guide the subsequent design and provide a means of objectively assessing progress and minimizing subjective opinions.

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### QFD Process

There are four phases of product development.

- Product Planning
- Part Development
- Process Planning
- Production Planning

The various steps required in QFD process are

### Phase I: Product Planning

1. List customer requirements
2. List technical descriptors
3. Develop relationship between customer requirements and technical descriptors



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4. Develop interrelationship matrix between technical descriptors
5. Do competitive assessments
6. Develop prioritized customer requirements
7. Develop prioritized technical descriptors

Phase I 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 I is critical to the success of the entire QFD process

### **Phase II: Part Development**

This step involves development of a design matching the customer requirement and trial production. 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

1. Deploy QFD process down to sub-components level both in terms of requirements and characteristics
2. Deploy the component requirement chart. Relate the critical sub-component control characteristics

### **Phase III: Process Planning**

This step involves development of a suitable process and develop control plans. Process planning is led by manufacturing engineering. During process planning, manufacturing processes are flowcharted and process parameters (or target values) are documented

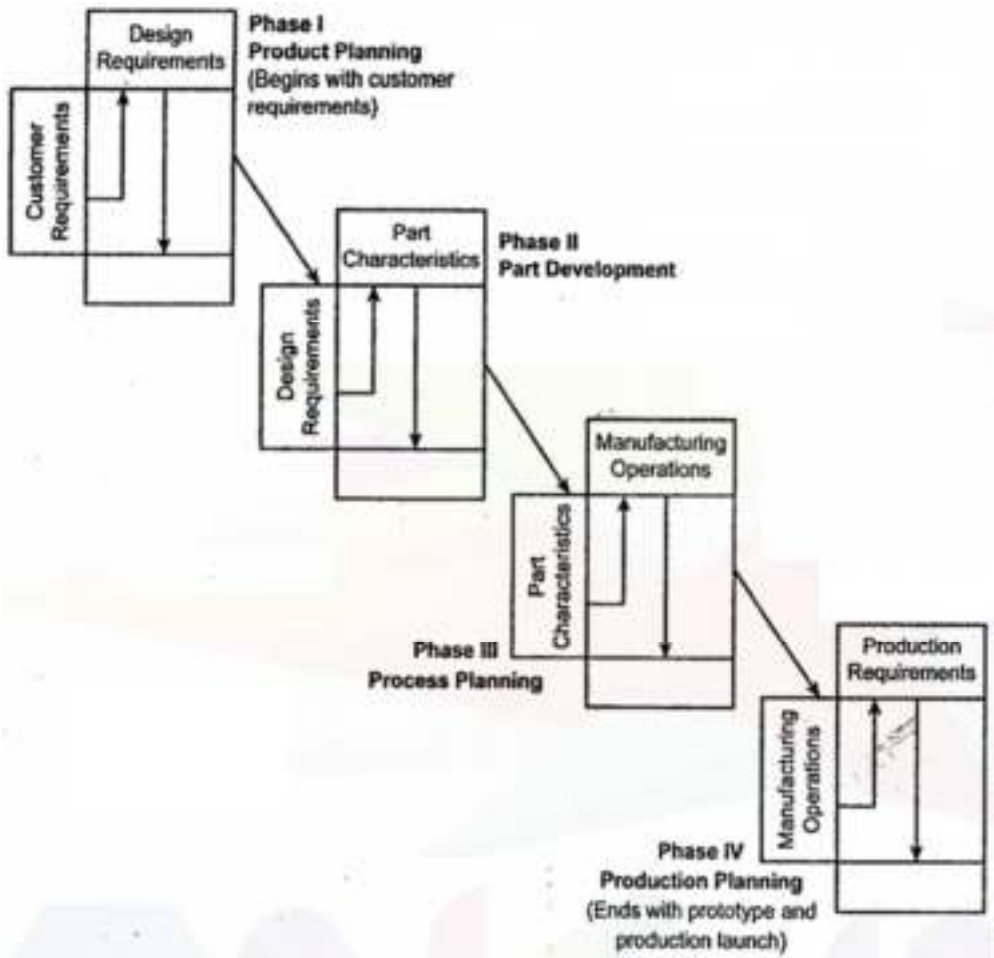
1. Develop the relationship between the critical characteristics and process used to create the characteristics
2. Develop the control plan relating critical control to critical processes

