

UNIT I : INTRODUCTION**9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II : TQM PRINCIPLES**9**

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III : TQM TOOLS & TECHNIQUES I**9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV : TQM TOOLS & TECHNIQUES II**9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V : QUALITY SYSTEMS**9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL : 45**TEXT BOOK**

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Total Quality Management

UNIT-1

INTRODUCTION

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INTRODUCTION

Liberalization and Globalization: With the opening up of the economy multinational companies, the world over, are setting up organizations in India. Also, Indian Government has liberalized and many products that were previously manufactured by the public sector and government organizations are now being manufactured by Private organizations.

The opening up of the economy has brought to the advantage of the customers many benefits

- **Sellers market to Buyers market:** Previously, Customers had to depend on only a few products. They are now able to choose whatever the product they want. So organizations have to be agile and introduce many variants of the same product and that too in a very short period of time.
- **Awareness:** With the connectivity increasing, the world has become very small and even remote places are now connected through internet and mobile phones, not to mention the connectivity through road and rail.
- **Increased Competition:** More and more organizations are setting up industries in India to produce products and services. Also, any product produced anywhere in the world can be sold in any part of the world.

Indian companies have come under lot of pressure under the present circumstances because

- **Freedom to produce:** Many products that were under the domain of the cottage industry are now being manufactured by multinational companies (ex: chips, soft drinks).
- **Organizational Systems and Culture:** These multinational companies that enter the Indian market bring with them proven systems through which they have a great advantage over many of the Indian organizations that still need to think in terms of progressive systems.

In view of the above circumstances organizations in India need to look ahead to be competitive to survive and succeed. One of the best ways of taking the first step forward is to

- **Improve productivity** of all activities, inside the organization and in the delivery process i.e., they need to respond faster to the environmental requirement and produce products and services at continually reduced costs.
- Secondly, organizations need to **process information and products at a faster rate**, For this to happen managers in such organizations need to be provided with updated, timely and strategic information
- All the **departments in the organization need to work in unison** to serve the ultimate customer. Customer is the king in the present age and he will not pay for the producers' inefficiency.
- Product costs have to continually decrease.

All these things should happen in a situation in which employee salary, interests on loans, insurance costs electricity charges, to name a few, keep on increasing as expenses to the organization.

QUALITY

Quality has been the most exploited word but at the same time most mis-understood word. Quality is an off shoot of the work we do. It is a bi-product of an act. It shows the level of commitment in doing our activity.

Examples such as: High quality at low price, Quality Hawaii chappal, High class quality etc., are being mentioned.

Definition: The Quality is defined in many ways:

Quality is Excellence: When quality is defined as excellence, it loses its measurability. Each person understands to the level of his own excellence and involves in his work. It is often misunderstood that high cost is high quality. Judgmental in nature. Ex. (Rolex watches, BMW automobiles).

Quality is Value: With this definition the performance and features or the usefulness of the products are compared to only the cost of price of the product. Many a times the utility/ possession value is more than the value of the product. Ex: the features of the product are compared to the cost of the product.

Quality is Conformance to Requirements: This definition has a manufacturing orientation. It requires that the customer gives the specification and the products are manufactured to that requirement.

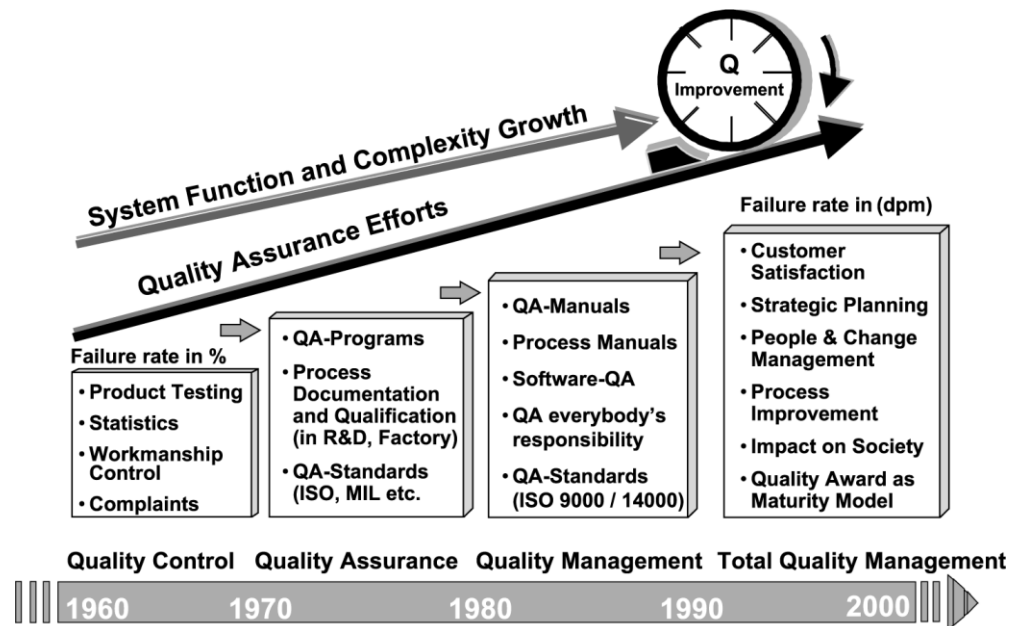
Quality is degree to which the inherent capabilities of the product satisfy (implicit and explicit) Requirements (Customer driven).

Need for Quality

- Good quality of goods and services can provide an organization with competitive edge.
- Good quality reduces costs due to product returns, rework and scrap.
- Good quality increases productivity, profits and other measures of success such as brand image, product image and company goodwill.
- Most importantly, good quality generates satisfied customers today and tomorrow.
- Good quality creates an atmosphere for high employee morale, which improves productivity.

Evolution of Quality

Before the concepts and ideas of TQM were formalised, much work had taken place over the centuries to reach this stage. This section charts the evolution, from inspection through to the present day concepts of total quality.



From inspection to total quality

Inspection

Inspection involves measuring, examining, and testing products, process and services against specified requirements to determine conformity. In the late Middle Ages, special measures were taken to inspect the work of apprentices and journeymen in order to guard the Guild against claims of makeshift or shoddy work.

During the early years of manufacturing, inspection was used to decide whether a worker's job or a product met the requirements; therefore, acceptable. It was not done in a systematic way, but worked well when the volume of production was reasonably low. However, as organisations became larger, the need for more effective operations became apparent.

In 1911, Frederick W. Taylor helped to satisfy this need. He published 'The Principles of Scientific Management' which provided a framework for the effective use of people in industrial organisations. One of Taylor's concepts was clearly defined tasks performed under standard conditions. Inspection was one of these tasks and

- was intended to ensure that no faulty product left the factory or workshop;
- focuses on the product and the detection of problems in the product;
- involves testing every item to ensure that it complies with product specifications;
- is carried out at the end of the production process; and relies on specially trained inspectors.

Accompanying the creation of inspection functions, other problems arose:

- More technical problems occurred, requiring specialised skills, often not possessed by production workers
- The inspectors lacked training
- Inspectors were ordered to accept defective goods, to increase output
- Skilled workers were promoted into other roles, leaving less skilled workers to perform the operational jobs, such as manufacturing

This movement led to the emergence of a separate inspection department. An important new idea that emerged from this new department was defect prevention, which led to quality control.

Quality Control and Statistical Theory

Quality Control was introduced to detect and fix problems along the production line to prevent the production of faulty products. Statistical theory played an important role in this area. In the 1920s, Dr W. Shewhart developed the application of statistical methods to the management of quality. He made the first modern control chart and demonstrated that variation in the production process leads to variation in product. Therefore, eliminating variation in the process leads to a good standard of end products.

Statistical Quality Control:

- focuses on product and the detection and control of quality problems;
- involves testing samples and statistically infers compliance of all products;
- is carried out at stages through the production process; and
- relies on trained production personnel and quality control professionals.

Shewart's work was later developed by Deming, Dodge and Roming. However, manufacturing companies did not fully utilise these techniques until the late 1940s.

Quality in Japan

In the 1940s, Japanese products were perceived as cheap, shoddy imitations. Japanese industrial leaders recognised this problem and aimed to produce innovative high quality products. They invited a few quality gurus, such as Deming, Juran, and Feigenbaum to learn how to achieve this aim.

In the 1950s, quality control and management developed quickly and became a main theme of Japanese management. The idea of quality did not stop at the management level. Quality circles started in the early 60s. A quality circle is a volunteer group of workers who meet and discuss issues to improve any aspects of workplace, and make presentations to management with their ideas.

A by-product of quality circles was employee motivation. Workers felt that they were involved and heard. Another by-product was the idea of improving not only quality of the products, but also every aspect of organisational issues. This probably was the start of the idea, total quality.

Total Quality

The term 'total quality' was used for the first time in a paper by Feigenbaum at the first international conference on quality control in Tokyo in 1969. The term referred to wider issues within an organisation.

Ishikawa also discussed 'total quality control' in Japan, which is different from the western idea of total quality. According to his explanation, it means 'company-wide quality control' that involves all employees, from top management to the workers, in quality control.

Total Quality Management

In the 1980s to the 1990s, a new phase of quality control and management began. This became known as Total Quality Management (TQM). Having observed Japan's success of employing quality issues, western companies started to introduce their own quality initiatives. TQM, developed as a catchall phrase for the broad spectrum of quality-focused strategies, programmes and techniques during this period, became the centre of focus for the western quality movement.

Historical Review (Evolution in short-chronological order)

- **In the middle ages** the concept of quality in the individuals was instilled by long hours of on the job training. The manufacturer would act as the inspector. The concept of business was in the barter system. Even now we see such skilled craftsmen like carpenters, idol makers and others, who make their own product and inspect it.
- **In the early 20th century**, the work of F.W.Taylor, known as the father of scientific management, led to a new philosophy of separating planning function from execution function. During this phase the total work was segmented into specific work tasks for focusing on increased efficiency. The quality assurance of the items/products produced fell into the hands of the inspectors. During manufacturing, defects were present but were removed by inspectors before passing it on to the next stage or to the customer. Eventually organizations formed separate quality departments to pass materials produced. This worked during that period because of lack of skill and education of the workers. Later on it led to a lot of indifference to quality among production workers thinking that quality personnel were responsible for quality goods produced.
 - **During this period Henry Ford** had identified lot of best practices of Total Quality and put it in a book called "My Life and Work", which people in Ford came to know later when they visited Japan to learn best practices.
 - **During 1920s** in the Bell Telephone Laboratories, a team led by Walter Shewart, developed the control chart, which became a popular means of identifying quality problems in production processes and ensuring consistency of output.
 - **During the Second World War** sampling tables (MIL STD) were developed for sampling inspection.
- **During the early 40s and 50s** the shortage of civilian goods made production a top priority. Quality was not a priority of top managers and remained the domain of the specialist managers. Edward Deming learned statistical quality control from Shewart and propagated the same to Japanese along with Joseph Juran.
- **During late 1970s and 1980s US** managers were making frequent trips to Japan to see the miracle in Japan on Quality issues.
- **During late 1980s** automotive industry in US began to emphasize SPC. Suppliers and their suppliers were required to use these techniques. Genechi Taguchi introduced his concepts of parameter and tolerance design and brought a resurgence of design of experiments.

- The 1990s ISO 9000 became the worldwide model for quality management system.

Dimensions of Quality

Manufacturing Quality Dimensions

- | | | |
|---------------|---------------|--------------|
| • Performance | • Reliability | • Aesthetics |
| • Features | • Durability | • Reputation |
| • Conformance | • Service | • Response |

Performance: A product's primary operating characteristics.

- Automobile- Braking Distance, Acceleration, Steering, Handling, etc.
- Mobile Phone: Clarity, Audibility, Ease of use, etc.

Features: Additional provisions provided in the product

- Automobile: Stereo systems, Antilock Brakes, Air conditioning
- Mobile Phones: MP3, Email facility,

Reliability: Probability of product surviving over a specified period of time under specified conditions.

- Automobile: Able to start on cold days, Good mileage
- Mobile Phones: Catches even feeble signals, Battery life is good

Conformance: The degree to which physical and performance characteristics of a product match pre-established standards

- Automobile: No sounds while driving as all components fit well with each other.
- Mobile: Battery and additional cards fit well into the unit. Battery gets charged properly

Durability: The amount of use one gets from a product before it physically deteriorates or until replacement is preferable.

- Automobile: Corrosion resistance, Upholstery wears.
- Mobile: Battery life, Sturdiness of buttons

Serviceability: The speed, courtesy and competence of repair work.

- Automobile: Ease with which the cables can be replaced.
- Mobile: Service expenses

Aesthetics: How a product looks, feels, tastes, smells and sounds

- Automobile: Colour, ergonomic seats, panel design
- Mobile: Sleekness, weight, Colour combination

Reputation: The name the supplier has made over time

- Automobile: Maruthi Suzuki service.
- Mobile: Nokia's reliability

Response: Willingness to help customers and provide prompt service.

- Automobile: Replacement of defective parts – TATA Indica, Honda
- Mobile: Nokia battery replacement

Service Quality

Service can be defined as ‘any primary or complimentary activity that does not directly produce a physical product – that is, the non-goods part of the transaction between buyer (customer) and seller (provider).

The service sector grew rapidly in the second half of the twentieth century. A service might be as simple as handling a complaint or as complex as getting a housing loan. The service sector began to recognise the importance of quality several years after manufacturing had done so. This lag can be attributed to the fact that service industry had not confronted the same aggressive foreign competition that manufacturing faced. Another factor is the high turnover rate in service industry jobs. Constantly changing personnel makes establishment of a continual improvement process more difficult.

Service Quality Characteristics:

- **Intangibility:** inability to assess the value gained from engaging in an activity using any tangible evidence
- **Perish-ability:** capacity cannot be stored for sale in the future.
- **Inseparability:** renders it impossible to divorce the supply or production of the service from its consumption.
- **Variability:** Differences in service in terms of time and person.

Dimensions of Service Quality:

Five key dimensions of service quality contribute to customer perceptions:

- **Reliability:** The ability to provide what was promised, dependably and accurately. Ex: providing error free invoices, making repairs correctly first time.
- **Assurance:** The knowledge and courtesy of employees, and their ability to convey trust and confidence. Ex: ability to answer questions, having capability to do the necessary work, avoiding possible fraud with the system of operations.
- **Tangibles:** The physical facilities of the equipment, and the appearance of personnel. Attractive front office, well dressed employees, well designed forms etc.
- **Empathy:** The degree of caring and individual attention provided by the customers. Ex: willingness to schedule deliveries at the customer’s convenience, explaining technical jargon in a layman’s language.
- **Responsiveness:** The willingness to help customers and provide prompt service. Ex: acting quickly to resolve problems, promptly crediting returned materials.

Improving Service Quality

Customer service is the set of activities an organization uses to win and retain customers’ satisfaction. It can be provided before, during, or after the sale of the product or exist on its own. Elements of customer service are:

Organization:

To ensure the same level of quality of service for all customers, organization must record and communicate to its employees the directions for all tasks. A service quality handbook has to be prepared.

Communicating it to all employees would be through formal training, videos, personal coaching, or meetings. The organization shall take into consideration the following

1. Identify each market segment they are serving.
2. Write down the requirements.
3. Communicate the requirements
4. Organise processes
5. Organise physical spaces.

Customer Care:

The organization should revolve around the customer, because customers are the key to the business. The issues under customer care are:

1. Meet the customers' expectations
2. Get the customer's point of view.
3. Deliver what is promised
4. Make the customer feel valued.
5. Respond to all complaints
6. Over-respond to the customer
7. Provide a clean and comfortable customer reception area.

Communication:

The organization should be in communication with its customers matching with its level of service quality. A customer will be dissatisfied if what is advertised and what is delivered are not the same.

Under communication organizations need to

1. Optimize the trade-off between time and personal attention.
2. Minimize the number of contact points
3. Provide pleasant, knowledgeable, and enthusiastic employees.
4. Write documents in customer-friendly language.

Front Line People:

Customers are the most valuable assets and should not be left to employees who have not been trained to handle people and complaints. To attend to customers and their requirements, organizations need to

1. Hire people who like people
2. Challenge them to develop better methods
3. Give them the authority to solve the problems.
4. Serve them as internal customers
5. Be sure they are adequately trained.
6. Recognise and reward performance

Quality Planning

Before offering any product/service to the market, organizations need to plan upfront, about the level of quality, the features and the services they are going to offer in the market. They need to decide the customer segment they are going to serve with the products which they are making.

The steps for quality planning are as follows:

- **Identify who are the customers:** If a company is making a car, it has to decide which segment of the society it is going to serve. Appropriately requirements have to be met.
- **Determine the customer needs:** An in-depth survey and detailed analysis has to be done to know the requirements of the customer. Customers may ask for an automobile but their actual need to be collected to know whether they are giving value for aesthetics or reliability.
- **Translate the needs into language:** Once requirements are noted, then the data has to be analyzed to know the pattern or trend. Accordingly, the features and performance of the product have to be defined.
- **Develop a product to meet the needs:** Once requirements have been translated to needs and parameters, a prototype need to be produced.
- **Optimize the product so as to meet the company's as well as the customers' needs:** Matching the customers' requirement with the organizations capability to produce, it could be decided what features need to be added to the product and how the same could be manufactured. This is done in an organized process by making use of advanced tools and techniques, such as Quality Function Deployment and Failure Mode Effect Analysis.
- **Develop the Process to produce the product:** At this stage the knowledge and record in the earlier step is transferred to technical requirements and the machinery and processes need to produce are added to the organization.
- **Optimize the Process:** The process has to be fine tuned to optimize the working condition in order to minimize wastage and delay.
- **Prove the processes can a make the product under optimal conditions:** Produce products in the setup to ensure that the setting of the process results in cost effective products and improves efficiency of operation.

Total Quality Management

TQM is composed of three paradigms:

- **Total:** Organization wide
- **Quality:** With its usual Definitions, with all its complexities ([External Definition](#))
- **Management:** The system of managing with steps like Plan, Organize, Control, Lead, Staff, etc.

Definition: As defined by the [International Organization for Standardization](#) (ISO):

"TQM is a management approach for an organization, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society."

Basic Concepts: TQM requires six basic concepts

1. **A committed and involved management:** TQM is a continual long term activity that must be imbibed in the culture of the organization. Everything begins with the long-term-top-to-bottom-

organization support. Management must participate in the quality program, establish a council to develop clear vision, set goals and direct the programs.

2. **An unwavering focus on the customer:** Customers are the very purpose of any organization. Key to an effective TQM is orienting all activities towards the need of the customer, both internally and externally.
3. **Effective involvement and achievement of the entire work force:** Implementing TQM is everyone's responsibility. Employees are the future of any organization. All personnel must be trained in TQM, its tools. They must be empowered to perform processes in an optimal manner.
4. **Continuous improvement of the business and production processes:** All employees must continually strive to improve all business and production systems.
5. **Treating Suppliers as Partners:** 40 to 60 % of the product cost is outsourced. So all supplier organizations have to be treated as extension of one's organisations.
6. **Establish Performance measures:** Measure and prosper. Measures should be available to note downtimes, nonconformities and satisfaction of customers, absenteeism etc.

Principles of Total Quality Management: The eight principles are:

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

Principle 1 - Customer-Focused Organisation

"Organisations depend on their customers and therefore should understand current and future needs of the customer, meet customer requirements and strive to exceed customer expectations".

Steps in application of this principle are:

1. Understand customer needs and expectations for products, delivery, price, dependability, etc.
2. Ensure a balanced approach among customers and other stake holders (owners, people, suppliers, local communities and society at large) needs and expectations.
3. Communicate these needs and expectations throughout the organisation.
4. Measure customer satisfaction & act on results, and
5. Manage customer relationships.

Principle 2 - Leadership

"Leaders establish unity of purpose and direction of the organisation. They should create and maintain the internal environment in which people can become fully involved in achieving the organisation's objectives."

Steps in application of this principle are:

1. Be proactive and lead by example.
2. Understand and respond to changes in the external environment.
3. Consider the needs of all stake holders including customers, owners, people, suppliers, local communities and society at large.
4. Establish a clear vision of the organisation's future.

5. Establish shared values and ethical role models at all levels of the organisation.
6. Build trust and eliminate fear.
7. Provide people with the required resources and freedom to act with responsibility and accountability.
8. Inspire, encourage and recognise people's contributions.
9. Promote open and honest communication.
10. Educate, train and coach people.
11. Set challenging goals and targets, and
12. Implement a strategy to achieve these goals and targets.

Principle 3 - Involvement of People

"People at all levels are the essence of an organisation and their full involvement enables their abilities to be used for the organisation's benefit".

Steps in application of this principle are:

1. Accept ownership and responsibility to solve problems.
2. Actively seek opportunities to make improvements, and enhance competencies, knowledge and experience.
3. Freely share knowledge & experience in teams.
4. Focus on the creation of value for customers.
5. Be innovative in furthering the organisation's objectives.
6. Improve the way of representing the organisation to customers, local communities and society at large.
7. Help people derive satisfaction from their work, and
8. Make people enthusiastic and proud to be part of the organisation.

Principle 4 - Process Approach

"A desired result is achieved more efficiently when related resources and activities are managed as a process."

Steps in application of this principle are:

1. Define the process to achieve the desired result.
2. Identify and measure the inputs and outputs of the process.
3. Identify the interfaces of the process with the functions of the organisation.
4. Evaluate possible risks, consequences and impacts of processes on customers, suppliers and other stake holders of the process.
5. Establish clear responsibility, authority, and accountability for managing the process.
6. Identify internal and external customers, suppliers and other stake holders of the process, and
7. When designing processes, consider process steps, activities, flows, control measures, training needs, equipment, methods, information, materials and other resources to achieve the desired result.

Principle 5 - System Approach to Management

"Identifying, understanding and managing a system of interrelated processes for a given objective improve the organisation's effectiveness and efficiency."

Steps in application of this principle are:

1. Define the system by identifying or developing the processes that affect a given objective.
2. Structure the system to achieve the objective in the most efficient way.
3. Understand the interdependencies among the processes of the system.
4. Continually improve the system through measurement and evaluation, and
5. Estimate the resource requirements and establish resource constraints prior to action.

Principle 6 - Continual Improvement

"Continual improvement should be a permanent objective of the organisation."

Steps in application of this principle are:

1. Make continual improvement of products, processes and systems an objective for every individual in the organization.
2. Apply the basic improvement concepts of incremental improvement and breakthrough improvement.
3. Use periodic assessments against established criteria of excellence to identify areas for potential improvement.
4. Continually improve the efficiency and effectiveness of all processes.
5. Promote prevention based activities.
6. Provide every member of the organisation with appropriate education and training, on the methods and tools of continual improvement such as the Plan-Do-Check-Act cycle, problem solving, process re-engineering, and process innovation.
7. Establish measures and goals to guide and track improvements, and
8. Recognise improvements.

Principle 7 - Factual Approach to Decision Making

"Effective decisions are based on the analysis of data and information."

Steps in application of this principle are:

1. Take measurements and collect data and information relevant to the objective.
2. Ensure that the data and information are sufficiently accurate, reliable and accessible.
3. Analyse the data and information using valid methods.
4. Understand the value of appropriate statistical techniques, and
5. Make decisions and take action based on the results of logical analysis balanced with experience and intuition.

Principle 8 - Mutually Beneficial Supplier Relationships

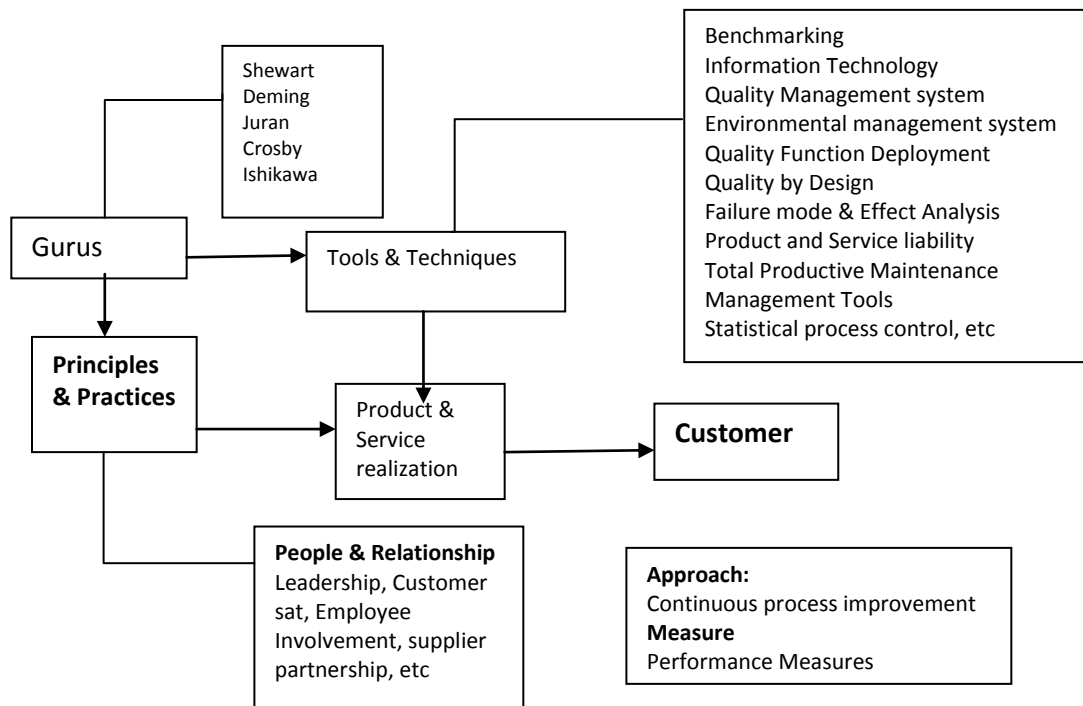
"An organisation and its suppliers are interdependent, and a mutually beneficial relationship enhances the ability of both to create value."

Steps in application of this principle are:

1. Identify and select key suppliers.

2. Establish supplier relationships that balance short-term gains with long-term considerations for the organisation and society at large.
3. Create clear and open communications.
4. Initiate joint development and improvement of products and processes.
5. Jointly establish a clear understanding of customers' needs.
6. Share information and future plans, and
7. Recognise supplier improvements and achievements

TQM FRAMEWORK



TQM has evolved over a period of time through practice and the contribution of principles by various gurus. The whole system is focused towards the customer, who is the basic purpose for which the organization exists. The products and services are realized by the combination of various principles and practices based on people and relationships, and Tools and Techniques, as shown above. The approach to product realization is by continuously identifying activities and process for incremental and breakthrough improvement so as to provide the best to the customer. This happens when at every stage all activities and process have progressive performance measures which channelize the performance in the direction of the set goal.

Benefits of TQM:

- Improved quality
- Employee participation
- Team work
- Working relationship
- Customer satisfaction
- Employee satisfaction.
- Increased productivity
- Communication]
- Profitability
- Increased market share

Implementation of TQM

It is very important to implement TQM in an organized manner. Even a good system does not work well nor is accepted by the employees if badly implemented. Leadership is essential in every stage of implementation. The following need to be followed for effective implementation of TQM in organizations:

1. Sr. Management needs to be educated in the TQM concept. In addition to formal education, managers need to visit other organizations where TQM has been implemented.
2. Timing of the implementation is important. Implementation should be postponed when any of the following are happening in the organization
 - a. Reorganization of roles and responsibilities
 - b. Change in Senior Management
 - c. Interpersonal conflicts
 - d. A crisis in the organization
 - e. A time consuming project is underway
3. A quality council has to be formed to take up the implementation activities of TQM. The quality council is responsible for developing core values, a vision, a mission and a quality policy statement with input all concerned.
4. Middle managers should be actively involved in the implementation of TQM only then the commitment percolates to the other levels of the organization.
5. If there is a union, then there should be a clear discussion regarding the purpose, approach and end result of the effort being taken to implement TQM. Their concurrence and cooperation is necessary for a successful implementation.
6. It is important, at this stage, to communicate to everyone in the organization about the implementation of TQM.
7. Everyone needs to be trained in the appropriate tools and techniques to learn and apply the same.
8. A survey has to be conducted to assess the level of understanding and commitment of the customers, suppliers and employees. This helps in benchmarking the activities for improvement.

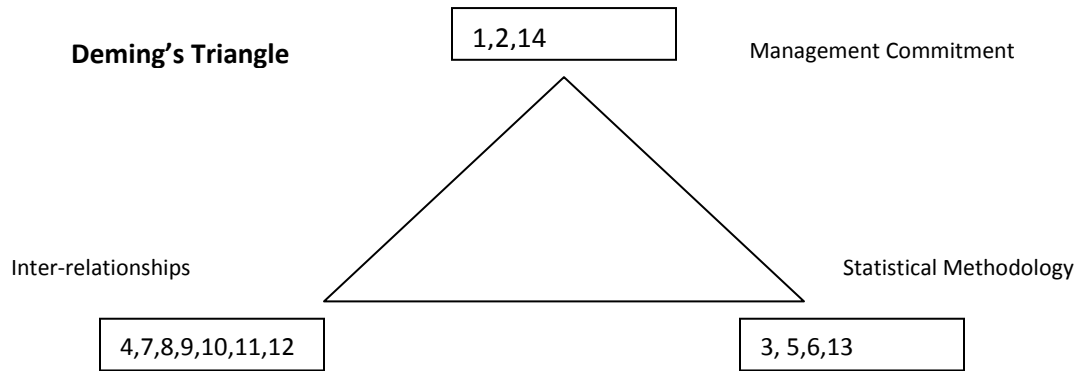
W. Edwards Deming

W. Edwards Deming holds a Ph.D. in physics, but is a statistician by experience. He is an educator, lecturer, author, and an internationally renowned consultant, best known for leading Japanese businesses on the course that has made them leaders in quality and productivity throughout the world. His contributions for Deming's 14 points, Deming's Triangle, Deming's Theory of Variance and Deming's Wheel.

Deming's 14 points:

- **Point 1:** Create constancy of purpose toward improvement of the product and service so as to **become competitive**, stay in business and provide jobs.
- **Point 2:** Adopt the new philosophy. We are in a **new economic age**. We no longer need live with commonly accepted levels of delay, mistake, defective material and defective workmanship.
- **Point 3:** Cease dependence on mass inspection; require, instead, statistical evidence that quality is built in.

- **Point 4:** Improve the quality of incoming materials. End the practice of awarding business on the basis of a price alone. Instead, depend on meaningful measures of quality, along with price.
- **Point 5:** Find the problems; constantly improve the system of production and service. There should be continual reduction of waste and continual improvement of quality in every activity so as to yield a continual rise in productivity and a decrease in costs.
- **Point 6:** Institute modern methods of training and education for all. Modern methods of on-the-job training use control charts to determine whether a worker has been properly trained and are able to perform the job correctly. Statistical methods must be used to discover when training is complete.
- **Point 7:** Institute modern methods of supervision. The emphasis of production supervisors must be to help people to do a better job. Improvement of quality will automatically improve productivity. Management must prepare to take immediate action on response from supervisors concerning problems such as inherited defects, lack of maintenance of machines, poor tools or fuzzy operational definitions.
- **Point 8:** Fear is a barrier to **improvement** so drive out fear by encouraging effective two-way communication and other mechanisms that will enable everybody to be part of **change**, and to belong to it.
- Fear can often be found at all levels in an organization: fear of change, fear of the fact that it may be necessary to learn a better way of working and fear that their positions might be usurped frequently affect middle and **higher management**, whilst on the shop-floor, workers can also fear the effects of change on their jobs.
- **Point 9:** Break down barriers between departments and staff areas. People in different areas such as research, design, sales, administration and production must work in teams to tackle problems that may be encountered with products or service.
- **Point 10:** Eliminate the use of slogans, posters and exhortations for the workforce, demanding zero defects and new levels of productivity without providing methods. Such exhortations only create adversarial relationships.
- **Point 11:** Eliminate work standards that prescribe numerical quotas for the workforce and numerical goals for people in management. Substitute aids and helpful **leadership**.
- **Point 12:** Remove the barriers that rob hourly workers, and people in management, of their right to pride of workmanship. This implies, abolition of the annual merit rating (appraisal of performance) and of management by objectives.
- **Point 13:** Institute a vigorous program of education, and encourage self-improvement for everyone. What an organization needs is not just good people; it needs people that are improving with education.
- **Point 14:** Top management's permanent commitment to ever-improving quality and productivity must be clearly defined and a management structure created that will continuously take action to follow the preceding 13 points.



Deming's Theory of Variance:

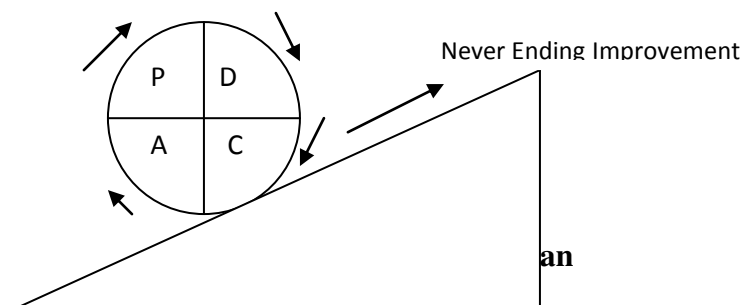
As per Deming, all variance can be categorized into **controlled variance** and **uncontrolled variance**. A controlled variance is a variation from standard process that a worker can control.

An uncontrolled variance is a variation from the standard process due to the impact of some factor outside the control of the employee.

Variances can be corrected by workers or managers by either changing its common causes or removing the special causes. Common causes are systematic issues such as improper product design, equipment malfunctioning, maintenance of equipment, inaccurate routing or improper selection of materials. Special causes include lack of skill, worker negligence or incoming bad quality material.

	Common Cause	Special Cause
Controlled Variance	Management	Employee
Uncontrolled variance	Management	Management

Deming Wheel or P-D-C-A Cycle



Joseph Moses Juran

Joseph Moses Juran (December 24, 1904 – February 28, 2008) was a 20th century management consultant who is principally remembered as an evangelist for quality and quality management, writing several influential books on those subjects.

The relevant things that Dr. Juran did was conceptualized the Pareto Principal to apply it in quality management. He also spent some years with the reengineering concepts. During this time he observed that an organization could work better if they standardized the process and give more importance to the quality. He also developed the "Juran's trilogy," an approach to cross-functional management that is composed of three managerial processes: quality planning, quality control and quality improvement.

Dr. Juran's trilogy defined the three management processes required by every organization to improve: Quality control, quality improvement and quality planning. This Trilogy shows how an organization can improve every aspect by better understanding of the relationship between processes that plan, control and improve quality as well as business results. It was created in the 1950's and defines managing for quality as three basic quality-oriented, interrelated processes:

Quality Planning --- To determine customer needs and develop processes and products required to meet and exceed those of the customer needs. The processes are called Design for Six Sigma or Concurrent Engineering. This can be particularly challenging for a planning team, because customers are not always consistent with what they say they want. The challenge for quality planning is to identify the most important needs from all the needs expressed by the customer.

- Identify who are the customers.
- Determine the needs of those customers.
- Translate those needs into our language.
- Develop a product that can respond to those needs.
- Optimize the product features so as to meet our needs and customer needs.

Quality Control --- The purposes of quality control is to ensure the process is running in optimal effectiveness, or to ensure that any level of chronic waste inherent in the process does not get worst. Chronic waste, which is a cost of poor quality that can exist in any process, may exist due to various factors including deficiencies in the original planning. It could cost a lot of money to the company, from rework time to scrap product to overdue receivables. If the waste does get worst (sporadic spike), a corrective action team is brought in to determine the cause or causes of this abnormal variation. Once the cause or causes had been determined and corrected, the process again falls into the zone defined by the "quality control" limits.

- Prove that the process can produce the product under operating conditions with minimal inspection.
- Transfer the process to Operations.

Quality Improvement --- Eliminate waste, defects and rework that improves processes and reduces the cost of poor quality. The processes have to be constantly challenged and continuously improved. Such an improvement does not happen of its own accord. It results from purposeful Quality Improvement or "Breakthrough."

- Develop a process which is able to produce the product.
- Optimize the process.

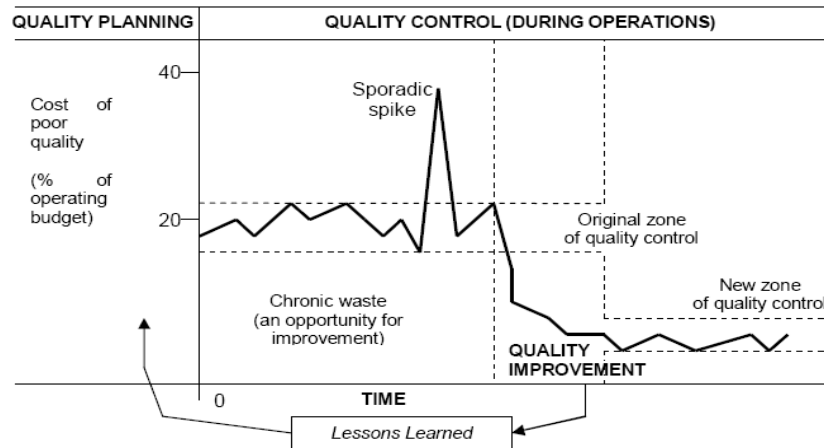


Figure 8 The Juran Trilogy (Juran, 1988; 1992; 1995)

Examples of use and where it is used

One example of Juran quality program was used in patient care program. The Juran center gathered several health care executives from several regions of Minnesota in order to improve several aspects like health care cost, patients safety and worker shortages. The Juran center launched a research project called Leading to Perfect Patient Care or LPPC, to test and implement a plan to eliminate medical errors. This was made for a 90 day period of time, in some important clinics and hospitals. The results expected with this program were an improvement in the safety and other organizational outcomes.

The Dr. Juran quality program is also used in benchmarking, change management, design for six sigma, lean techniques, performance improvement, quality management and six sigma deployments.

Philip B. Crosby

Philip B. Crosby is an internationally known quality expert. He is best known for popularizing the "Zero Defects" concept that originated in the United States at the Martin Marietta Corporation where Crosby worked during the 1960s.

The foundation of Crosby's approach is prevention. His approach to quality is best described by the following concepts: (1) "Do It Right the First Time"; (2) "Zero Defects" and "Zero Defects Day"; (3) the "Four Absolutes of Quality"; (4) the "Prevention Process"; (5) the "Quality Vaccine"; and (6) the Six C's.

Four absolutes of quality

1. The definition of quality is conformance to requirements (requirements meaning both the product and the customer's requirements)
2. The system of quality is prevention
3. The performance standard is zero defects (relative to requirements)
4. The measurement of quality is the price of nonconformance

Do it Right First Time

Crosby's approach focuses on doing things right the first time and every time. There is no place in his philosophy for differing levels of quality or categories of quality (e.g., high/low, good/poor). He believes there should be no reason for planning and investing in strategies that are designed in case something does not conform to requirements and goes wrong

Zero Defects and Zero Defects Day

The ultimate goal of his quality improvement process is "Zero Defects" or "defect-free" products and services. Contrary to what is generally believed, "Zero Defects" is not just a motivational slogan, but an attitude and commitment to prevention. "Zero Defects" does not mean that the product has to be perfect. It does mean that every individual in the organization is committed to meet the requirement the first time, every time, and that not meeting the requirements is not acceptable.

His approach provides for the establishment of a "Zero Defects Day," a day that provides a forum for management to reaffirm its commitment to quality and allows employees to make the same commitment.

All the actions necessary to run the organization, produce a product and a service, and deal with customers must be met and agreed.

The system that produces quality is prevention (i.e., eliminating errors before they occur). To Crosby, training, discipline, example, and leadership produce prevention. Management must consciously commit themselves to a prevention oriented environment.

The attitude of 'close enough' is not tolerated in Crosby's approach. Errors are too costly to ignore. Leaders must help others in their pursuit of conforming to requirements by allocating resources for training, providing time, tools etc to employees.

Nonconformance is a management tool for diagnosing an organization's effectiveness and efficiency.