### **Phase IV: Production Planning**

This step involves the development of a suitable production, Develop prototype and do testing and launching the final product to the market

1. Tabulate operating instructions from process requirements
2. Develop prototype and do testing
3. Launch the final product to market

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QFD Process



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### **FAILURE MODE & EFFECT ANALYSIS (FMEA)**

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. “FMEA is an analytical technique that combines the technology and experience of people in identifying foreseeable failure modes of a product or process and planning for its elimination.” FMEA is a “before-the-event” action event and is done when existing systems/products/processes are changed or redesigned. It is a group of activities comprising the following:

- Recognize the potential failure of a product or process.
- Identify actions that eliminate / reduce the potential failure.
- Document the process.

*Failure Modes and Effects Analysis (FMEA) is designed to identify potential failure modes for a product or process before the problems occur, to assess the risk. Ideally, FMEA is conducted in the product design or process development stages, although conducting an FMEA on existing products or processes may also yield benefits.*

#### **Objectives of FMEA:**

- The objective of FMEA is to anticipate failures and prevent them from occurring. FMEA prioritizes failures and attempts to eliminate their causes.
- FMEA 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.
- FMEA is a before the event action and is done when existing systems products processes are changed or redesigned.
- FMEA is a never ending process improvement tool.

#### **Concepts of FMEA**

The FMEA concept is used to analyze concept alternatives in the early stages before a final concept is selected and hardware is defined (most often at system and subsystem). It focuses on potential failure modes associated with the proposed functions of a concept proposal. In order to streamline the FMEA process, focus should be on the concept's primary functions and limit the scope to those failure modes, effects, and causes that are the greatest concern. This type of FMEA includes the interaction of multiple systems and interaction between the elements of a system at the concept stages.

FMEA requires the identification of the following basic information:

- Item(s)
- Function(s)
- Failure(s)

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- Effect(s) of Failure
- Cause(s) of Failure
- Current Control(s)
- Recommended Action(s)
- Plus other relevant details

### **Types of FMEA:**

- System FMEA:- Analyses components, subsystems and main system in early stage of design
- Design FMEA: - Analyses products/parts before they are released to manufacturing.
- Process FMEA: - Focuses on manufacturing and assembly processes.
- Service FMEA:- Analyses the service industry processes before they are released to impact the customer
- Equipment FMEA
- Maintenance FMEA
- Concept FMEA
- Environmental FMEA

In practice all the above types are categorized in two types

#### **1. Design FMEA**

Design FMEA involves the analysis of the potential failures of product or service due to component or subsystem unreliability. Implementing Design FMEA helps to establish priorities based on expected failures and severity of those failures and also helps to uncover oversights, misjudgements and errors that may have been made. Design FMEA also helps to reduce development time and cost of manufacturing by eliminating many potential failures prior to operation. It also specifies the appropriate tests to check the designed product.

#### **2. Process FMEA**

Process FMEA is used to identify potential process failure modes by ranking the failures and then goes in for establishing priorities according the failures impact on the internal and external customer. Process FMEA also helps to identify potential manufacturing and assembly level failures in order to establish controls for reduction of failures.

### **Intent of FMEA:**

Continuously measuring the reliability of a machine, product or process becomes an essential part of TQM. While buying new machines, creating a new product or modifying a new product, it is necessary to determine the reliability of the product or process. The most powerful method for measuring reliability of the product/process is FMEA.

- FMEA attempts to find out the potential product related failures. This technique is used to anticipate causes of failure and prevent them from happening.

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- FMEA is an important step in debugging and preventing problems that may occur in the manufacturing process.
- The FMEA evaluation should be carried out immediately after the design phase of product and certainly before purchasing and setting up any machinery.
- FMEA allows the engineers to document all the thoughts and actions carried out to ensure a safe and reliable product.