Crosby's fourteen steps

1. Management Commitment: the need for quality improvement must be recognised and adopted by management, with an emphasis on the need for defect prevention.

Quality improvement is equated with profit improvement. A quality policy is needed which states that '... each individual is expected to perform exactly like the requirement or cause the requirement to be officially changed to what we and the customer really need.'

Crosby's 14 Steps

- | | |
|---------------------------------|-------------------------|
| 1. Management commitment | 8. Quality education |
| 2. The quality improvement team | 9. "Zero Defects Day" |
| 3. Quality measurement | 10. Goal setting |
| 4. The cost of quality | 11. Error-cause removal |
| 5. Quality awareness | 12. Recognition |
| 6. Corrective action | 13. Quality councils |
| 7. Zero defects planning | 14. "Do it over again" |

2. Quality Improvement Team: representatives from each department or function should be brought together to form a quality improvement team. These should be people who have sufficient authority to commit the area they represent to action.

3. **Quality Measurement:** the status of quality should be determined throughout the company. This means establishing quality measures for each area of activity that are recorded to show where improvement is possible, and where corrective action is necessary. Crosby advocates delegation of this task to the people who actually do the job, so setting the stage for defect prevention on the job, where it really counts.
4. **Cost of Quality Evaluation:** the cost of quality is not an absolute performance measurement, but an indication of where the action necessary to correct a defect will result in greater profitability.
5. **Quality Awareness:** this involves, through training and the provision of visible evidence of the concern for quality improvement, making employees aware of the cost to the company of defects. Crosby stresses that this sharing process is a - or even - the - key step in his view of quality.
6. **Corrective Action:** discussion about problems will bring solutions to light and also raise other elements for improvement. People need to see that problems are being resolved on a regular basis. Corrective action should then become a habit.
7. **Establish an Ad-hoc Committee for the Zero Defects Programme:** Zero Defects is not a motivation programme - its purpose is to communicate and instil the notion that everyone should do things right first time.
8. **Supervisor Training:** all managers should undergo formal training on the 14 steps before they are implemented. A manager should understand each of the 14 steps well enough to be able to explain them to his or her people.
9. **Zero Defects Day:** it is important that the commitment to Zero Defects as the performance standard of the company makes an impact, and that everyone gets the same message in the same way. Zero Defects Day, when supervisors explain the programme to their people, should make a lasting impression as a 'new attitude' day.
10. **Goal Setting:** each supervisor gets his or her people to establish specific, measurable goals to strive for. Usually, these comprise 30-, 60-, and 90-day goals.
11. **Error Cause Removal:** employees are asked to describe, on a simple, one-page form, any problems that prevent them from carrying out error-free work. Problems should be acknowledged within twenty-four hours by the function or unit to which the problem is addressed. This constitutes a key step in building up trust, as people will begin to grow more confident that their problems will be addressed and dealt with.
12. **Recognition:** it is important to recognise those who meet their goals or perform outstanding acts with a prize or award, although this should not be in financial form. The act of recognition is what is important.
13. **Quality Councils:** the quality professionals and team-leaders should meet regularly to discuss improvements and upgrades to the quality programme.
14. **Do It Over Again:** during the course of a typical programme, lasting from 12 to 18 months, turnover and change will dissipate much of the educational process.

It is important to set up a new team of representatives and begin the programme over again, starting with Zero Defects day. This 'starting over again' helps quality to become ingrained in the organization.

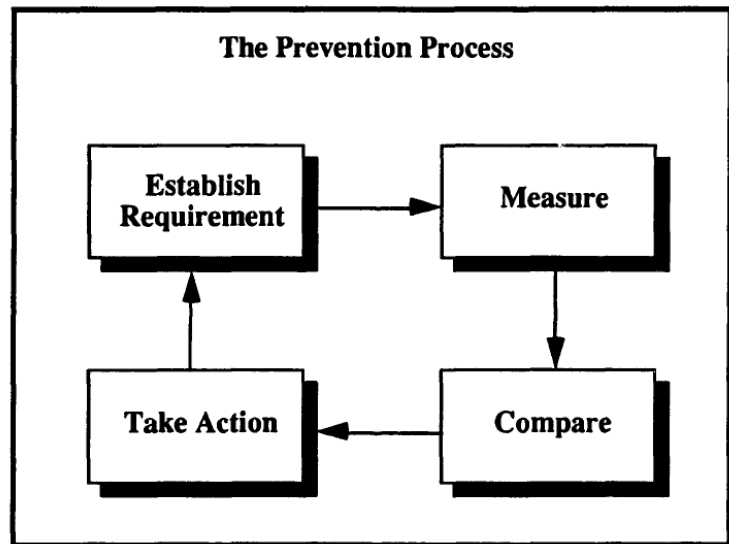
Prevention Process

Crosby's approach addresses prevention rather than inspection and correction of errors. He says that prevention involves thinking, planning and analyzing processes to anticipate where errors could occur, and then taking action to keep them from occurring.

Quality Vaccine

Crosby sees problems as 'bacteria of nonconformance' that must be 'vaccinated' with 'antibodies' to prevent problems. He has formulated a 'quality vaccine' that consists of three distinct management actions- determination, education and implementation.

- Determination surfaces when management sees the need to change and recognizes that change requires management action,
- Education is the process of providing all employees with the common language of quality, helping them to understand what their role is in the quality improvement process, as well as helping them to develop a knowledge base for preventing problems.
- Implementation consist of resources, and the support of an environment consistent with a quality improvement philosophy.



Six C's

To Crosby, education is a multi-stage process that every organization must go through, a process he calls the "Six C's".

1. **Comprehension:** Addresses the importance of understanding what is meant by quality. It must begin at the top and eventually include all employees.
2. **Commitment:** Also begins at the top and represents the stage when managers establish a quality policy.
3. **Competence:** Developing an education and training plan during this stage is critical to implementing the quality improvement process in a methodical way.
4. **Communication:** All efforts must be documented and success stories published so that complete understanding of quality of all people in the corporate culture is achieved
5. **Correction:** Focuses on prevention and performance
6. **Continuance:** Emphasizes that the process must become a way of life in the organization.

Obstacles to Implementation of TQM

- **Lack of Management Commitment:** Management should commit their time and organizational resources. The purpose must be clearly and continuously communicated to all personnel. Management should consistently apply the principles of TQM.
- **Inability to Change Organizational Culture:** Change in an organizational set up takes lot of time and Management must understand and utilize the basic concepts of change:
 - People change when they want to and to meet their own needs.
 - People need to know the reason to change
 - To change trust has to be built instead of fear.
- **Improper Planning:** All the functions and departments of the organization should involve in planning and implementation of the system. Customer satisfaction should be the goal rather than financial or sales goals.
- **Lack of Continuous Training and Education:** It is an ongoing process for everyone in the organization. Needs must be determined and a plan developed to achieve those needs.
- **Incompatible organizational structure and isolated individuals and departments:** The departments have to be restructured to make the organization more responsive. Differences between departments will make the implementation more difficult.
- **Ineffective measurement techniques and lack of access to data and results:** Whatever is being produced should be checked for the intended purpose of use. This will ensure that we are in the right direction.
- **Paying adequate attention to internal and external customers:** Organizations need to understand the changing needs and expectations of their customers. Effective feedback mechanisms should be devised to convert the needs/feedback of both internal and external customers into tangible product features and actions.
- **Inadequate use of empowerment and teamwork:** Progressive organizations depend on interdisciplinary teams to implement actions and the recommendation of these teams should be followed. Individuals should be empowered to take decisions appropriate to their levels.

Failure to continually improve: Products, Processes and services should be continually improved so that organizations stay ahead of competition. Even if people are in the right track they get run over if they are slow.

Continuous Process Improvement

In today's highly competitive and dynamic environment, organisations need to continuously change their tactics to survive and maintain their competitive advantage. Advanced technological developments and globalization are constantly presenting organisations with new products, markets and challenges. As a result, any organisation need to be forward looking when formulating business strategies. There is need to embrace change and not resist it.

The first stage in implementing successful continuous improvement is understanding the basic concepts behind it and also the benefits to the organisation. Continuous improvement is based on quality, process improvements and teamwork. The organisation needs to identify the needs of your customers first and then produce products that meet those needs. Also, there is need to leverage on technology. For example you could use IT for sending out electronic invoices as opposed to paper invoices. This will save time as well as postage money. As there is instant delivery of the invoice, there are higher chances that payment will be received early from your customer.

Also, you can collaborate with your business partners to improve processes. One of the advantages of collaborating with partners is that the process allows sharing of ideas when it comes to problem-solving. Teamwork is also essential for continuous improvement to work. Remember, "Two heads are better than one".

By promoting a culture of continuous improvement, the benefits to the organisation are many. Some of the benefits are:

- **More efficient business planning:** Because the organisation is focused on reducing waste, appropriate measures that monitor performance can be established.
- **Improvements in customer satisfaction:** When customers are satisfied, they become loyal to your business and will want to continue doing business with you. They can also refer their friends, family and other colleagues to your business.
- **Reduced waste because of better use of resources:** The saved resources e.g. time and money can then be channelled to other projects.
- **Increased profits** through a reduction in costs and an increase in revenues. Happy customers will always come back and buy more. They are also prepared to pay a premium for quality products.
- **Employees are motivated** as they feel they have to be innovative and creative to solve problems and improve business processes. Since continuous improvement is an ongoing process, employees feel challenged as they have to constantly come up with better ideas. This increases morale as there is a sense of ownership of the project.

The second stage in implementing continuous improvement is ensuring that all the essential factors for its implementation are in place. These include:

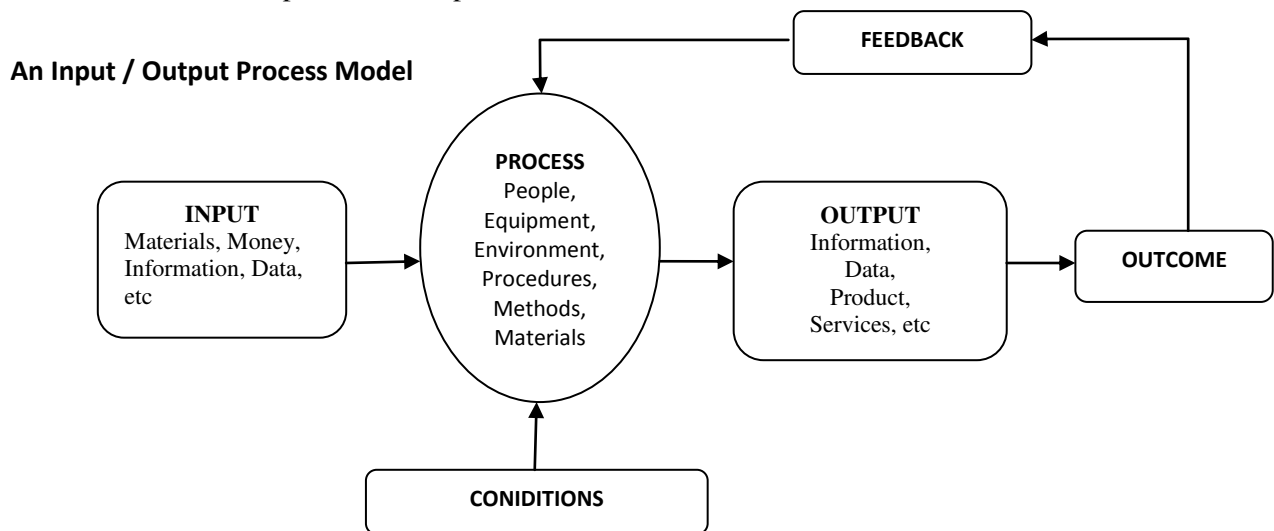
- **Understanding your businesses' environment:** This will help establish what your business does and what processes you employ to achieve your goals. An evaluation of these processes will allow for continuous improvements.
- **Commitment from senior management:** Senior managers need not just do the talking, but they should walk the journey too. This is necessary for motivating employees.
- **Ongoing monitoring of performance and contribution of employees:** Are the employees meeting the targets set or they are missing them? If they are missing targets, are they missing narrowly or not? The extent of the miss will allow for improvements to take place.
- **Good communications throughout the organisation:** Everyone should be aware of what the organisation is trying to achieve and their role in achieving the organisation's strategy.

- **Since continuous improvement is also about quality**, there is need to have recognised quality management systems: You could have a group of employees from different functions of the organisation meeting up regularly to discuss quality and quality control issues. This will help in improving quality.

By regularly monitoring the above factors and ensuring that they are in place, the organisation will always focus on the right priorities, improve performance and maintain the business advantage.

Quality based organizations should strive to achieve perfection in all activities by continuously striving to improve the business and production process.

We need to initially know what a process is: - A process is the interaction of some combination of people, materials and equipment, methods, measurement and the environment to produce and outcome such as a product, a service, or an input to another process.



For any improvement in the process has to happen,

1. All activities in the organization, either business or production process, should be viewed as a process.
2. All such processes should be made effective, efficient and adaptable.
3. By regularly anticipating changes in customer needs
4. By eliminating waste and rework in whatever activities
5. By maintaining constructive dissatisfaction with the present level of performance
6. By having progressive performance measures such as – reducing cycle time, reduction of scrap and rework, use of control charts etc.
7. By using benchmarking to improve competitive advantage.
8. By bringing in innovative breakthroughs.
9. By using technical tools such as Experimental design, Quality function deployment and so forth.

For example:

1. When Maruthi Suzuki (MS) came to India, one of the organizations from South India (SI) wanted to supply some components to MS and they quoted 3 months as the lead time for supplying that component. MS informed that it does not plan for 3 months ahead for such components and the SI company has to review its process if it wishes to enter into business with MS.
When SI reviewed its own manufacturing and delivery process, it was in for a shock. It noticed that out of the 3 months of production and delivery time, only 3 days was the active processing time and the rest was delay due to various reasons.

SI had to completely revamp the process to bring the down-times to be in business with MS. SI became a regular supplier to MS.

2. When a steel rods manufacturing company ALB wanted to supply 31 dia rods to a major textile machine manufacturing company (TMM), it was told that 31 dia rods were of very less size and they need a minimum of 34 dia.

When the same company ALB, went to approach the company TMM through an agent who had a sound knowledge about the finished sizes of TMM, it was noticed that the finished size of the component was only around 28 diameter.

- When the purchase department was approached, they said that was the specification given by the production department.
- When the production department was approached that they are able to use 31 dia rods as the finished size is only around 28 dia, but the concentricity has to be ensured. However, they are insisting on 34 dia rods because the design department has given that size.
- Ultimately the design department informed that even though there was a change in size of the finished component, the change in raw material size was not insisted.
- With the above discussion, the change in input size was brought in and the sales deal came through.
- All along, lot of scrap and waste was generated by wasting precious processing time of the machine and the men, which eventually was resulting in huge losses for the organization TMM.

The solution was the change in specifications for the raw materials.

It resulted in reduction of raw material cost by 20 % and processing cost by 35 %.

3. In an electronic component manufacturing company many types of small components in large quantities (say 10,000 pieces each) were being manufactured and all the components were 100 % inspected for soldering, colour coding, casting etc. Some components were subcontracted and incoming inspection was also 100 %. The components would come in a tray in bulk. Young men and women would inspect it and keep it in another box that had slots to keep the components in proper alignment. It is necessary that all components have to pass inspection. In spite of the 100 % inspection at least 5 to 6 % of the defectives would be in the box.

Two main deviations were observed

1. Around 5 to 6% defectives were still found in the box after inspection
2. Only 85 % of the target was met.

When investigated, the following reasons emerged.

- i. Time was getting wasted while picking up the component and aligning it for inspection. Again it had to be put in proper alignment which had slots.
- ii. Inspectors were sitting on stools without backrest and this would cause strain and fatigue.
- iii. Lighting was not to the required level and so would strain their eyes.

The solution to the problem was

- proper seating arrangement with backrest
- Proper lighting to the area of inspection
- Providing the box with slots to the suppliers so that he will keep it in proper alignment, which would aid in proper inspection.

The results

- Increase efficiency and upto 96 % of the components were inspected.
- 1 % defective were found in the box after inspection.

The various continual improvement approaches are:

1. Juran's Trilogy.
2. Shewart's Plan-Do-Study-Act cycle.
3. Kaizen approach
4. Problem Solving Methodology
5. 5 S techniques
6. Six-Sigma

Improvement strategies

Once a situation has been analysed, there are primarily four improvement strategies- repair, refinement, renovation and reinvention. Choosing the right strategy for the right situation is critical. Proper integration of the strategies will produce never ending improvements.

Repair: The strategy is set right any broken piece. The customer receives a damaged product that has to be set right at the earliest. This is a temporary and short term measure.

Refinement: This strategy involves continually improving a process that is not broken. Refinement improves effectiveness and efficiency.

For example:

- Effectiveness manufacturing components as planned in the given time. Efficiency is producing the planned components (or more) with lesser inputs are better processing methodology.
- Banks disbursing home loans of Rs. 20 crores, as planned, in the particular year is effectiveness. Disbursing Rs. 25crores is efficiency

Renovation: This strategy involves major breakthrough improvements. Although the product, service, process, or activity appears to be different from the original, it is basically the same. Example: Landlines to chord less phones.

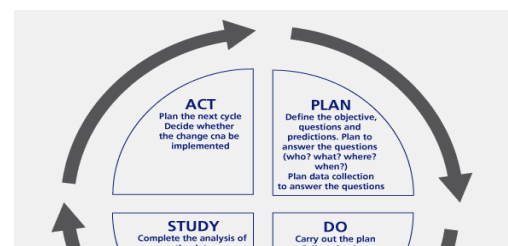
Reinvention: It is the most demanding improvement strategy. It is preceded by the feeling that the existing approach will never satisfy customer requirements. Example: Land line phones to Pagers to Mobile phones.

The repair and refinement strategies require that all employees have the freedom to solve problems and do incremental improvements in their jobs. Change is immediate and not costly. However, renovation and reinvention are effective in making breakthrough improvements.

There are five types of problems that we normally come across that need improvement.

- **Compliance:** When a system has standardized inputs and processes but the outputs is performing unacceptably. In such cases root causes have to be identified and eliminated. Ex: Manufacturing of EN 9 grade steel as per standard process. But there is a deviation in the carbon content.
- **Unstructured:** inputs and processing are time tested and followed but not contained in the standard. All activities are focused towards the customer and identification of the deviation is indicated by the customer. Woodworker adjusts his processing to the type of wood. But the outcome is not very smooth and finish is not good.
- **Efficiency:** occurs when the system is working unacceptably from the view point of the users. Ex: Two wheeler is not giving enough mileage as it was giving earlier.
- **Process Design:** It requires development of a new process or modifying an existing process. Processes become obsolete with time. Ex: Process/product layout to cellular manufacturing.
- **Product Design:** Developing new products and making improvements in existing products. Ex: Land lines to cell phones- various facilitates in cell phones.

P-D-S-A Cycle



The "Plan-Do-Study-Act" (PDSA) cycle was first developed by Shewart and modified by Deming. It is a shorthand method for testing a change — by planning it, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.

Use of PDSA cycles is a way of testing an idea by putting a change into effect on a temporary basis and learning from its potential impact. This

Approach traditionally used in healthcare settings, where new ideas are often introduced without sufficient testing.

A PDSA cycle involves testing change ideas on a small scale. By building on the learning from these test cycles in a structured and incremental way, a new idea can be implemented with a greater chance of success.

There are four stages to a PDSA cycle:

Step 1: Plan

Plan the test or observation

- State the objective
- Make predictions about what will happen and why
- Develop a plan to test the change. (Who? What? When? Where?)

Step 2: Do

Try out the test on a small scale

- Carry out the test
- Document problems and unexpected observations
- Begin analysis of the data

Step 3: Study

Set aside time to analyse the data and study the results

- Complete the analysis of the data
- Compare the data to your predictions
- Summarize and reflect on what was learned

Step 4: Act

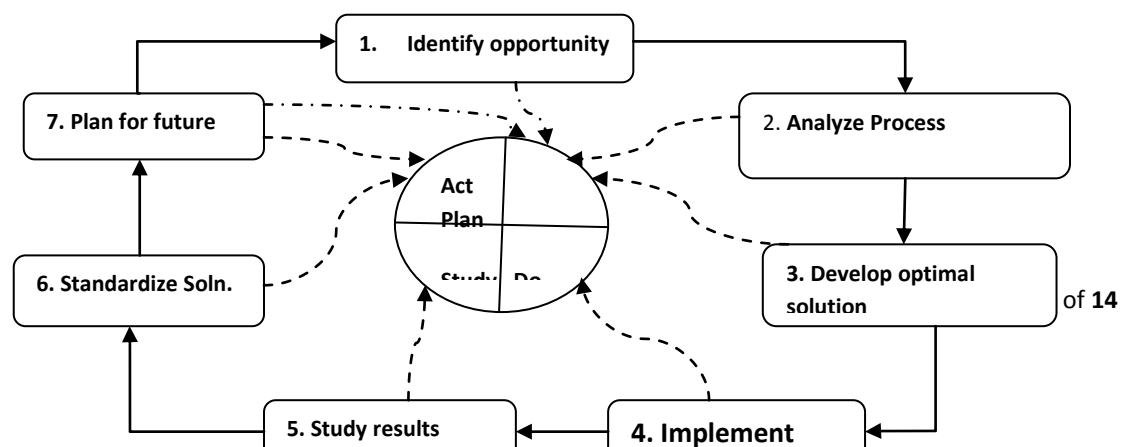
Refine the change, based on what was learnt from the test

- Determine what modifications should be made
- Prepare a plan for the next test

Problem Solving Methodology

Seven Step Problem Solving Technique

Continuous Process Improvement Cycle



Step 1. Identify the Opportunity

"Do not focus on finding an answer: focus on defining the question" Peter Drucker

It is essential for each group member to clearly understand the problem so that all energy will be focused in the same direction. Otherwise lot of time, resources and energy is spent on an unnecessary problem.

This is taken in three steps

How do you go about finding the right problems to solve?

This is the first phase of **Step 1**.

Normally it is better to focus on a problem that is resulting in maximum losses in the form of scrap, rework, processing time, additional resources, etc. We use Pareto analysis to identify problems that are contributing maximum to the deviations/losses. Other areas from which problems are identified are customer survey, employee survey, statutory requirements, brainstorming sessions etc. While considering a particular problem to solve, the following questions have to be answered.

1. Is the problem important
2. Will solving this problem contribute to attainment of goals
3. Can the problem be defined properly?

The **step 2** is to formation of a team to solve the problem. The goals and objectives of the team have to be clearly defined. Depending on the nature and enormity of the problem, the team members would be either from the same work area or from various departments.

The **step 3** is to define scope of the problem. Failure in problem solving is frequented because of poor definition of the problem.

- A problem statement clearly describes the problem as it currently exists, and is easily understood.
- It states the effect-what is wrong, when it happens, and where it is occurring, and not why it is happening and who is responsible.
- It focuses on what is known and what is unknown and what needs to be done.
- It uses facts and is free of judgment.
- It emphasizes impact on the customer.

Ex:

1. At the end of the manufacturing process it was evidenced that there are 20 % rejections.
2. While going through the hospital admission process, it indicates that there is a delay in admitting the patients to the wards.

The phase also specifies the preparation of the charter for the team i.e., Authority, Objective and scope, Composition, Direction and control and General.

Step 2 Analyse the Current Process

The objective of this phase is to understand the process and how it is currently performing. A **process flow diagram is prepared** indicating the process boundaries, inputs and suppliers, outputs and customers, process flow etc. The Level of customer satisfaction because of the process has to be measured and the root causes of the problem to be identified.

The customer requirements are considered and accordingly performance measures have to be defined. Each stage of the process has to be reviewed with respect to the performance criteria and the data needed to manage the process has to be defined. A procedure to regularly seek feedback from the customer and the supplier has to be established. Clear measures for quality/cost/timeliness of inputs and outputs have to be established.

Once performance measures are established proper data from the process has to be collected to (a) Confirm that the problem exists. (b) Enable the team work with facts. (c) Establish measurement criteria for baseline (d) to measure the effectiveness of the implemented solution.

Normally, the following information is collected

- Customer information
- Design information
- Process information
- Statistical information
- Supplier information
- Quality information

At this stage of analysis, a cause and effect relationship diagram would be effective. Determining all the causes requires experience, brainstorming sessions, a thorough knowledge of the process. The cause and effect diagram helps us to identify the root cause of the problem.

Step 3 Develop the optimal solution

In this phase the objective is establish potential and feasible solutions and recommending the best solution to improve the process. This is a creative process and Brainstorming helps to arrive at the optimal solution. Creativity lies in (i) Creating new process (ii) combining different processes (iii) modifying the existing process.

Areas of possible changes are the number and length of delays, bottlenecks, equipment, timing, and number of inspections, rework, cycle time and materials handling. Consideration should be given to combining, eliminating, rearranging, and executing simultaneously the process steps. The sources of change could be reducing cycle times, lowering inventory levels and searching for non-value-added activities.

Step 4 Implement Changes

This stage involves implementing the best option. The process involves preparing the implementation plan, obtaining approval, and implementing the process improvements.

The content of the implementation plan shall contain

- Why will it be done
- How will it be done
- When will it be done
- Who will do it
- Where will it be done

Answers to the above question will designate actions, assigns responsibilities, and establish implementation milestones. After approval of the quality council, the concurrence of the user departments

has to be considered as they are the ones who are implementing the change and following it. The final element of the implementation is the monitoring activity indicating what will be measured, who will measure it, where will the measurements be made, how will it be made and when will it be made.

Step 5 Study the Results

This phase involves study the implementation and monitoring the effectiveness and efficiency over a period of time. The team meets periodically to study the collected data and takes a decision on the implementation aspects.

Step 6 Standardize the solution

Once the team is satisfied with the implementation and working of the process, the process should be institutionalized by controlling the process, process certification and operator certification. Clearcut authority and responsibilities have to be defined to take care of the process henceforth.

Step 7 Plan for the future

In this stage, an improved level of performance is aimed at even though the implementation aspects are through.

Kaizen

Kaizen means "improvement". Kaizen strategy calls for never-ending efforts for improvement involving everyone in the organization – managers and workers alike. It is a philosophy that defines management's role in continuously encouraging and implementing small improvements involving everyone. The kaizen improvement focuses on

1. Value-added and non-value added activities.
2. Muda-seven classes of waste-Overproduction, delay, transportation, processing, inventory, wasted motion, and defective parts.
3. Principles of motion study and use of cell technology
4. Principles of material handling and single piece flow
5. Documentation of standard operating procedures
6. Five 'S' for workplace

The Five-S approach

The "5S" refers to five Japanese principles for workplace management to increase efficiency.

- a. **Seiri (Sort):** Do things in the proper order. Eliminate unnecessary items from the workplace. Keep the strict minimum.
- b. **Seiton (Set in order):** Specify a location for everything. Put things where they belong. Set in order and identify useful items in order to locate them more easily. "A place for everything and everything in its place." Designate Location by number, color coding, name. etc.
- c. **Seiso (Shine):** Specify recommended procedures for cleanup. Follow the procedures. Thoroughly clean the work area or work place.
- d. **Seiketsu (Standardize):** Standardize best practices in the work area. Keep equipment and the workplace in the best possible condition.
- e. **Shitsuke (Sustain):** Scrutinize practices; expose the wrong ones; learn correct practices and make sure you use them.

The 5 S approach is a basis for continuous improvement and can lead to less waste. The 2 S (Sort and Set in order) are the keystone for the 5S. The other 3 S (Shine, Standardize, and Sustain) are the keystone for the 2 S.

Implementation

The Five Ss are implemented through frequent grading of each work area by using an inspection check sheet. In some factories, Five-S committees conduct regular inspections of plants and departments using Five-S criteria. In other factories, the work areas evaluate themselves on a weekly basis.

All work areas are expected to continuously find ways to improve regardless of their performance. Results of evaluations are posted on bulletin boards to foster responsibility and pride. The best work areas are awarded recognition plaques.

Benefits

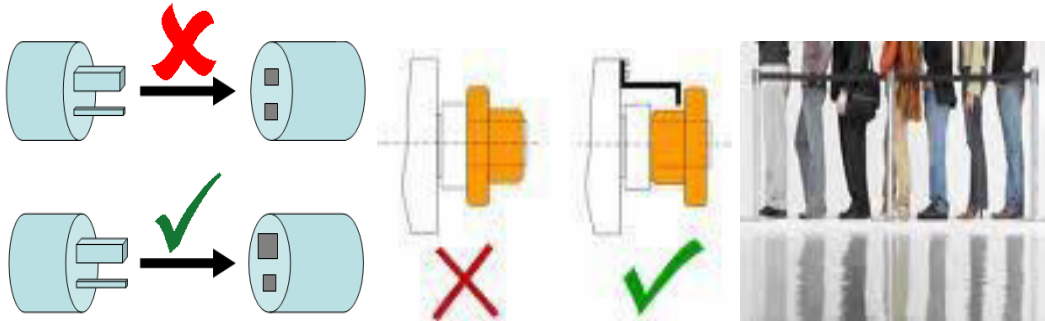
The Five-S movement helped change attitudes. Employees started readily follow workplace rules (keeping parts and tools in the right place, etc.), that previously had been difficult to employ. As a result, performance measures such as defect rates, equipment breakdowns, and number of accidents have all been improved.

7. Visual management by visual displays for better communication. Ex:
Arrangement of work place with clear names and sockets to keep tools and materials. Arrangement of files in the rack with a clear band to indicate the purpose of the file.



8. Just-in-time principles: The underlying principles namely
- Elimination of waste- covered earlier
 - Quality at the source- (Jidoka) or ensuring quality at the source ranks amongst the major JIT principles. This principle entails identification and correction of problems at the manufacturing stage itself, as soon as it occurs.
 - Simplification- using minimum resources to attain process efficiency- smooth process flow, elimination of storage space, etc.
 - Cellular Manufacturing System- The Cellular manufacturing system advocates that segmented and product focused manufacturing is much simpler than a linear process oriented manufacturing- multiple small machines instead of bulkier machines.
 - Respect for People- at all levels, be it employees (empowered to ensure smooth flow), customers (effective communication), suppliers or management (understanding requirement).

9. Poka-yoke



10. Team Dynamics- which includes problem solving, communication skills, and conflict resolution.

Utilizing the power of teams to get things done through their voluntary involvement and Contribution.



If the various departments in an organization are not working for the common goal of serving the end user, the product/service does not match the requirement of the end user. This is illustrated by the figure below.

Figure 1 indicates the understanding of the sales personnel about a product the customer wanted.

Figure 1



Figure 2 indicates how the project manager understood what the sales man explained to him.

Figure 2



Figure 3 indicates how the designer understood and designed it.



Figure 4 indicates how the production controller understood it and gave instructions for production.



Figure 3

Figure 4

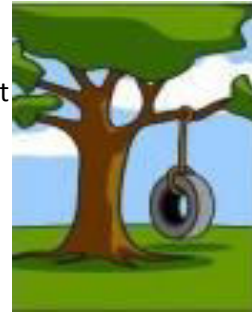
Figure 5 indicates how the manufacturer produced because it has to swing.

Figure 6 indicates what The customer really Wanted.

Figure 5



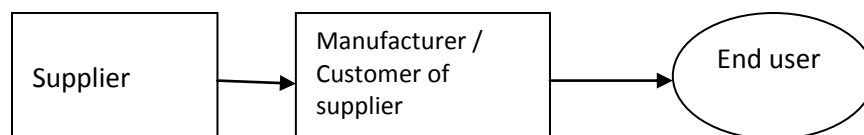
Figure 6



The figures above clearly indicate what happens when adequate, timely and relevant information is not exchanged between departments. It is also an indication of the absence of team work. All the effort taken to produce the product, the materials, and other resources are a total waste when the product produced is not appealing to the customer. Organizations have to work smart to ensure customer requirements are understood properly at all levels and the same is translated into specific technical and process requirements thereby serving what the customer wants would be easy.

Supplier Relationships

Another important aspect of TQM is the relationship an organization should have with its trading partners. Trading partners are those organizations who work together with the organization to ensure that the best reaches the customer in time in full.



In the supply chain the supplier supplies goods (Components, sub assemblies, assemblies) and services (canteen, logistics, security, etc) to the manufacturer (or customer as he purchases from him) to ensure

that the final product produced by the manufacturer reaches the end user (customer or consumer) in time without any breakages.

In any manufacturing organization, 60% of the cost of the products sold is outsourced from other organizations. In order to ensure that the manufacturer provides good products and services to the customer/end user, the supplier and the manufacturer has to have common goals and objectives regarding, quality of goods and supplies, transportation and delivery, and quantity and timing. For example, Crysler, one of the three major automobile manufacturers in USA, shares its tools such as CAD etc with its suppliers and trains them so that they match with each other and enough compatibility is available in all aspects including designing and material selection.

Just-in time supply is a concept which gaining ground and is being accepted as the norm. For example, Hyundai Motor Company keeps only a few days stock of its components and supplies. The suppliers are expected to supply good quality components in time in full to the point of use. The suppliers, as their overheads would be lesser would keep stock of their finished goods and ensure that they send their products to the manufacturer as planned. This will enable continuous production in the manufacturer's place.

Principles of Customer (manufacturer) / Supplier Relationships

1. Both the customer and supplier are responsible for the quality.
2. The customer should tell his requirement and give clear specifications for the components and supplies.
3. The supplier is responsible for the quality of goods and services offered by him.
4. The customer and the supplier should be independent of each other and should respect each other. For example: Lucas TVS will be supplying variants of a particular component to various automobile manufacturers. The customer (say Hyundai, Maruthi Suzuki, etc) should ensure that they give independence to Lucas TVS after having selected them and given them the specifications for supplying the products. At the same time Lucas TVS should ensure that the drawing and the uniqueness available in a product supplied to Hyundai is not disclosed to FORD.
5. The customer and the supplier shall enter into a contract regarding quality, quantity, price, delivery method and terms of payment.
6. A methodology should be evolved to evaluate the quality of goods.
7. Both the customer and the supplier should be continuously exchanging information in a timely manner.
8. A methodology should be available for resolution of any dispute that arises and this should be part of a contract.
9. Both parties should strive to keep the relationship healthy, active and progressive.
10. Both should have the best interest of the end user in mind.

Sourcing

A make or buy decision has to be made for each of the items by considering the following aspects.

- Technical and Economic feasibility- whether the organization is capable technically to produce the component/service inhouse or is it to be outsourced. If capable of producing, is it financially viable for the quantity required.
- Once the answer for the above question is answered, it is easy to take a decision to outsource.
- There are primarily three types of sourcing

- a. **Sole-** Due to monopoly the organization is forced to take from the supplier (for example, patents, technical specifications, raw material location, etc)
- b. **Multiple-** The theory is that this results in competition among suppliers and will help in improve quality and delivery. It will also prevent disruption of supplies.
- c. **Single-** It is a planned decision. More and more organizations are moving towards getting their materials from very few or a lone supplier and also have a long and healthy relationship with them.

Partnering

There should be a healthy partnership between the customer and the supplier to give the best to the end user. This would happen from the stage of selection of a supplier.

Selection:

Having decided to outsource, the foremost thing needed is to get a good supplier for the component/service. The following need to be checked before selecting a supplier.

- | | |
|--|---|
| 1. Criticality of the item | 7. Readiness to exchange information |
| 2. Technical knowledge of the supplier | 8. Usage of statistical techniques |
| 3. Financial capability | 9. Has a good track record |
| 4. Management commitment | 10. Has a certified quality management system |
| 5. Specialization | |
| 6. Commitment to delivery | |

Other issues with partnering are

- **Supplier certification:** It is a concept wherein the supplier is certified by the buyer to supply materials to the buyer at the point of use at the right time. The buyer will not inspect the material at his end. It is the responsibility of the supplier to supply good quality material in full quantity at the right time to the point of use. This is possible only when the supplier has a history of supplying good quality material without getting rejected by the buyer. The conditions are such that there should have been no rejections at all for a long time.
- **Supplier involvement:** Supplier is involved with the buyer from the early stages of product and component development and is able to contribute to develop the component or part and supply the same in good quality.
- **Trust and Commitment:** The supplier and the buyer will enjoy so much confidence between themselves that each of them work beyond the contract and help each other in developing a superior product/service. The supplier will be supplying similar material to other buyers and therefore he should keep the design of each buyer a secret.
- **Cross Functional Teams:** The supplier is part of a team formed by the buyer for sorting out and for improving an ongoing problems related to the product. They exchange information in a timely manner so that the end user is benefited.
- **Long Term Relationship:** Both the buyer and the supplier should work such that they maintain a healthy relationship with each other. They contribute to each one's growth. They work beyond the contract to ensure that problems are sorted out. A clear dispute resolution mechanism should be available to ensure justice to both the parties.

Supplier Rating: Suppliers are rated periodically by the buyer to know the status of the supplier with respect to his manufacturing performance (Line rejections, process control equipments available, supply rejections, penalties paid, PPM deductions, sourcing patterns, etc) and Supply performance (on time delivery, lead time, full quantity delivery, etc). Once the supplier is assessed on the above points, he is graded as an A class, B class or a C class supplier. Accordingly, the type of component and the inspection level (Normal, Tightened or Liberal) can be decided.

Four Phases of Relationship Development:

First phase: 100% inspection of all items is conducted for all critical quality characteristics.

Second Phase: Use of statistical control charts and process capability by customer on supplier performance. Random sampling is adopted by customer to audit supplier performance.

Third Phase: Supplier continues with statistical control charts and process capability on his own. Customer has complete confidence on the supplier.

Fourth phase: The customer and supplier have only identity checks on the materials and the effort is on improvement in the process.

UNIT V

QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION

INTRODUCTION

Standards give the professional a clarity of achievability. The Quality Management System has to engulf the organization so as to achieve Total Quality Management. Involvement of everyone-employee, leader and other stakeholders in a positive way will bring in success. To achieve this, the use of latest technologies like Computers, Telecommunication have become part of system organization and implementation process. This unit deals with Introduction to IS / ISO 9004 : 2000, Quality Management Systems, Guidelines for performance improvements, Quality Audits, TQM Culture, Leadership, Quality Council, Employee involvement, Motivation, Empowerment, Recognition and Reward, Information Technology Computers and quality functions, Internet and electronic communications, Information Quality Issues

LEARNING OBJECTIVES

Upon completion of this unit, you will be able to:

- Classify the quality systems
- Develop and organize Quality Management Systems
- Handle change management on culture
- Focusing on all the stakeholders
- Apply latest developments in ICT for ensuring quality in organization.

5.1 Introduction to IS / ISO 9004 : 2000

ISO 9000

The ISO 9000 Series, issued in 1987 by the International Organization for Standardization (ISO), is a set of international standards on quality and quality management. The standards are generic and not specific to any particular product. They were adopted by the American Society for Quality Control (ASQC), now American Society for Quality, and issued in the United States as the ANSI/ASQC Q90 Series (revised in 1994 as the ANSI/ASQC Q9000 Series). ISO 9000:2000 is the most recent revision of the standards.

ISO 9000 is a family of standards for quality management systems. ISO 9000 is maintained by ISO, the International Organization for Standardization and is administered by accreditation and certification bodies. For a manufacturer, some of the requirements in ISO 9001 (which is one of the standards in the ISO 9000 family) would include:

- a set of procedures that cover all key processes in the business;
- monitoring manufacturing processes to ensure they are producing quality product;
- keeping proper records;
- checking outgoing product for defects, with appropriate corrective action where necessary; and
- regularly reviewing individual processes and the quality system itself for effectiveness.

A company or organization that has been independently audited and certified to be in conformance with ISO 9001 may publicly state that it is "ISO 9001 certified" or "ISO 9001 registered." Certification to an ISO 9000 standard does not guarantee the compliance (and therefore the quality) of end products and services; rather, it certifies that consistent business processes are being applied.