### **Benefits of FMEA:**

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

### **Stages of FMEA:**

#### **1. Specifying Possibilities**

- a) The functions involved are identified
- b) The possible failure modes are determined
- c) The root causes for the failure are found out
- d) The effects of the failure on other components of the system is found out
- e) Steps involved in the detection/prevention of failures is found out

#### **2. Quantifying Risk**

- a) Probability of cause is determined
- b) Severity of the failure and its effect is determined
- c) The effectiveness of control system to prevent cause is checked
- d) The risk is prioritized

#### **3. Correcting High Risk Causes**

- a) The work is prioritized
- b) Action is explained in a detailed manner
- c) Now the action is assigned to the necessary people
- d) Go in for Check points to check the completion level

#### **4. Re-evaluation of Risk**

- a) Recalculate the risk priority number

### **FMEA Team:**

FMEA process is a team effort which involves engineers, assembly level workers, manufacturing level workers, people from material department and people from quality

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department, service department, suppliers and customers. The responsibilities of team leader is to determine the meeting time and place, communicating with the rest of the team, coordinating actions assigning workers and following it up. Has to maintain files and records of FMEA forms, keep the team active by drawing everyone into participation.

### FMEA Documentation:

The purpose of FMEA documentation is

- To allow all involved Engineers to have access to others thoughts
- To design and manufacture using these collective thoughts (promotes team approach)

For documentation to be effective it must be continuously updated as and when changes occur in the design and manufacturing process.

### Steps involved in FMEA

A block diagram is created to describe the system and its function. Then a worksheet is created, which contains the important information about the system, such as the revision date or the names of the components. On this worksheet all the items or functions of the subject should be listed in a logical manner, based on the block diagram. Other steps followed are discussed below.

- **Step 1 – Severity** – Determine all failure modes based on the functional requirements and their effects. Then effect of each failure mode is identified. Each effect is then given a *severity number (S)* from 1 (no danger) to 10 (critical).
- **Step 2 – Occurrence** – In this step it is necessary to look at the cause of a failure mode and how many times it occurs. A failure mode is given an *occurrence ranking (O)*, again 1–10.
- **Step 3 – Detection** – In this step, the current controls of the system, that prevent failure modes from occurring or which detect the failure are checked. Then a *detection number (D)* which indicates the ability of planned tests and inspections to remove defects or detect failure modes in time. A high detection number indicates that the chances are high that the failure will escape detection, or in other words, that the chances of detection are low.

After these 3 basic steps, **Risk Priority Number (RPN)** is calculated multiplying  $S \times O \times D$ . Then actions such as inspection, testing, redesign are carried out. Once the actions have been implemented in the design/process, the new RPN should be checked, to confirm the improvements.

Function	Failure Mode	Effects	Severity (S)	Occurrence (O)	Detection (D)	RPN	Action

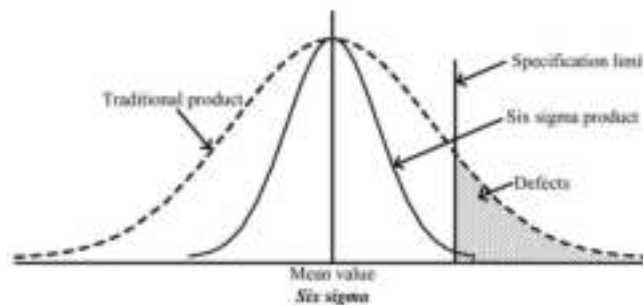
*An example of FMEA worksheet*



### SIX SIGMA APPROACH

Six Sigma is an advance tool in quality management and process improvement. It is a methodology for creating products/processes that perform at high standards. The phrase 'Six Sigma' is emerged from the statistical foundation of the methodology. It measures how far a given process deviates from perfection. It is associated with 'process capability', a process that operates at six sigma will produce no more than 3.4 defective parts per million although this will debase over time to around a 99.5% yield. Most companies will operate at around 1 to 2. The Six Sigma is based on numerous theories of quality management (Deming's 14 point for management, Juran's 10 steps on achieving quality). The main scheme behind Six Sigma is that if one can measure how many "defects" have in a process, then it can systematically figure out how to eliminate them and get as close to "zero defects" as possible and specially it means a failure rate of 3.4 parts per million or 99.9997% perfect. Six Sigma is well-organized process that helps to focus on developing and delivering near-perfect products and services. The concept of six sigma was developed by Motorola Corporation. Six sigma is a quality improvement programme with a goal to reduce the number of defects to as low as 3.4 parts per million. Six sigma seeks to identify and remove the causes of defects and errors in manufacturing and business process.

**Definition:** *Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects. Six Sigma approach is a collection of managerial and statistical concept and techniques that focuses on reducing variation in processes and preventing deficiencies in product.*



The bell shape curve shown in the figure is called 'normal distribution' in statistical terms. In real life, a lot of frequency distributions follow normal distribution. Natural variations cause such a distribution or deviation. One of the characteristics of this distribution is that 68% of area (i.e., the data points) falls within the area of  $-1\sigma$  and  $+1\sigma$  on either side of the mean. Similarly,  $2\sigma$  on either side will cover approximately 95.5% area.  $3\sigma$  on either side from mean covers almost 99.7% area. A more peaked curve (eg. more and more deliveries were made on target) indicates lower variation or more mature and capable process. Whereas a flatter bell curve indicates higher variation or less mature or capable process. Six Sigma is not just a statistical approach to measure variance; it is a process and culture to achieve excellence.

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Within a business and industry, the sigma value indicates how well a process is performing. A defect is anything that may result in customer dissatisfaction. Consider a process that produces one million parts, for this process to meet a Six sigma quality level, it must only produce less than 3.4 defective parts out of the million that is produced. To achieve this task best practice for product development must be identified.

Sigma in six sigma is used to measure performance. It is used to designate the distribution or spread about the mean of any processor procedure. Six sigma is aimed at correcting the process variation to reduce defects, not by adjusting specification limits. The product produced using six sigma methodologies is shown with less variation, represented by the steeper slope of the curve and more narrow spread around the mean value, than the traditional product. The sigma measure is used for general communication and motivational purposes it should not be used in a technical sense.

### **Key Concepts of Six Sigma**

Six Sigma revolves around a few key concepts.

- Critical to Quality: Attributes most important to the customer.
- Defect: Failing to deliver what the customer wants.
- Process Capability: What process can deliver.
- Variation: What the customer sees and feels.
- Stable Operations: Ensuring consistent, predictable processes to improve what the customer sees and feels.
- Design for Six Sigma: Designing to meet customer needs and process capability.

### **Features of Six Sigma**

Major aim of Six Sigma is to eliminate waste and wastefulness, thus increasing customer satisfaction by delivering what the customer is expecting.

- Six Sigma follows a structured methodology, and has definite roles for the participants.
- Six Sigma is a data driven method, and requires precise data collection for the processes being analysed.
- Six Sigma is about putting results on Financial Statements.
- Six Sigma is a business-driven, multi-dimensional structured approach for:
  - It is an improving Process.
  - It is used to lower Defects.
  - It reduces process variability
  - It also reduces costs
  - Application of Six Sigma enhances customer satisfaction
  - Its use increases profits



### Characteristics of Six Sigma

- **Statistical Quality Control** – Standard Deviation is used as an important tool for measuring non-conformance quality of the output is concerned.
- **Methodical Approach** – The Six Sigma is not merely a quality improvement strategy in theory as it features a well defined methodical approach of application in DMAIC and DMADV which can be used to improve the quality of production.
- **Fact and Data Based Approach** – The statistical and methodical aspects of Six Sigma show the scientific basis of the technique. This accentuates an important aspect of Six Sigma that it is fact and data based.
- **Project and Objective Based Focus** – The Six Sigma process is implemented for an organization's project tailored to its specifications and requirement. The process is flexed to suit the requirements and conditions in which a project is operating to get the best results. Six Sigma is also objective based. It is aimed to enhance profitability and to generate financial.
- **The Customer Focus** – The quality improvement and control standards are based on the explicit customer requirements.
- **Teamwork Approach to Quality Management** – The Six Sigma process requires organizations to get organized when it comes to controlling and improving quality. Six Sigma actually involves a lot of training depending on the role of an individual in the Quality Management team.