Although the standards originated in manufacturing, they are now employed across a wide range of other types of organizations. A "product", in ISO vocabulary, can mean a physical object, or services, or software. In fact, according to ISO in 2004, *"service sectors now account by far for the highest number of ISO 9001:2000 certificates - about 31% of the total"*

History of ISO 9000

Pre ISO 9000

During World War II, there were quality problems in many British high-tech industries such as munitions, where bombs were going off in factories. The adopted solution was to require factories to document their manufacturing procedures and to prove by record-keeping that the procedures were being followed. The name of the standard was BS 5750, and it was known as a management standard because it did not specify what to manufacture, but how to manage the manufacturing process. According to Seddon, "In 1987, the British Government persuaded the International Standards Organisation to adopt BS 5750 as an international standard. BS 5750 became ISO 9000."

Certification

ISO does not itself certify organizations. Many countries have formed accreditation bodies to authorize certification bodies, which audit organizations applying for ISO 9001 compliance certification. It is important to note that it is not possible to be certified to ISO 9000. Although commonly referred to as ISO 9000:2000 certification, the actual standard to which an organization's quality management can be certified is ISO 9001:2000. Both the accreditation bodies and the certification bodies charge fees for their services. The various accreditation bodies have mutual agreements with each other to ensure that certificates issued by one of the Accredited Certification Bodies (CB) are accepted world-wide.

The applying organization is assessed based on an extensive sample of its sites, functions, products, services and processes; a list of problems ("action requests" or "non-compliances") is made known to the management. If there are no major problems on this list, the certification body will issue an ISO 9001 certificate for each geographical site it has visited, once it receives a satisfactory improvement plan from the management showing how any problems will be resolved.

An ISO certificate is not a once-and-for-all award, but must be renewed at regular intervals recommended by the certification body, usually around three years. In contrast to the Capability Maturity Model there are no grades of competence within ISO 9001.

Fundamentals of ISO 9000

ISO 9000 represents an evolution of traditional quality systems rather than a technical change. Whereas traditional quality systems rely on inspection of products to ensure quality, the ISO 9000-compliant quality system relies on the control and continuous improvement of the processes used to design, produce, inspect, install, and service products. In short, ISO 9000 represents a systemic tool for bringing quality processes under control. Once processes are controlled, they can be continuously improved, resulting in higher-quality products.

ISO 9000 represents a significant step beyond ensuring that specific products or services meet specifications or industry standards. It certifies that a facility has implemented a quality system capable of consistently producing quality products. That is, ISO 9000 does not certify the quality of products; it certifies the processes used to develop them.

Thus ISO 9000 is a process-oriented rather than a results-oriented standard. It affects every function, process, and employee at a facility, and it stresses management commitment to quality. But above all, it is customer-focused: It strives to meet or exceed customer expectations.

ISO 9000 is not a prescriptive standard for quality. The requirements section (ISO 9001), which covers all aspects of design, development, production, test, training, and service, is less than 10 pages long. For example, when addressing the product design process, ISO 9000 focuses on design inputs, outputs, changes, and verification. It is not meant to inhibit creative thinking.

ISO 9000 is a system quality standard that provides requirements and guidance on all aspects of a company's procedures, organization, and personnel that affect quality—from product inception through delivery to the customer. It also provides significant requirements and guidance on the quality of the output delivered to the customer. Pertinent questions are: What benefits will the proposed changes to the procedures, organization, and personnel provide to the customer? Will the proposed changes help to continuously improve product delivery schedules and product quality and reduce the amount of variance in product output?

ISO 9000 does not require inspection to verify quality, nor is it the preferred method. ISO requires that the output be verified according to documented process-control procedures. ISO 9000 does not mandate that specific statistical processes be used; it requires the user to implement appropriate statistical processes. ISO 9000 mandates product-control methods such as inspection only when process-control methods are neither practical nor feasible.

ISO 9000 does not provide industry-specific performance requirements. It provides a quality model that can be applied to virtually every industry procurement situation and is being used worldwide for commercial and, recently, government procurements.

Many suppliers already have a quality system in place, be it simple or elaborate. ISO 9000 does not require a supplier to add new or redundant requirements to an existing quality system. Rather, it requires that the supplier specify a basic,

common-sense, minimal quality system that will meet the quality needs of the customer. Thus, many suppliers find that their operative quality system already meets some or all of the ISO 9000 requirements. They only need to show that their existing procedures correspond to the relevant sections of ISO 9000.

ISO 9000 provides suppliers with the flexibility of designing a quality system for their particular type of business, market environment, and strategic objectives. It is expected that management, aided by experienced internal quality personnel and, if necessary, external ISO consultants, will determine the exact set of supplier quality requirements. To ensure the overall success of the quality program, however, the specific work procedures should be created by those actually doing the work rather than by management or ISO consultants. Although an organization's documentation of work procedures may be ISO 9000 compliant, if employees do not follow the procedures, the organization may not attain ISO 9000 certification. Drawing upon employee expertise and keeping employees involved in the process when improving and controlling procedures are critical to attaining ISO 9000 compliance.

Developing a quality system is not a sprint, but a journey, and because processes are continuously being improved, it is a journey without an end. ISO 9000 does not mandate the use of short-term motivational techniques to foster employee enthusiasm for a supplier's quality system program. Attempting to motivate employees by promising lower overhead or greater market share is not likely to be successful. Instead, it is recommended that employees be educated on how ISO 9000 standards will help them perform their jobs better and faster.

ISO 9000 emphasizes that for any quality system to be successful, top-management commitment and active involvement are essential. Management is responsible for defining and communicating the corporate quality policy. It must define the roles and responsibilities of individuals responsible for quality and ensure that employees have the proper background for their jobs and are adequately trained. Management must periodically review the effectiveness of the quality system. It should not back the effort to comply with ISO 9000 during its inception and then back down when the scope and cost of the effort is fully realized. When employees sense that management commitment has diminished, their own commitment slackens. Employees typically want out of a costly project not backed by management.

ISO 9000 does require that an organization have documented and implemented quality procedures that ensure personnel understand the quality system, that management maintain control of the system, and that internal and external audits be performed to verify the system's performance. Because ISO 9000 affects the entire organization, all employees should be given at least basic instruction in

the ISO 9000 process and its specific implementation at their facility. Training should emphasize goals, benefits, and the specific responsibilities and feedback required of each employee. ISO 9000 uses customer satisfaction as its benchmark. But the "customers" of ISO 9000-compliant processes include not only the obvious end-users of the product, but also an organization's product designers, manufacturers, inspectors, deliverers, and sales force.

Improving the processes that produce a quality product can provide an additional benefit: When the processes are well defined and constant and when employees are well trained to perform these processes, employee safety typically improves significantly. Also, during the course of improving its processes, a company often finds after close inspection that many of its processes and procedures are ineffectual and can be eliminated. Thus, while ISO 9000 requires preparation and maintenance of a formidable set of documents and records, the total paperwork of a company implementing ISO 9000 may decrease significantly in the long run. Other benefits of ISO 9000 compliance are a decrease in product defects and customer complaints and increased manufacturing yields. A final but very important by-product of implementing ISO 9000 is a heightened sense of mission at a company and an increased level of cooperation between departments.

ISO 9000 is not product-quality oriented. It does not provide criteria for separating acceptable output from defective output. Instead, it is a strategy for continuous improvement where employees meet and exceed customer quality requirements and, in doing so, continuously improve the quality of the product.

ISO 9000 recognizes that when a customer is looking at a specific part of a product (e.g., car, stereo system), he is often looking at an item (e.g., engine, stereo cabinet) provided by a subcontractor. Hence, ISO 9000 requires that a company verify that its subcontractors are providing quality items. Today, organizations with excellent quality systems often partner with their subcontractors. ISO 9000 provides an excellent framework for such a relationship, with subcontractors providing the raw materials and components of the final product.

The ISO 9000 family is a set of "quality system management" standards, the first in a set of evolving management system standards. Standards for environmental management are in place; standards for occupational safety, health management, and energy management will soon follow. These new standards will affect the space and aircraft industries just as they affect other industries.

In summary, ISO 9000 compliance provides customers with the assurance that approved raw materials for a product have been purchased and that the product

has been manufactured according to the correct specifications, assembled by trained employees, properly inspected and tested, adequately packaged for preservation, and transported in a manner that prevents damage to it en route. Overall, ISO 9000 compliance helps generate quality awareness among a company's employees, an improved competitive position for the company, an enhanced customer quality image, and increased market share and profits.

Components of the ISO 9000 Series

The ISO 9000 Series includes three standards:

- ISO 9000:2000 Quality Management Systems – Fundamentals and Vocabulary
- ISO 9001:2000 Quality Management Systems – Requirements
- ISO 9004:2000 Quality Management Systems – Guidelines for Performance Improvement

ISO 9000 family

ISO 9000 includes the following standards:

- **ISO 9000:2005, Quality management systems - Fundamentals and vocabulary.** covers the basics of what quality management systems are and also contains the core language of the ISO 9000 series of standards.
- **ISO 9001:2000 Quality management systems - Requirements** is intended for use in any organization which designs, develops, manufactures, installs and/or services any product or provides any form of service. It provides a number of requirements which an organization needs to fulfill if it is to achieve customer satisfaction through consistent products and services which meet customer expectations. This is the only implementation for which third-party auditors may grant certifications.
- **ISO 9004:2000 Quality management systems - Guidelines for performance improvements.** covers continual improvement. This gives you advice on what you could do to enhance a mature system. This standard very specifically states that it is not intended as a guide to implementation.

ISO 9002:1994 and ISO 9003:1994 were discontinued in the ISO 9000:2000 family of standards. Organizations that do not have design or manufacturing responsibilities (and were previously certified using ISO 9002:1994) will now have to use ISO 9001:2000 for certification. These organizations are allowed to exclude design and manufacturing requirements in ISO 9001:2000 based on the rules for exception given in Clause 1.2, Permissible Exclusions.

ISO Facts

The International Organization for Standardization (ISO), founded in 1946, is a global federation of national standards organizations that includes some 130 member nations:

- ISO is based in Geneva, Switzerland.
- ISO's mission is to develop standards that facilitate trade across international borders.
- In 1979, the Technical Committee 176 (ISO/TC 176) was established to create international standards for quality assurance.
- Representatives from the United States and many other countries served on the committees responsible for developing ISO 9000.
- Early in the 1990s, the chair of the consortium was a U.S. citizen from American Telephone & Telegraph (AT&T).
- The U.S. standards organization within ISO is the American National Standards Institute (ANSI).
- The American Society for Quality (ASQ) has published a U.S. version of the ISO 9000 standards under the name Q9000.
- ISO serves only as a disseminator of information on system quality.
- ISO 9000 certificates are not issued on behalf of ISO.
- ISO does not monitor the activities of ISO 9000 accreditation bodies. Monitoring is done by accreditation boards within member nations.

Philosophy of ISO 9000

ISO 9000 places the responsibility for the establishment, performance, and maintenance of a quality system directly with a company's top management:

- ISO requires the top management to define a quality policy, provide adequate resources for its implementation, and verify its performance.
- Top management must demonstrate how its employees acquire and maintain awareness of its quality policy.

The ISO 9000 process strives for generic applicability:

- No specific methods, statistical processes, or techniques are mandated.
- Emphasis is on the overall objective of meeting customer expectations regarding the output of the system quality process.
- ISO has said that it will never issue industry (product-specific) quality guidelines.

ISO 9000 strives to achieve a quality system by employing the following practices for continuous improvement:

- Prevention rather than detection by inspection
- Comprehensive review of critical process points
- Ongoing communication between the facility, its suppliers, and its customers
- Documentation of processes and quality outcomes
- Management commitment at the highest levels

ISO 9000 provides a clear definition of the management style required to achieve a "world-class" quality system:

- Formal organization that delineates responsibilities
- Documented, authorized, and enforced procedures for all key activities
- Full set of archived but periodically analyzed quality outcome records
- Set of periodic reviews to track system quality performance and plan and implement corrective actions
- Philosophy of regulating, but not eliminating, individual initiative in achieving system quality

ISO 9000 provides a facility with a formal management style leading to system quality. The measure of success in implementing system quality is determined by well-organized, well-planned, and well-executed periodic internal and external audits of the processes and quality outcomes of the facility.

The majority of ISO member nations will not mandate the adoption of the ISO 9000 standards in the foreseeable future. To date, only Australia mandates adoption of the standards.

How well the ISO standards facilitate trade in the international marketplace will determine how widespread their use becomes.

Advantages

According to *the Providence Business News* , implementing ISO often gives the following advantages:

1. Create a more efficient, effective operation
2. Increase customer satisfaction and retention
3. Reduce audits
4. Enhance marketing
5. Improve employee motivation, awareness, and morale

6. Promote international trade

Problems

A common criticism of ISO 9000 is

- the amount of money
- time
- paperwork required for registration

According to Barnes, "Opponents claim that it is only for documentation. Proponents believe that if a company has documented its quality systems, then most of the paperwork has already been completed."

The ISO 9004:2000 standard

ISO 9004:2000 goes beyond ISO 9001:2000 in that it provides guidance on how you can continually improve your business' quality management system so that it benefits not only your customers but also:

- employees
- owners
- suppliers
- society in general

By measuring these groups' satisfaction with your business, you'll be able to assess whether you're continuing to improve.

Read about ISO 9004:2000 at the British Standards Institution (BSI) website.

The ISO 9000 series, which includes 9001 and 9004, is based around eight quality management principles that the senior managers should use as a framework to improve the business:

Customer focus - they must understand and fulfil customer needs.

Leadership - they should demonstrate strong leadership skills to increase employee motivation.

Involvement of people - all levels of staff should be aware of the importance of providing what the customer requires and their responsibilities within the business.

Process approach - identifying your essential business activities and considering each one as part of a process.

System approach to management - managing your processes together as a system, leading to greater efficiency and focus. You could think of each process as a cog in a machine, helping it to run smoothly.

Continual improvement - this should be a permanent business objective.

Factual approach to decision-making - senior staff should base decisions on thorough analysis of data and information.

Mutually beneficial supplier relationships - managers should recognise that your business and its suppliers depend on each other.

As ISO 9004:2000 is a set of guidelines and recommendations, you can't be certified as achieving it.

5.2 Quality Management Systems

Quality Management System (QMS) can be defined as a set of policies, processes and procedures required for planning and Execution (Production / Development / Service) in their core business area of an Organization. QMS integrates the various internal processes within the organization and intends to provide a process approach for project execution. QMS enables the organizations to identify, measure, control and improve the various core business processes that will ultimately lead to improved business performance.

Concept of QMS

The concept of quality as we think of it now first emerged out of the Industrial Revolution. Previously goods had been made from start to finish by the same person or team of people, with handcrafting and tweaking the product to meet 'quality criteria'. Mass production brought huge teams of people together to work on specific stages of production where one person would not necessarily complete a product from start to finish. In the late 1800's pioneers such as Frederick Winslow Taylor and Henry Ford recognised the limitations of the methods being used in mass production at the time and the subsequent varying quality of output. Taylor established Quality Departments to oversee the quality of production and rectifying of errors, and Ford emphasised standardisation of design and component standards to ensure a standard product was produced. Management of quality was the responsibility of the Quality department and was implemented by Inspection of product output to 'catch defects'.

Application of statistical control came later as a result of World War production methods. Quality management systems are the outgrowth of work done by W. Edwards Deming, a statistician, after whom the Deming Prize for quality is named.

Quality, as a profession and the managerial process associated with the quality function, was introduced during the second-half of the 20th century, and has evolved since then. No other profession has seen as many changes as the quality profession.

The quality profession grew from simple control, to engineering, to systems engineering. Quality control activities were predominant in the 1940s, 1950s, and 1960s. The 1970s were an era of quality engineering and the 1990s saw quality systems as an emerging field. Like medicine, accounting, and engineering, quality has achieved status as a recognized profession.

Quality management organizations and awards

The International Organization for Standardization's ISO 9000 series describes standards for a QMS addressing the processes surrounding the design, development and delivery of a general product or service. Organisations can participate in a continuing certification process to demonstrate their compliance with the standard.

The Malcolm Baldrige National Quality Award is a competition to identify and recognize top-quality U.S. companies. This model addresses a broadly based range of quality criteria, including commercial success and corporate leadership. Once an organization has won the award it has to wait several years before being eligible to apply again.

The European Foundation for Quality Management's EFQM Excellence Model supports an award scheme similar to the Malcolm Baldrige Award for European companies.

In Canada, the National Quality Institute presents the 'Canada Awards for Excellence' on an annual basis to organisations that have displayed outstanding performance in the areas of Quality and Workplace Wellness, and have met the Institute's criteria with documented overall achievements and results.

The Alliance for Performance Excellence is a network of state, local, and international organizations that use the Malcolm Baldrige National Quality Award criteria and model at the grassroots level to improve the performance of local organizations and economies. NetworkforExcellence.org is the Alliance web site; browsers can find Alliance members in their state and get the latest news and events from the Baldrige community.

5.3 Guidelines for performance improvements

1. Purpose: The purpose of a Performance Improvement Plan is to communicate to the employee the specific job performance areas that do not meet expected standards.
2. Develop a Performance Improvement Plan:
 - a) Clearly state why the employee's job performance is a concern and how it impacts the work environment.
 - b) Summarize the facts and events that necessitate the development of a Performance Improvement Plan.
 - c) Develop specific and measurable steps to improve performance and include the employee's ideas for improvement.
 - d) Establish reasonable timelines for improved performance on each expectation.
 - e) Conduct periodic reviews on a regular basis to monitor progress being made toward the expected outcome and provide feedback.
 - f) Communicate consequences for failure to meet expectations and sustain improved performance.

3. Implement the Performance Improvement Plan:

- a) Document each step of the Performance Improvement Plan
- b) Provide constructive feedback to help the employee understand how he/she is doing and what is expected.
- c) Focus on the job and not on the person. Concentrate on a specific behavior to enable the employee to understand what you want and why.

The individual will feel less defensive.

* Example with focus on behavior: "Your report is two days late."

* Example with focus on person: "You are not very reliable about getting things done on time."

- d) Always meet with the employee and provide an opportunity for discussion and feedback.
- e) At the end of the Performance Improvement Plan period, the supervisor will determine if the process was satisfactorily completed or if progressive discipline will be implemented in conjunction with Human Resources.

5.4 Quality Audits

Quality audit means a systematic, independent examination of a quality system. Quality audits are typically performed at defined intervals and ensures that the institution has clearly-defined internal quality monitoring procedures linked to effective action. The checking determines if the quality system complies with applicable regulations or standards. The process involves assessing the standard operating procedures (SOP's) for compliance to the regulations, and also assessing the actual process and results against what is stated in the SOP.

The U.S. Food and Drug Administration requires quality auditing to be done as part of its Quality System Regulation (QSR) for medical devices, title 21 of the United States Code of Federal Regulations part 820.

The process of a Quality Audit can be managed using software tools, often Web-based.

Internal Quality auditing is an important element in ISO's quality system standard, ISO 9001. . With the upgrade of the ISO9000 series of standards from the 1994 to 2000 series, the focus of audits has shifted from procedural adherence only to measurement of the effectiveness of the Quality Management System processes to deliver in accordance with planned results.

Higher education quality audit is an approach adopted by several countries, including New Zealand, Australia, Sweden, Finland Norway and the USA. It was initiated in the UK and is a term designed to focus on procedures rather than quality.

Guidelines for Planning and Performing Quality Audits

ISO 10011-1: 1990

Quality audit objectives

- Quality audits are intended to achieve the following kinds of objectives:
 - To determine to what extent your quality system:
 - Achieves its objectives.
 - Conforms to your requirements.
 - Complies with regulatory requirements.
 - Meets customers' contractual requirements.
 - Conforms to a recognized quality standard.
 - To improve the efficiency and effectiveness of your quality management system.
 - To list your quality system in registry of an independent agency.
 - To verify that your quality system continues to meet requirements.

Professional conduct

- Auditors must behave in a professional manner. Auditors must:
 - Have integrity and be independent and objective.
 - Have the authority they need to do a proper job.
 - Avoid compromising the audit by discussing audit details with auditees during the audit.

The lead auditor's job

A lead auditor's job is to:

- Manage the audit.
- Assign audit tasks.
- Help select auditors.
- Orient the audit team.
- Prepare the audit plan.
- Define auditor qualifications.
- Clarify quality audit requirements.
- Communicate audit requirements.
- Prepare audit forms and checklists.
- Review quality system documents.
- Report major nonconformities immediately.
- Interact with auditee's management and staff.
- Prepare, submit, and discuss audit reports.

Auditor's job

- An auditor's job is to:
 - Evaluate the quality system.
 - Carry out assigned audit tasks.
 - Comply with audit requirements.
 - Respect all confidentiality requirements.
 - Collect evidence about the quality system.
 - Document audit observations and conclusions.
 - Safeguard audit documents, records, and reports.
 - Determine whether quality policy is being applied.
 - Find out if the quality objectives are being achieved.
 - See whether quality procedures are being followed.
 - Detect evidence that might invalidate audit results.

Client's job

- A client's job is to:
 - Initiate the audit process.
 - Select the auditor organization.
 - Decide whether an audit needs to be done.
 - Define the purpose and scope of the audit.
 - Ensure that audit resources are adequate.
 - Determine how often audits must be done.
 - Specify which follow-up actions the auditee should take.
 - Indicate which standards should be used to evaluate compliance.
 - Select the elements, activities, and locations that must be audited.
 - Ensure enough evidence is collected to draw valid conclusions.
 - Receive and review the reports prepared by auditors.

NOTE: A "client" is the organization that asked for the audit. The client could be an auditee, a customer, a regulatory body, or a registrar.

Auditee's job

- An auditee's job is to:
 - Explain the nature, purpose, and scope of the audit to employees.
 - Appoint employees to accompany and assist the auditors.
 - Ensure that all personnel cooperate fully with the audit team.
 - Provide the resources the audit team needs to do the audit.
 - Allow auditors to examine all documents, records, and facilities.
 - Correct and prevent problems that were identified by the audit.

NOTE: An "auditee" is the organization being audited or a member of that organization.

When to do an audit

- A client may initiate an audit because:
 - A regulatory agency requires an audit.
 - A previous audit indicated that a follow-up audit was necessary.
 - An auditee has made important changes in:
 - Policies or procedures.
 - Technologies or techniques.
 - Management or organization.
- An auditee may carry out audits on a regular basis to improve quality system performance or to achieve business objectives.

Prepare an audit plan

- The auditor should begin planning the audit by reviewing documents (e.g. manuals) that both describe the quality system and explain how it is attempting to meet quality requirements.
 - If this preliminary review shows that the quality system is inadequate, the audit process should be suspended until this inadequacy is resolved.
- Prepare an audit plan. The plan should be prepared by the lead auditor and approved by the client before the audit begins. The audit plan should:
 - Define the objectives and scope of the audit.
 - Explain how long each phase of the audit will take.
 - Specify where and when the audit will be carried out.
 - Introduce the lead auditor and his team members.
 - Identify the quality elements that will be audited.
 - Identify the groups and areas that will be audited.
 - List the documents and records that will be studied.
 - List the people who are responsible for quality and whose areas and functions will be audited.
 - Explain when meetings will be held with auditee's senior management.
 - Clarify who will get the final audit report and when it will be ready.

Perform the quality audit

- ***Start the quality audit.*** Start the audit by having an opening meeting with the auditee's senior management. This meeting should:
 - Introduce the audit team.
 - Clarify scope, objectives, and schedule.
 - Explain how the audit will be carried out.
 - Confirm that the auditee is ready to support the audit process.
- ***Prepare audit working papers.***
 - Prepare checklists (use to evaluate quality management system elements).
 - Prepare forms (use to record observations and collect evidence).
- ***Collect evidence by:***
 - Interviewing personnel.
 - Reading documents.
 - Reviewing manuals.
 - Studying records.
 - Reading reports.

- Scanning files.
- Analyzing data.
- Observing activities.
- Examining conditions.
- **Confirm interview evidence.** Evidence collected through interviews should, whenever possible, be confirmed by more objective means.
- **Investigate clues.** Clues that point to possible quality management system nonconformities should be thoroughly and completely investigated.
- **Document observations.** Auditors must study the evidence and document their observations.
- **List nonconformities.** Auditors must study their observations and make a list of key nonconformities. They must ensure that nonconformities are:
 - Supported by the evidence.
 - Cross-referenced to the standards that are being violated.
- **Draw conclusions.** Auditors must draw conclusions about how well the quality system is applying its policies and achieving its objectives.
- **Discuss results.** Auditors should discuss evidence, observations, conclusions, recommendations, and nonconformities with auditee senior managers before they prepare a final audit report.

Prepare the audit report

- **Prepare the final audit report.** The audit report should be dated and signed by the lead auditor. This report should include:
 - The detailed audit plan.
 - A review of the evidence that was collected.
 - A discussion of the conclusions that were drawn.
 - A list of the nonconformities that were identified.
 - A judgment about how well the quality system complies with all quality system requirements.
 - An assessment of the quality system's ability to achieve quality objectives and apply the quality system policy.
- **Submit the audit report.** The lead auditor should send the audit report to the client, and the client should send it to the auditee.

Follow-up steps

- **Take remedial actions.** The auditee is expected to take whatever actions are necessary to correct or prevent nonconformities.
- **Schedule follow-up audit.** Follow-up audits should be scheduled in order to verify that corrective and preventive actions were taken.

Quality Management Vs Quality Audit

In the ePMbook, we will make a distinction between Quality Management and Quality Audit.

- By Quality Management, we mean all the activities that are intended to bring about the desired level of quality.
- By Quality Audit we mean the procedural controls that ensure participants are adequately following the required procedures.

These concepts are related, but should not be confused. In particular, Quality Audit relates to the approach to quality that is laid down in quality standards such as the ISO-900x standards.

The abbreviation "QA" has been generally avoided in the ePMbook as it can mean different things - e.g. "Quality Assurance", "Quality Audit", testing, external reviews, etc.

The principle behind Quality Audit

The principles of Quality Audit, in the sense we mean it here, are based on the style of quality standards used in several formal national and international standards such as the ISO-900x international quality standards. These standards do not in themselves create quality. The logic is as follows.

Every organization should define comprehensive procedures by which their products or services can be delivered consistently to the desired level of quality. As was discussed in the section on Quality Management, maximum quality is rarely the desired objective since it can cost too much and take too long. The average product or service provides a sensible compromise between quality and cost. There is also a legitimate market for products that are low cost and low quality.

Standards authorities do not seek to make that business judgement and enforce it upon businesses, except where certain minimum standards must be met (e.g. all cars must have seat belts that meet minimum safety standards, but there is no attempt to define how elegant or comfortable they are).

The principle is that each organization should create thorough, controlled procedures for each of its processes. Those procedures should deliver the quality that is sought. The Quality Audit, therefore, only needs to ensure that procedures have been defined, controlled, communicated and used. Processes will be put in place to deal with corrective actions when deviations occur. This principle can be

applied to continuous business process operations or recurring project work. It would not be normal to establish a set of quality controlled procedures for a one-off situation since the emphasis is consistency.

This principle may be applied whether or not the organization seeks to establish or maintain an externally recognized quality certification such as ISO-900x. To achieve a certification, the procedures will be subjected to internal and external scrutiny.

Preparing for Quality Audit

Thorough procedures need to be defined, controlled, communicated and used.

Thorough	Procedures should cover all aspects of work where conformity and standards are required to achieve desired quality levels. For example, one might decide to control formal program testing, but leave the preliminary testing of a prototype to the programmer's discretion.
Procedures	Any recurring aspect of work could merit regulation. The style and depth of the description will vary according to needs and preferences, provided it is sufficiently clear to be followed.
Defined	A major tenet is that the defined procedures are good and will lead to the desired levels of quality. Considerable thought, consultation and trialing should be applied in order to define appropriate procedures. Procedures will often also require defined forms or software tools.
Controlled	As with any good quality management, the procedures should be properly controlled in terms of accessibility, version control, update authorities etc.
Communicated	All participants need to know about the defined procedures - which they exist, where to find them, what they cover. Quality reviewers are likely to check that team members understand about the procedures.
Used	The defined procedures should be followed.

	Checks will be made to ensure this is the case. A corrective action procedure will be applied to deal with shortcomings. Typically the corrective action would either be to learn the lesson for next time, or to re-work the item if it is sufficiently important.
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There is no reason why these Quality Audit techniques should conflict with the project's Quality Management processes. Where project work is recurring, the aim should be for the Quality Methods and other procedures to be defined once for both purposes.

Problems may occur where the current project has significant differences from earlier ones. Quality standards may have been set in stone as part of a quality certification. In extreme situations this can lead to wholly inappropriate procedures being forced upon the team, for example, using traditional structured analysis and design in a waterfall style approach for what would be handled best using iterative prototyping. The Project Manager may need to re-negotiate quality standards with the organization's Quality Manager.

Operating Quality Audit

A Quality Audit approach affects the entire work lifecycle:

- Pre-defined standards will impact the way the project is planned
- Quality requirements for specific work packages and deliverables will be identified in advance
- Specific procedures will be followed at all stages
- Quality Methods must be defined and followed
- Completed work and deliverables should be reviewed for compliance.

This should be seen as an underlying framework and set of rules to apply in the project's Quality Management processes.

Quality Audit reviews

Although the impact of Quality Audit will be across all parts of the lifecycle, specific Quality Audit activities tend to be applied as retrospective reviews that the Project Team correctly followed its defined procedures. Such reviews are most likely to be applied at phase end and project completion. Of course, the major drawback of such a review is that it is normally too late to affect the outcome of the work. The emphasis is often on learning lessons and fixing

administrative items. In many ways, the purpose of the review is to encourage conformity by the threat of a subsequent bad experience with the quality police.

CHARACTERISTICS OF AUDITS

What is a quality auditor and what is the purpose of a quality audit? Is a quality audit similar to a financial audit? Is an audit the same as a surveillance or inspection? These types of questions are often asked by those unfamiliar with the quality auditing profession. As far as *what* a quality auditor is, Allan J. Sayle says it best:

Auditors are the most important of the quality professionals. They must have the best and most thorough knowledge of business, systems, developments, etc. They see what works, what does not work, strengths, weaknesses of standards, codes, procedures and systems.

The purpose of a quality audit is to assess or examine a product, the process used to produce a particular product or line of products or the system supporting the product to be produced. A quality audit is also used to determine whether or not the subject of the audit is operating in compliance with governing source documentation such as corporate directives, federal and state environmental protection laws and regulations, etc. A quality audit distinguishes itself from a financial audit in that a financial audit's primary objective is to verify the integrity and accuracy of the accounting methods used within the organization. Yet, despite this basic difference, it is important to note that many of the present-day quality audit techniques have their traditional roots in financial audits.

WHO'S AUDITING WHOM?

The audit can be accomplished by three different sets of auditors and auditees: first party, second party, and third party.

First-Party Audits

The first-party audit is also known as an *internal audit* or *self audit*. It is performed within your own company. This can be a central office group auditing one of the plants, auditing within a division, local audits within the plant, or any number of similar combinations. There are no external customer-supplier audit relationships here, just internal customers and suppliers.

Second-Party Audits

A customer performs a second-party audit on a supplier. A contract is in place and goods are being, or will be, delivered. If you are in the process of approving a potential supplier through the application of these auditing techniques, you are performing a supplier survey. A survey is performed before the contract is signed; an audit is performed after the contract is signed. Second-party audits are also called *external audits*, if you are the one doing the auditing. If your customer is auditing you, it is still a second-party audit, but, since you are now on the receiving end, this is an *extrinsic* (not external) audit.

Third-Party Audits

Regulators or registrars perform third-party audits. Government inspectors may examine your operations to see if regulations are being obeyed. Within the United States, this is quite common in regulated industries, such as nuclear power stations and medical device manufacturers. Through these regulatory audits, the consumer public receives assurance that the laws are being obeyed and products are safe. Registration audits are performed as a condition of joining or being approved. Hospitals and universities are accredited by nongovernmental agencies to certain industry standards. Trade organizations may wish to promote the safety and quality of their industry products or services through an audit program and seal of approval. Other countries often use the term *certification* rather than *registration*. Businesses around the world are registering their facilities to the ISO 9001 standard in order to gain marketing advantage. Done properly, this registration promotes better business practices and greater efficiencies.

5.5 TQM Culture

Culture

Culture is the pattern of shared beliefs and values that provides the members of an organization rules of behaviour or accepted norms for conducting operations. It is the philosophies, ideologies, values, assumptions, beliefs, expectations, attitudes, and norms that knit an organization together and are shared by employees.

For example, IBM's basic beliefs are (1) respect for the individual (2) best customer service and (3) pursuit of excellence. In turn, these beliefs are operationalized in terms of strategy and customer values. In simple terms, culture provides a framework to explain "the way things are done around here".

Other examples of basic beliefs include:

Company	Basic belief
Ford	Quality is job one
Delta	A family feeling
3M	Product innovation
Lincoln electric	Wages proportionate to productivity
Caterpillar	Strong dealer support; 24-hour spare parts support around the world
McDonald's	Fast service, consistent quality

Institutionalizing strategy requires a culture that supports the strategy. For most organizations a strategy based on TQM requires a significant if not sweeping change in the way people think. Jack Welch, head of General Electric and one of the most controversial and respected executives in America, states that cultural change must be sweeping – not incremental change but “quantum”. His cultural transformation at GE calls for a “boundary-less” company where internal divisions blur, everyone works as a team, and both suppliers and customers are partners. His cultural concept of change may differ from Juran, who says that, “when it comes to quality, there is no such thing as improvement in general. Any improvement is going to come about project by project and no other way. The acknowledged experts agree on the need for a cultural or value system transformation:

Deming calls for a transformation of the American management style.

Feigenbaum suggests a pervasive improvement throughout the organization.

According to Crosby, “Quality is the result of a carefully constructed culture, it has to be the fabric of the organization”

It is not surprising that many executives hold the same opinions. In a Gallup Organization survey of 615 business executives, 43 percent rated a change in corporate culture as an integral part of improving quality. The needed change may be given different names in different companies. Robert Crandall, CEO of American Airlines, calls it an innovative environment,” while at DuPont it is “The Way People Think” and at Allied Signal “Workers attitudes had to change. Xerox specified a 5-year cultural change strategy called Leadership through Quality.

Successful organizations have a central core culture around which the rest of the company revolves. It is important for the organization to have a sound basis of core values into which management and other employees will be drawn. Without this central core, the energy of members of the organization will dissipate as they develop plans, make decisions, communicate, and carry on

operations without a fundamental criteria of relevance to guide them. This is particularly true in decisions related to quality. Research has shown that quality means different things to different people and levels in the organization. Employees tend to think like their peers and think differently from those at other levels. This suggests that organizations will have considerable difficulty in improving quality unless core values are embedded in the organization.

Commitment to quality as a core value for planning, organizing and control will be doubly difficult when a concern for the practice is lacking. Research has shown that many U.S. supervisors believe that a concern for quality is lacking among workers and managers. Where this is the case, the perceptions of these supervisors may become a self-fulfilling prophecy.

Embedding a Culture of Quality

It is one thing for top management to state a commitment to quality but quite another for this commitment to be accepted or embedded in the company. The basic vehicle for embedding an organizational culture is a teaching process in which desired behaviours and activities are learned through experiences, symbols, and explicit behaviour. Once again, the components of the total quality system provide the vehicles for change. Above all, demonstration of commitment by top management is essential. This commitment is demonstrated by behaviours and activities that are exhibited throughout the company. Categories of behaviours include:

- Signalling. Making statements or taking actions that support the vision of quality, such as mission statements, creeds, or charters directed toward customer satisfaction. Public supermarkets “Where shopping is a pleasure” and JC Penney’s “The customer is always right are examples of such statements.
- Focus. Every employee must know the mission, his or her part in it, and what has to be done to achieve it. What management pays attention to and how they react to crisis is indicative of this focus. When all functions and systems are aligned and when practice supports the culture, everyone is more likely to support the vision. Johnson and Johnson’s cool reaction to the Tylenol scare is such an example.
- Employee policies. These may be the clearest expression of culture, at least from the view point of the employee. A culture of quality can be easily demonstrated in such policies as the reward and promotion system status symbols, and other human resource actions.

Executives at all levels could learn a lesson from David T. Kearns, Chairman and Chief Executive Officer of Xerox Corporation. In an article for the academic

journal, Academy of Management Executive, he describes the change at Xerox: "At the time Leadership-Through-Quality was introduced, I told our employees that customer satisfaction would be our top priority and that it would change the culture of the company. We redefined quality as meeting the requirements of our customers. It may have been the most significant strategy xerox ever embarked on".

Among the changes brought about by the cultural change were the management style and the role of first-line management, Kearns continues: "We altered the role of first-line management from that of the traditional, dictatorial foreman to that of a supervisor functioning primarily as a coach and expeditor."

Using a modification of the Ishikawa (fishbone) diagram, Xerox demonstrated how the major component of the company's quality system was used for the transition to TQM.

5.6 Leadership

Leadership Commitment

People create results. Involving all employees is essential to the GE quality approach. GE is committed to providing opportunities and incentives for employees to focus their talents and energies on satisfying customers.

All GE employees are trained in the strategy, statistical tools and techniques of Six Sigma Quality. Training courses are offered at various levels:

- Quality Overview Seminars: basic Six Sigma awareness
- Team Training: basic tool introduction to equip employees to participate on Six Sigma teams
- Master Black Belt, Black Belt and Green Belt Training: in-depth quality training that includes high-level statistical tools, basic quality control tools, Change Acceleration Process and Flow technology tools
- Design for Six Sigma (DFSS) Training: prepares teams for the use of statistical tools to design it right the first time

Quality is the responsibility of every employee. Every employee must be involved, motivated and knowledgeable if we are to succeed.

5.7 Quality Council

Quality Control

Quality control may generally be defined as a system that is used to maintain a desired level of quality in a product or service. This task may be achieved through different measures such as planning, design, use of proper equipment and procedures, inspection, and taking corrective action in case a deviation is observed between the product, service or process output and a specified standard (ASQC 1983; Walsh et al.1986). This general area may be divided into three main subareas – namely, off-line quality control, statistical process control, and acceptance sampling plans.

Off-Line Quality Control

Off-line quality control procedures deal with measures to select and choose control label product and process parameters in such a way that the deviation between the product or process output and the standard will be minimized. Much of this task is accomplished through product and process design. The goal is to come up with a design within the constraints of resources and environmental parameters such that when production takes place, the output meets the standard. Thus, to the extent possible, the product and process parameters are set before production begins. Principles of experimental design and the Taguchi method, discussed in a later chapter, provide information on off-line process control procedures.

Statistical Process Control

Statistical process control involves comparing the output of a process or a service with a standard and taking remedial actions in case of a discrepancy between the two. It also involves determining whether a process can produce a product that meets desired specifications or requirements.

For example, to control paperwork errors in an administrative department, information might be gathered daily on the number of errors. If the observed number exceeds some specified standard, then on identification of possible causes, action should be taken to reduce the number of errors. This may involve training the administrative staff, simplifying operations if the error is of an arithmetic nature, redesigning the form, or other appropriate measures.

On-line statistical process control means that information is gathered about the product, process, or service while it is functional. When the output differs from a determined norm, corrective action is taken in that operational phase. It is

preferable to take corrective actions on a real-time basis for quality control problems. This approach attempts to bring the system to an acceptable state as soon as possible, thus minimizing either the number of unacceptable items produced or the time over which undesirable service is rendered.

One question that may come to mind is: Shouldn't all processes be controlled on an off-line basis? The answer is yes, to the extent possible. The prevailing theme of quality control is that quality has to be designed into the product or service, it cannot be inspected into it. However, in spite of taking off-line quality control measures, there may be a need for on-line quality control, because variation in the manufacturing stage of a product or the delivery stage of a service is inevitable. Therefore, some rectifying measures are needed in this phase. Ideally, a combination of off-line and on-line quality control measures will lead to a desirable level of operation.