### Objectives of Six sigma

The main objectives of six sigma are as follows

- **Overall Business Improvement** – Six Sigma methodology focuses on business improvement. Beyond reducing the number of defects present in any given number of products.
- **Reduce wastage** – Any business seeking improved numbers must reduce the number of defective products or services it produces. Defective products can harm customer satisfaction levels.
- **Reduce Costs** – Reduced costs equal increased profits. A company implementing Six Sigma principles has to look to reduce costs wherever it possibly can without reducing quality.
- **Reduced Cycle Time** – Any reduction in the amount of time it takes to produce a product or perform a service means money saved, both in maintenance costs and personnel wages. Additionally, customer satisfaction improves when both retailers and end users receive products sooner than expected. The company that can get a product to its customer faster may win her business.

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- **Increase Customer Satisfaction** – Customer satisfaction depends upon successful resolution of all Six Sigma's other objectives. But customer satisfaction is an objective all its own

### Calculation of Six Sigma

The model of Six Sigma is helpful to eliminate defects/variations in processes with respect to customer requirement. Achieving a six-sigma level quality means that processes produce only 3.4 *defects per million opportunities (DPMO)*. Six-Sigma in addition to being a methodology for improving process capability is also viewed as a philosophy that leads to faultlessness on a continuous basis. The capability index, DPMO and the implied performance at select levels are mentioned below:

CAPABILITY INDEX	DPMO	IMPLIED PERFORMANCE
6 sigma	3.4	World Class
5 sigma	233	
4 sigma	6210	Average
3 sigma	66807	
2 sigma	308537	Non Competitive

### Concepts in Six Sigma

- **DPMO (Defects Per Million Opportunities)**  $DPMO = \frac{\text{Total Defects Observed}}{\text{Total Opportunities}} (1,000,000)$
- **Critical to Quality:** Critical to quality is one of the major concept in Six Sigma methodologies because the quality can affect the whole business objective or Goal. Critical to quality means the measurable characteristics of a product or service which must be matches the customer requirement of product or service.
- **Defect:** The defect is defined as a product or service characteristics which are not the customer want.
- **Process Capability:** Process capability can be defined as a ability of your business process to deliver or produce a service or product which are meeting the customer demands.
- **Variation:** Variation term is a bit different in Six Sigma methodology, here variation means after delivering service and product the control person can measure the difference between the what customer sees and what they actual feels after acceptance of product or service.
- **Stable Operations:** Stable operations means not only the stabilizing the process but businesses have to ensure that the process of business in consistent to reduce the gap between what customer sees and feels.

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### Elements of Six Sigma:

There are three key elements of Six Sigma Process Improvement:

- **The Customers** – Customers define quality. They expect performance, reliability, competitive prices, ontime delivery, service, clear and correct transaction processing and more. This means it is important to provide what the customers need to gain customer delight.
- **The Processes** – Defining processes as well as defining their metrics and measures are the central aspect of Six Sigma. In a business, the quality should be looked from the customer's perspective and so we must look at a defined process from the outside-in. By understanding the transaction lifecycle from the customer's needs and processes, we can discover what they are seeing and feeling. This gives a chance to identify weak areas within a process and then we can improve them.
- **The Employees** – A company must involve all its employees in the Six Sigma program. Company must provide opportunities and incentives for employees to focus their talents and ability to satisfy customers. It is important to Six Sigma that all the team members should have a well-defined role with measurable objectives.