Acceptance Sampling Plans

This branch of quality control deals with inspection of the product or service. When 100 percent inspection of all items is not feasible, a decision has to be made on how many items should be sampled or whether the batch should be sampled at all. The information obtained from the sample is used to decide whether to accept or reject the entire batch or lot. In the case of attributes, one parameter is the acceptable number of nonconforming items in the sample. If the observed number of nonconforming item is less than or equal to this number, the batch is accepted. This is known as the acceptance number. In the case of variables, one parameter may be the proportion of items in the sample that are outside the specifications. This proportion would have to be less than or equal to a standard for the lot to be accepted.

A plan that determines the number of items to sample and the acceptance criteria of the lot, based on meeting certain stipulated conditions is known as an acceptance sampling plan.

Let's consider a case of attribute inspection where an item is classified as conforming or not conforming to a specified thickness of 12 ± 0.4 mm. Suppose the items come in batches of 500 units. If an acceptance sampling plan with a sample size of 50 and an acceptance number of 3 is specified, then the interpretation of the plan is as follows. Fifty items will be randomly selected by the inspector from the batch of 500 items. Each of the 50 items will then be inspected and classified as conforming or not conforming. If the number of nonconforming items in the sample is 3 or less, the entire batch of 500 items is accepted. However, if the number of nonconforming items is greater than 3, the

batch is rejected. Alternatively, the rejected batch may be screened; that is, each item is inspected and nonconforming ones are removed.

Benefits of Quality Control

The goal of most companies is to conduct business in such a manner that an acceptable rate of return is obtained by the shareholders. What must be considered in this setting is the short-term goal versus the long-term goal. If the goal is to show a certain rate of return this coming year, this may not be an appropriate strategy, because the benefits of quality control may not be realized immediately. However, from a long-term perspective, a quality control system may lead to a rate of return that is not only better but is also sustainable.

One of the drawbacks of the manner in which many U.S. companies operate is that the output of managers is measured in short time frames. It is difficult for a manager to show an increase of a 5 percent rate of return, say, in the quarter after implementing a quality system. Top management may then doubt the benefits of quality control.

The advantages of a quality control system, however, become obvious in the long run. First and foremost is the improvement in the quality of products and services. Production improves because a well-defined structure for achieving production goals is present. Second, the system is continually evaluated and modified to meet the changing needs of the customer. Therefore, a mechanism exists to rapidly modify product or process design, manufacture, and service to meet customer requirements so that the company remains competitive. Third, a quality control system improves productivity, which is a goal of every organization. It reduces the production of scrap and rework, thereby increasing the number of usable products. Fourth, such a system reduces costs in the long run. The notion that improved productivity and cost reduction do not go hand in hand is a myth. On the contrary, this is precisely what a quality control system does achieve. With the production of fewer nonconforming items, total costs decrease, which may lead to a reduced selling price and thus increased competitiveness. Fifth, with improved productivity, the lead time for producing parts and subassemblies is reduced, which results in improved delivery dates. Once again, quality control keeps customers satisfied. Meeting their needs on a timely basis helps sustain a good relationship. Last, but not least, a quality control system maintains an "improvement" environment where everyone strives for improved quality and productivity. There is no end to this process – there is always room for improvement. A company that adopts this philosophy and uses a quality control system to help meet this objective is one that will stay competitive.

5.8 Employee involvement

Employment involvement

In a Harvard Business Review article, David Gumpert described a small “microbrewery” where the head of the company attributed their success to a loyal, small, and involved work force. He found that keeping the operation small strengthened employee cohesiveness and gave them a feeling of responsibility and pride. This anecdote tells a lot about small groups and how they can impact motivation, productivity, and quality. If quality is the objective, employee involvement in small groups and teams will greatly facilitate the result because of two reasons: motivation and productivity.

The theory of motivation, but not necessarily its practice, is fairly mature, and there is substantial proof that it can work. By oversimplifying a complex theory, it can be shown why team membership is an effective motivational device that can lead to improved quality.

Teams improve productivity as a result of greater motivation and reduced overlap and lack of communication in a functionally based classical structure characterized by territorial battles and parochial outlooks. There is always the danger that functional specialists, if left to their own devices, may pursue their own interests with little regard for the overall company mission. Team membership, particularly a cross-functional team, reduces many of these barriers and encourages an integrative systems approach to achievement of common objectives, those that are common to both the company and the team. There are many success stories. To cite a few:

- Globe Metallurgical Inc., the first small company to win the Baldrige Award, had a 380 percent increase in productivity which was attributed primarily to self-managed work teams.
- The partnering concept requires a new corporate culture of participative management and teamwork throughout the entire organization. Ford increased productivity 28 percent by using the team concept with the same workers and equipment.
- Harleysville Insurance Company’s Discovery program provides synergism resulting from the team approach. The program produced a cost saving of \$3.5 million, along with enthusiasm and involvement among employees.
- At Decision Data Computer Corporation middle management is trained to support “Pride Team”.
- Martin Marietta Electronics and Missiles Group has achieved success with performance measurement teams (PMTs).

- Publishers Press has achieved significant productivity improvements and attitude change from the company's process improvement teams (PITs).
- Florida Power and Light Company, the utility that was the first recipient of the Deming Prize, has long had quality improvement teams as a fundamental component of their quality improvement program.

5.9 Motivation



In psychology, **motivation** refers to the initiation, direction, intensity and persistence of behavior. Motivation is a temporal and dynamic state that should not be confused with personality or emotion. Motivation is having the desire and willingness to do something. A motivated person can be reaching for a long-term goal such as becoming a professional writer or a more short-term goal like learning how to spell a particular word. Personality invariably refers to more or less permanent characteristics of an individual's state of being (e.g., shy, extrovert, conscientious). As opposed to motivation, emotion refers to temporal states that do not immediately link to behavior (e.g., anger, grief, happiness).

Drive theory

There are a **number** of drive theories. The **Drive Reduction Theory** grows out of the concept that we have certain biological needs, such as hunger. As time passes the strength of the drive increases as it is not satisfied. Then as we satisfy that drive by fulfilling its desire, such as eating, the drive's strength is reduced. It is based on the theories of Freud and the idea of negative feedback systems, such as a thermostat.

There are several problems, however, that leave the validity of the Drive Reduction Theory open for debate. The first problem is that it does not explain how Secondary Reinforcers reduce drive. For example, money does not satisfy any biological or psychological need but reduces drive on a regular basis through a pay check (see: second-order conditioning). Secondly, if the drive reduction theory held true we would not be able to explain how a hungry human being can prepare a meal without eating the food before the end of the preparation. Supposedly, the drive to satiate one's hunger would drive a person to consume the food, however we prepare food on a regular basis and "ignore" the drive to eat. Thirdly, a drive is not able to be measured and therefore cannot be proven to exist in the first place (Barker 2004).

Rewards and incentives

A reward is that which is given following the occurrence of a behavior with the intention of acknowledging the positive nature of that behavior, and often with the additional intent of encouraging it to happen again. The definition of reward is not to be confused with the definition of reinforcer, which includes a measured increase in the rate of a desirable behavior following the addition of something to the environment. There are two kinds of rewards, extrinsic and intrinsic. Extrinsic rewards are external to, or outside of, the individual; for example, praise or money. Intrinsic rewards are internal to, or within, the individual; for example, satisfaction or accomplishment.

It was previously thought that the two types of motivation (intrinsic and extrinsic) were additive, and could be combined to produce the highest level of motivation. Some authors differentiate between two forms of intrinsic motivation: one based on enjoyment, the other on obligation. In this context, obligation refers to motivation based on what an individual thinks ought to be done. For instance, a feeling of responsibility for a mission may lead to helping others beyond what is easily observable, rewarded, or fun.

Intrinsic motivation

Intrinsic motivation is evident when people engage in an activity for its own sake, without some obvious external incentive present. A hobby is a typical example.

Intrinsic motivation has been intensely studied by educational psychologists since the 1970s, and numerous studies have found it to be associated with high educational achievement and enjoyment by students.

There is currently no "grand unified theory" to explain the origin or elements of intrinsic motivation. Most explanations combine elements of Bernard Weiner's attribution theory, Bandura's work on self-efficacy and other studies relating to locus of control and goal orientation. Thus it is thought that students are more likely to experience intrinsic motivation if they:

- Attribute their educational results to internal factors that they can control (eg. the amount of effort they put in, not 'fixed ability').
- Believe they can be effective agents in reaching desired goals (eg. the results are not determined by dumb luck.)
- Are motivated towards deep 'mastery' of a topic, instead of just rote-learning 'performance' to get good grades.

Note that the idea of reward for achievement is absent from this model of intrinsic motivation, since rewards are an extrinsic factor.

In knowledge-sharing communities and organizations, people often cite altruistic reasons for their participation, including contributing to a common good, a moral obligation to the group, mentorship or 'giving back'. This model of intrinsic motivation has emerged from three decades of research by hundreds of educationalists and is still evolving.

Extrinsic Motivation

Traditionally, **extrinsic motivation** has been used to motivate employees:

- Tangible rewards such as payments, promotions (or punishments).
- Intangible rewards such as praise or public commendation.

Within economies transitioning from assembly lines to service industries, the importance of intrinsic motivation rises:

- The further jobs move away from pure assembly lines, the harder it becomes to measure individual productivity. This effect is most pronounced for knowledge workers and amplified in teamwork. A lack of objective or universally accepted criteria for measuring individual productivity may make individual rewards arbitrary.
- Since by definition intrinsic motivation does not rely on financial incentives, it is cheap in terms of dollars but expensive in the fact that the inherent rewards of the activity must be internalized before they can be experienced as intrinsically motivating.

However, intrinsic motivation is no panacea for employee motivation. Problems include:

- For many commercially viable activities it may not be possible to find any or enough intrinsically motivated people.
- Intrinsically motivated employees need to eat, too. Other forms of compensation remain necessary.
- Intrinsic motivation is easily destroyed. For instance, additional extrinsic motivation is known to have a negative impact on intrinsic motivation in many cases, perceived injustice in awarding such external incentives even more so.

Telic and Paratelic motivational modes

Psychologist Michael Apter's studies of motivation led him to describe what he called the "telic" (from Greek *telos* or "goal") and "paratelic" motivational modes, or states. In the telic state, a person is motivated primarily by a particular goal or objective--such as earning payment for work done. In the paratelic mode, a person is motivated primarily by the activity itself--intrinsic motivation.

Punishment

Punishment, when referred in general, is an unfavorable condition introduced into the environment to eliminate undesirable behavior. This is used as one of the measures of Behavior Modification. Action resulting in punishment will dismotivate repetition of action.

Aggression

Aggression is generally used in the civil service area where units are devoted to maintaining law and order. In some environments officers are grounded by their superiors in order to perform better and to stay out of illegal activities.

Stress

Stress works in a strange way to motivate, like reverse psychology. When under stress and difficult situations, a person feels pressured. This may trigger feelings of under-achieving, which results in a reverse mindset, to strive to achieve. This is almost sub-conscious. The net amount motivation under stress may motivate a person to work harder in order to "compensate" for his feelings.

Secondary goals

These important biological needs tend to generate more powerful emotions and thus more powerful motivation than secondary goals. This is described in models like Abraham Maslow's hierarchy of needs. A distinction can also be made between direct and indirect motivation: In direct motivation, the action satisfies the need, in indirect motivation, the action satisfies an intermediate goal, which can in turn lead to the satisfaction of a need. In work environments, money is typically viewed as a powerful indirect motivation, whereas job satisfaction and a pleasant social environment are more direct motivations. However, this example highlights well that an indirect motivational factor (money) towards an important goal (having food, clothes etc.) may well be more powerful than the direct motivation provided by an enjoyable workplace.

Coercion

The most obvious form of motivation is coercion, where the avoidance of pain or other negative consequences has an immediate effect. When such coercion is permanent, it is considered slavery. While coercion is considered morally reprehensible in many philosophies, it is widely practiced on prisoners, students in mandatory schooling, and in the form of conscription. Critics of modern capitalism charge that without social safety networks, wage slavery is inevitable. However, many capitalists such as Ayn Rand have been very vocal against coercion. Successful coercion sometimes can take priority over other types of motivation. Self-coercion is rarely substantially negative (typically only negative in the sense that it avoids a positive, such as undergoing an expensive dinner or a period of relaxation), however it is interesting in that it illustrates how lower levels of motivation may be sometimes tweaked to satisfy higher ones.

Social and self regulation

Self control

The self-control of motivation is increasingly understood as a subset of emotional intelligence; a person may be highly intelligent according to a more conservative definition (as measured by many intelligence tests), yet unmotivated to dedicate this intelligence to certain tasks. Victor Vroom's "expectancy theory" provides an account of when people will decide whether to exert self control to pursue a particular goal. Self control is often contrasted with automatic processes of stimulus-response, as in the methodological behaviorist's paradigm of JB Watson.

Drives and desires can be described as *a deficiency or need that activates behaviour that is aimed at a goal or an incentive*. These are thought to originate within the individual and may not require external stimuli to encourage the behaviour. Basic drives could be sparked by deficiencies such as hunger, which motivates a

person to seek food; whereas more subtle drives might be the desire for praise and approval, which motivates a person to behave in a manner pleasing to others.

By contrast, the role of extrinsic rewards and stimuli can be seen in the example of training animals by giving them treats when they perform a trick correctly. The treat motivates the animals to perform the trick consistently, even later when the treat is removed from the process.

Business Application

At lower levels of Maslow's hierarchy of needs, such as Physiological needs, money is a motivator, however it tends to have a motivating effect on staff that lasts only for a short period (in accordance with Herzberg's two-factor model of motivation). At higher levels of the hierarchy, praise, respect, recognition, empowerment and a sense of belonging are far more powerful motivators than money, as both Abraham Maslow and Douglas McGregor's Theory X and theory Y have demonstrated vividly.

Maslow has money at the lowest level of the hierarchy and shows other needs are better motivators to staff. McGregor places money in his Theory X category and feels it is a poor motivator. Praise and recognition are placed in the Theory Y category and are considered stronger motivators than money.

- Motivated employees always look for better ways to do a job.
- Motivated employees are more quality oriented.
- Motivated workers are more productive.

5.10 Empowerment

Empowerment

Empowerment means investing people with authority. Its purpose is to tap the enormous reservoir of potential contribution that lies within every worker.

Empowerment is an environment in which people have the ability, the confidence and the commitment to take the responsibility and ownership to improve the process and initiate the necessary steps to satisfy the process and initiate the necessary steps to satisfy customer requirements within well defined boundaries in order to achieve organizational values and goals.

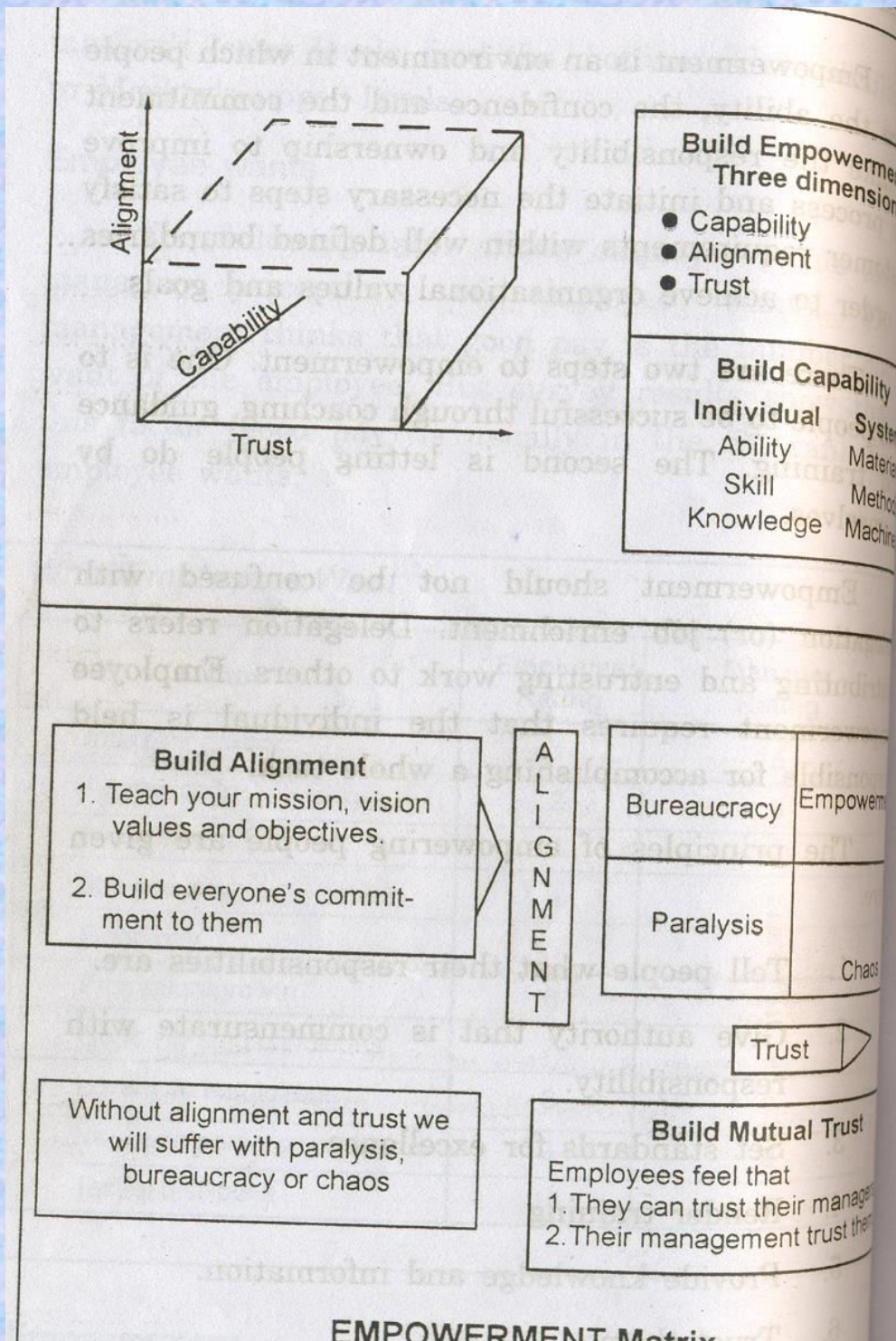
There are two steps to empowerment. One is to arm people to be successful through coaching, guidance and training. The second is letting people do by themselves.

Empowerment should not be confused with delegation (or) job enrichment. Delegation refers to distributing and entrusting work to others. Employee empowerment requires that the individual is held responsible for accomplishing a whole task.

The principles of empowering people are given here.

1. Tell people what their responsibilities are.
2. Give authority that is commensurate with responsibility.
3. Set standards for excellence.
4. Render training.
5. Provide knowledge and information.
6. Trust them.
7. Allow them to commit mistakes.
8. Treat them with dignity and respect.

The empowerment matrix is shown here.



One of the dimensions of empowerment is capability. Employees must have the ability, skills and knowledge needed to know their jobs as well as their willingness to cooperate.

A key dimension to empowerment is alignment. All employees need to know the organization's mission, vision, values, policies, objectives and methodologies. Fully aligned employees not only know their roles, they are also dedicated to attain the goals.

Once the management has developed empowerment capabilities and alignment, it can unleash the power, creativity and resourcefulness of the workforce. This is not possible without trust. Employees need to trust management and feel that management trusts them. Mutual trust therefore completes the picture required to build an empowerment workforce.

5.11 Recognition and Reward

Quality Management Philosophies:

W. Edwards Deming is best known for helping to lead the Japanese manufacturing sector out of the ruins of World War II to becoming a major presence in the world market. The highest quality award in Japan, The Deming Prize, is named in his honor. He is also known for his 14 points (a new philosophy for competing on the basis of quality), for the Deming Chain Reaction, and for the Theory of Profound Knowledge. Read more about Deming's Theory of Profound Knowledge at the MAAW web site. He also modified the Shewart cycle (Plan, Do, Check, Act) to what is now referred to as the Deming Cycle (Plan, Do, Study, Act). Beginning in the early 1980s he finally came to prominence in the United States and played a major role in quality becoming a major competitive issue in American industry. His book, *Out of the Crisis* (1986), is considered a quality classic. Read more about Dr. Deming and his philosophy at the W. Edwards Deming Institute Home Page.