### Methodology of Six Sigma:

There are various methodology of six sigma:

**DMAIC** (Six Sigma improvement methodology): It is most popular process improvement methodology which consists of Define, Measure, Analysis, Improve and Control. Six sigma was introduced by engineer Bill Smith while working at Motorola in 1980. General Electric (GE) was the company that continued the progress of Motorola and standardized the methodology. GE focused on the following five steps, which together make up the DMAIC model. DMAIC is recognized as a simple performance improvement model that is used within an intense use of statistical computer software, and is acronym for Define-Measure-Analyse-Improve-Control. The DMAIC process can be described as following:

1. Define the goals of the improvement activity
2. Measure the existing system
3. Analyse the system
4. Improve the system
5. Control the new system

DMAIC is used by improving an existing process or service to attain the company's goal or the project objective. DMAIC is a data driven quality strategy used to improve processes. It is about minimizing variation in an existing process and is a corrective method.

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**DMADV** model is short form for "Define-Measure-Analyse-Design-Verify" where it focuses in Design and Verify stages. It has five phases.

1. **Define:** Define design goals that are consistent with customer demands and the enterprise strategy.
2. **Measure:** Measure and identify CTQs (characteristics that are Critical To Quality), product capabilities, production process capability, and risks.
3. **Analyze:** Analyze to develop and design alternatives.
4. **Design:** Design an improved alternative, best suited per analysis in the previous step
5. **Verify:** Verify the design, set up pilot runs, implement the production process and hand it over to the process owner(s).

**DMADOV** (Creating new processes which will perform @ Six Sigma) comprises of define, measure, analyse, design, optimise and validate. DMADOV forces attention on the need to optimise the design. This six sigma model is used to develop new processes and product at high quality level or if a process that is already in the company needs more than just an incremental improvement.

### Advantages of six sigma:

- It generates sustained success
- It sets a performance goal for everyone
- It enhances value to customers
- It speeds up the rate of improvement
- It promotes learning and cross-pollination
- It executes strategic change

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### Disadvantages of six sigma:

- Improving product quality can generate capital costs and long term overhead costs
- It doesnot work well with intangible results
- It may create inflexibility and bureaucracy that can create delays and stifle creativity.

### Application of Six Sigma in various Industries

The demand for enhanced quality and reduced cost of the goods and services has coaxed many companies to introduce the Six Sigma system irrespective of the industry to which they belonged to. In India, Wipro was one of the first companies to introduce Six Sigma into it's applications in 1997. Wipro's every business from software development to hardware, FMCG, BPO; all adopted Six Sigma into its processes. It is said that after the initiation of Six Sigma into its projects, the company has been able to complete 91% of its projects on time, when compared to the industrial average of 55.

- **Pharmaceutical industry** - In pharmaceutical industry, adoption of the Six Sigma technique helped the industry reduce wastage and rework involved in the production. It was said that 5-10% of medicines produced during a period were to be discarded or modified due to the defects. The adoption of Six Sigma helped the pharmaceutical companies to reduce the errors in the production.
- **Airline industry** - Airline industry had to adopt the Six Sigma metrics for its survival. The increased cost of fuel, the competition driven by low budget airlines, etc has made the need for lower cost without a hit to quality the need of the hour. The number of errors in handling the calls from customers, and ticketing is to be minimised drastically. It was with this intention that the airline industry adopted Six Sigma into the organisation.
- **Hospitality services** - Hospitality services are another industry which benefited by the adoption of Six Sigma techniques. Providing personalised service to each and every customer by bending to their demands within a limited time without comprising the quality was aided by the Six Sigma matrices. The Six Sigma technique is adopted in every field from maintaining full occupancy to efficient housekeeping, ensuring a balanced inventory supply, and to minimise wastage in the inventory.
- **Steel industries** - Steel industries use this technique to minimise the inadequacies in the design, imperfect products, etc.

In 1998. Forbes Magazine applauded the *Mumbai Tiffin Suppliers Association or the Mumbai Dabbawallahs* for their way of functioning with just one error in every 8 million. Logistics, insurance, call centers, all embrace the Six Sigma techniques for improving the quality of service provided by them. Irrespective of the type of industry, all companies have to adopt Six Sigma techniques as quality and timely delivery are crucial for their survival.

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