Joseph Juran also assisted the Japanese in their reconstruction. Juran first became well known in the quality field in the U.S. as the editor of the *Quality Control Handbook* (1951) and later for his paper introducing the quality trilogy. While Deming's approach is revolutionary in nature (i.e. throw out your old system and "adopt the new philosophy" of his 14 points), Juran's approach is more evolutionary (i.e. we can work to improve your current system). Deming refers to statistics as being the language of business while Juran says that money is the language of business and quality efforts must be communicated to management in their language. Read more about Dr. Juran and his philosophy at the Juran Institute web site.

Phillip Crosby came to national prominence with the publication of his book, *Quality is Free*. He established the Absolutes of Quality Management which includes "the only performance standard (that makes any sense) is Zero Defects," and the Basic Elements of Improvement. Phillip Crosby Associates II, Inc. home page.

Armand Feigenbaum is credited with the creation of the idea of total quality control in his 1951 book, *Quality Control--Principles, Practice, and Administration* and in his 1956 article, "Total Quality Control." The Japanese adopted this concept and renamed it Company-Wide Quality Control, while it has evolved into Total Quality Management (TQM) in the U.S.

There are other major contributors to the quality field as we know it today. The list of major contributors would include **Walter Shewhart**, **Shigeo Shingo**, **Genichi Taguchi**, **Kaoru Ishikawa**, and **David Garvin** among others.

Quality Practice Award

The **Quality Practice Award (QPA)** is an award that is given to general practitioner practices in the United Kingdom to show recognition for high quality patient care by all members of staff in the team. It is awarded by the Royal College of General Practitioners (RCGP).

For the practice to achieve the award, evidence has to be provided that conforms to a set criteria in the following areas:

- Practice Profile
- Availability
- Clinical Care
- Communication
- Continuity of Care
- Equipment and Minor Surgery
- Health Promotion
- Information Technology
- Medical Records
- Nursing and Midwifery
- Practice Management
- Other Professional Staff
- Patient Issues
- Premises
- Prescribing/Repeat Prescribing
- The Practice as a Learning Organisation

After the evidence is completed, an onsite visit is arranged and takes place during a normal working day to assess the practice and interview the members of staff.

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- Prescribing / Repeat Prescribing
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5.12 INFORMATION TECHNOLOGY

Information Technology (IT), as defined by the Information Technology Association of America (ITAA) is: "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware." In short, IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information, securely.

In this definition, the term "information" can usually be replaced by "data" without loss of meaning. Recently it has become popular to broaden the term to explicitly include the field of electronic communication so that people tend to use the abbreviation **ICT (Information and Communication Technology)**.

The term "information technology" came about in the 1970s. Its basic concept, however, can be traced back even further. Throughout the 20th century, an alliance between the military and various industries has existed in the development of electronics, computers, and information theory. The military has historically driven such research by providing motivation and funding for innovation in the field of mechanization and computing.

The first commercial computer was the UNIVAC I. It was designed by J.Presper Eckert and John Mauchly for the U.S. Census Bureau. The late 70s saw the rise of microcomputers, followed closely by IBM's personal computer in 1981. Since then, four generations of computers have evolved. Each generation represented a step that was characterized by hardware of decreased size and increased capabilities. The first generation used vacuum tubes, the second transistors, and the third integrated circuits. The fourth (and current) generation uses more complex systems such as Very-large-scale integration.

Information technology refers to all forms of technology applied to processing, storing, and transmitting information in electronic form. The physical equipment used for this purpose includes computers, communications equipment and networks, fax machines, and even electronic pocket organizers. Information systems execute organized procedures that process and / or communicate information. We define information as a tangible or intangible entity that serves to reduce uncertainty about some state or event.

Data can originate from the internal operations of the firm and from external entities such as suppliers or customers. Data also come from external databases and services; for example, organizations purchase a great deal of marketing and competitive information. Brokerage firms provide a variety of research on different companies to clients.

An information system usually processes these data in some way and presents the results to users. With the easy availability of personal computers, users often process the output of a formal system themselves in an ad hoc manner. Human interpretation of information is extremely important in understanding how an organization reacts to the output of a system. Different results may mean different things to two managers. A marketing manager may use statistical programs and graphs to look for trends or problems with sales. A financial manager may see a problem with cash flow given the same sales data. The recipient of a system's output may be an individual, as in the example of the marketing manager, or it may be a workgroup.

Many systems are used routinely for control purposes in the organization and require limited decision making. The accounts receivable application generally runs with little senior management oversight. It is a highly structured application with rules that can be followed by a clerical staff. A department manager handles exceptions. The output of some systems may be used as a part of a program or strategy. The system itself could be implementing a corporate strategy, such as simplifying the customer order process. A system might help managers make decisions.

Information technology, however, extends far beyond the computational capabilities of computers. Today computers are used extensively for communications as well as for their traditional roles of data

storage and computation. Many computers are connected together using various kinds of communications lines to form networks. There are more than 43 million host computers, for example, on the Internet, and over 100 million computers around the world access it, an estimated 70 million of which are in the U.S. Through a network, individuals and organizations are linked together, and these linkages are changing the way we think about doing business. Boundaries between firms are breaking down from the electronic communications link provided by networks. Firms are willing to provide direct access to their systems for suppliers and customers. If the first era of computing was concerned with computation, the second era is about communications.

Manager and the IT

Managers are involved in a wide range of decisions about technology, decisions that are vital to the success of the organization. Some 45 to 50 percent of capital investment in the U.S. is for information, according to the Department of Commerce and other sources; Business Week estimate that there are 63 PCs per 100 workers in the U.S. (including machines at home), and others have estimated that one in three U.S. workers uses a computer on the job. A recent survey of 373 senior executives at large U.S. and Japanese companies found that 64 percent of the U.S. managers said they must use computers in their jobs. Other surveys have suggested that as many as 88 percent of managers use computers. One estimate is that in 1996, U.S. firms spent \$500 billion on information technology while the IT bill for the world was \$1 trillion. Because this technology is so pervasive, managers at all levels and in all functional areas of the firm are involved with IT. Managers are challenged with decisions about:

- The use of technology to design and structure the organization.
- The creation of alliances and partnerships that include electronic linkages. There is a growing trend for companies to connect with their customers and suppliers, and often with support service providers like law firms.
- The selection of systems to support different kinds of workers. Stockbrokers, traders and others use sophisticated computer-based workstations in performing their jobs. Choosing a vendor, designing the system, and implementing it are major challenges for

management.

- The adoption of groupware or group-decision support systems for workers who share a common task. In many firms, the records of shared materials constitute one type of knowledge base for the corporation.
- Determining a World Wide Web Strategy. The Internet and World Wide Web offer ways to provide information, communicate, and engage in commerce. A manager must determine if and how the firm can take advantage of the opportunities provided by the Web.
- Routine transactions processing systems. These applications handle the basic business transactions, for example, the order cycle from receiving a purchase order through shipping goods, invoicing, and receipt of payment. These routine systems must function for the firm to continue in business. More often today managers are eliminating physical documents in transactions processing and substituting electronic transmission over networks.
- Personal support systems. Managers in a variety of positions use personal computers and networks to support their work.
- Reporting and control. Managers have traditionally been concerned with controlling the organization and reporting results to management, shareholders, and the public. The information needed for reporting and control is contained in one or more databases on an internal computer network. Many reports are filed with the government and can be accessed through the Internet and the World Wide Web, including many 10K filings and other SEC-required corporate reports.
- Automated production processes. One of the keys to competitive manufacturing is increasing efficiency and quality through automation. Similar improvements can be found in the services sector through technologies such as image processing, optical storage, and workflow processing in which paper is replaced by electronic images shared by staff members using networked workstations.
- Embedded products. Increasingly, products contain embedded intelligence. A modern automobile may contain six or more computers on chips, for example, to control the engine and climate, compute statistics, and manage an antilock brake and traction control system. A colleague remarked a few years ago that his washing machine today contained more logic than the first

computer he worked on.

Major Trends

In the past few years, six major trends have drastically altered the way organizations use technology. These trends make it imperative that a manager become familiar with both the use of technology and how to control it in the organization.

1. The use of technology to transform the organization. The cumulative effect of what all the technology firms are installing is to transform the organization and allow new types of organizational structures. Sometimes the transformation occurs slowly as one unit in an organization begins to use groupware. In other cases, like Kennametal or Oticon, a Danish firm. The firm is totally different after the application of technology. This ability of information technology to transform organizations is one of the most powerful tools available to a manager today.
2. The use of information processing technology as a part of corporate strategy. Firms like Bron Passot are implementing information systems that give them an edge on the competition. Firms that prosper in the coming years will be managed by individuals who are able to develop creative, strategic applications of the technology.
3. Technology as a pervasive part of the work environment. From the largest corporations to the smallest business, we find technology is used to reduce labor, improve quality, provide better customer service, or change the way the firm operates. Factories use technology to design parts and control production. The small auto-repair shop uses a packaged personal computer system to prepare work orders and bills for its customers. The body shop uses a computer-controlled machine with lasers to take measurements so it can check the alignment of automobile suspensions, frames, and bodies. In this text we shall see a large number of examples of how technology is applied to change and improve the way we work.
4. The use of technology to support knowledge workers. The personal computer has tremendous appeal. It is easy to use and has a variety of powerful software programs available that can dramatically increase the user's productivity. When connected to a network within the organization and to the Internet, it is tremendous tool for knowledge workers.
5. The evolution of the computer from a computational device to a medium for communications. Computers first replaced punched card equipment and were used for purely computational tasks. From the large centralized computers, the technology evolved into desktop, personal

computers. When users wanted access to information stored in different locations, companies developed networks to link terminals and computers to other computers. These networks have grown and become a medium for internal and external communications with other organizations. For many workers today, the communications aspects of computers are more important than their computational capabilities.

6. The growth of the Internet and World Wide Web. The Internet offers a tremendous amount of information on-line, information that you can search from your computer. Network link people and organizations together, greatly speeding up the process of communications. The Internet makes expertise available regardless of time and distance, and provides access to information at any location connected to the Internet. Companies can expand their geographic scope electronically without having to open branch offices. The Internet leads naturally to electronic commerce-creating new ways to market, contract for, and complete transactions.

What does all this mean for the management student? The manager must be a competent user of computers and the Internet, and learn to manage information technology. The personal computer connected to a network is as commonplace in the office as the telephone has been for the past 75 years. Managers today are expected to make information technology an integral part of their jobs. It is the manager, not the technical staff member, who must come up with the idea for a system, allocate resources, and see that systems are designed well to provide the firm with a competitive edge. You will have to recognize opportunities to apply technology and then manage the implementation of the new technology. The success of information processing in the firm lies more with top and middle management than with the information services department.

Information technology today

Today, the term Information Technology has ballooned to encompass many aspects of computing and technology, and the term is more recognizable than ever before. The Information Technology umbrella can be quite large, covering many fields. IT professionals perform a variety of duties that range from installing applications to designing complex computer networks and information databases. A few of the duties that IT professionals perform may include:

- Data Management

- Computer Networking
- Database Systems Design
- Software design
- Management Information Systems
- Systems management

History of Information Technology

The term "information technology" came about in the 1970s. Its basic concept, however, can be traced back even further. Throughout the 20th century, an alliance between the military and various industries has existed in the development of electronics, computers, and information theory. The military has historically driven such research by providing motivation and funding for innovation in the field of mechanization and computing.

The first commercial computer was the UNIVAC 1. It was designed by J. Presper Eckert and John Mauchly for the U.S. Census Bureau. The late 70s saw the rise of microcomputers, followed closely by IBM's personal computer in 1981. Since then, four generations of computers have evolved. Each generation represented a step that was characterized by hardware of decreased size and increased capabilities. The first generation used vacuum tubes, the second transistors, and the third integrated circuits. The fourth (and current) generation uses more complex systems such as Very-large-scale integration.

- **Four basic periods:** Characterized by a principal technology used to solve the input, processing, output and communication problems of the time:
 1. Premechanical,
 2. Mechanical,
 3. Electromechanical, and
 4. Electronic

A. The Premechanical Age: 3000 B.C. -1450 A.D.

1. Writing and Alphabets--communication.
2. Paper and Pens--input technologies
3. Books and Libraries: Permanent Storage Devices.
4. The First Numbering Systems.

5. The First Calculators: The Abacus.

B. The Mechanical Age: 1450 - 1840

1. The First Information Explosion.
2. The first general purpose "computers"
3. Slide Rules, the Pascaline and Leibniz's Machine
4. Babbage's Engines The Difference Engine, The Analytical Engine.

C. The Electromechanical Age: 1840 - 1940.

The discovery of ways to harness electricity was the key advance made during this period. Knowledge and information could now be converted into electrical impulses.

1. The Beginnings of Telecommunication

1. Voltaic Battery.

1. Late 18th century.

2. Telegraph.

1. Early 1800s.

3. Morse Code.

1. Developed in 1835 by Samuel Morse
2. Dots and dashes.

4. Telephone and Radio.

5. Followed by the discovery that electrical waves travel through space and can produce an effect far from the point at which they originated.

6. These two events led to the invention of the radio

1. Guglielmo Marconi
2. 1894

2. Electromechanical Computing

1. Herman Hollerith and IBM

2. Mark

1. Howard Aiken, a Ph.D. student at Harvard University
2. Built the Mark I
 1. Completed January 1942
 2. 8 feet tall, 51 feet long, 2 feet thick, weighed 5 tons, used about

750,000 parts

D. The Electronic Age: 1940 - Present.

1. First Tries.

- * Early 1940s

- * Electronic vacuum tubes.

2. Eckert and Mauchly.

1. The First High-Speed, General-Purpose Computer Using Vacuum Tubes:

Electronic Numerical Integrator and Computer (ENIAC)

The ENIAC team (Feb 14, 1946). Left to right: J. Presper Eckert, Jr.; John Grist Brainerd; Sam Feltman; Herman H. Goldstine; John W. Mauchly; Harold Pender; Major General G. L. Barnes; Colonel Paul N. Gillon.

- Electronic Numerical Integrator and Computer (ENIAC)
 - 1946.
 - Used vacuum tubes (not mechanical devices) to do its calculations.
 - Hence, first electronic computer.
 - Developers John Mauchly, a physicist, and J. Prosper Eckert, an electrical engineer
- The Moore School of Electrical Engineering at the University of Pennsylvania
 - Funded by the U.S. Army.
 - But it could not store its programs (its set of instructions)
- 2. The First Stored-Program Computer(s)
 - Early 1940s, Mauchly and Eckert began to design the EDV AC the Electronic Discreet Variable Computer.
 - John von Neumann's influential report in June 1945:
 - "The Report on the EDV AC"
 - British scientists used this report and outpaced the Americans.
 - Max Newman headed up the effort at Manchester University
 - Where the Manchester Mark I went into operation in June 1948--becoming the first stored-program computer.
 - Maurice Wilkes, a British scientist at Cambridge University, completed the ED SAC (Electronic Delay Storage Automatic Calculator) in 1949--two years before EDV AC was finished.

- Thus, EDSAC became the first stored-program computer in general use (i.e., not a prototype).
- 4. The First General-Purpose Computer for Commercial Use: Universal Automatic Computer (UNIVAC)
 - Late 1940s, Eckert and Mauchly began the development of a computer called UNIVAC (Universal Automatic Computer)
 - Remington Rand.
 - First UNIVAC delivered to Census Bureau in 1951.
 - But, a machine called LEO (Lyons Electronic Office) went into action a few months before UNIVAC and became the world's first commercial computer.

THE FOUR GENERATIONS OF DIGITAL COMPUTING

1. The First Generation (1951-1958)

1. Vacuum tubes as their main logic elements.
2. Punch cards to input and externally store data.
3. Rotating magnetic drums for internal storage of data and programs
 1. Programs written in
 1. Machine language
 2. Assembly language
 1. Requires a compiler.

2. The Second Generation (1959-1963).

1. Vacuum tubes replaced by transistors as main logic element.
 1. AT&T's Bell Laboratories, in the 1940s
 2. Crystalline mineral materials called semiconductors could be used in the design of a device called a transistor
2. Magnetic tape and disks began to replace punched cards as external storage devices.
3. Magnetic cores (very small donut-shaped magnets that could be polarized in one of two directions to represent data) strung on wire within the computer became the primary internal storage technology.
 1. High-level programming languages
 1. E.g., FORTRAN and COBOL

3. The Third Generation (1964-1979).

1. Individual transistors were replaced by integrated circuits.
 2. Magnetic tape and disks completely replace punch cards as external storage devices.
 3. Magnetic core internal memories began to give way to a new form, metal oxide semiconductor (MOS) memory, which, like integrated circuits, used silicon-backed chips.
- **Operating systems**
 - Advanced programming languages like BASIC developed.
 - Which is where Bill Gates and Microsoft got their start in 1975.

2. The Fourth Generation (1979- Present).

1. Large-scale and very large-scale integrated circuits (LSIs and VLSICs)
 2. Microprocessors that contained memory, logic, and control circuits (an entire CPU = Central Processing Unit) on a single chip.
 - Which allowed for home-use personal computers or pes, like the Apple (II and Mac) and IBM pc.
- Apple II released to public in 1977, by Stephen Wozniak and Steven Jobs.
 - Initially sold for \$1,195 (without a monitor); had 16k RAM.
 - First Apple Mac released in 1984.
 - IBM PC introduced in 1981.
 - Debuts with MS-DOS (Microsoft Disk Operating System)
 - Fourth generation language software products
 - E.g., Visicalc, Lotus 1-2-3, dBase, Microsoft Word, and many others.
 - Graphical User Interfaces (GUI) for PCs arrive in early 1980s

Transforming Organizations

How is information technology changing organizations? One impact of IT, is its use to develop new organizational structures. The organization that is most likely to result from the use of these variables is the T-Form or Technology-Form organization, an organization that uses IT to become

highly efficient and effective.

The firm has a flat structure made possible by using e-mail and groupware (programs that help coordinate people with a common task to perform) to increase the span of control and reduce managerial hierarchy. Employees coordinate their work with the help of electronic communications and linkages. Supervision of employees is based on trust because there are fewer face-to-face encounters with subordinates and colleagues than in today's organization. Managers delegate tasks and decision making to lower levels of management, and information systems make data available at the level of management where it is needed to make decisions. In this way, the organization provides a fast response to competitors and customers. Some members of the organization primarily work remotely without having a permanent office assigned.

The company's technological infrastructure features networks of computers. Individual client workstations connect over a network to larger computers that act as servers. The organization has an internal Intranet, and internal client computers are connected to the Internet so members of the firm can link to customers, suppliers, and others with whom they need to interact. They can also access the huge repository of information contained on the Internet and the firm's own Intranet.

Technology-enabled firms feature highly automated production and electronic information handling to minimize the use of paper and rely extensively on images and optical data storage. Technology is used to give workers jobs that are as complete as possible. In the office, companies will convert assembly line operations for processing documents to a series of tasks that one individual or a small group can perform from a workstation. The firm also adopts and uses electronic agents, a kind of software robot, to perform a variety of tasks over networks.

These organizations use communications technology to form temporary task forces focused on a specific project. Technology like e-mail and groupware facilitate the work of these task forces. These temporary workgroups may include employees of customers, suppliers, and/or partner corporations; they form a virtual team that meets electronically to work on a project.

The organization is linked extensively with customers and suppliers.

There are numerous electronic customer / supplier relationships. These linkages increase responsiveness, improve accuracy, reduce cycle times, and reduce the amount of overhead when firms do business with each other. Suppliers access customer computers directly to learn of their needs for materials, then deliver raw materials and assemblies to the proper location just as they are needed. Customers pay many suppliers as the customer consumes materials, dispensing with invoices and other documents associated with a purchase transaction.

The close electronic linking of companies doing business together creates virtual components where traditional parts of the organization appear to exist, but in reality exist in a novel or unusual manner. For example, the traditional inventory of raw materials and subassemblies is likely not to be owned or stored by a manufacturing firm. This virtual inventory actually exists at suppliers' locations. Possibly the subassemblies will not exist at all; suppliers will build them just in time to provide them to the customer. From the customer's standpoint, however, it appears that all needed components are in inventory because suppliers are reliable partners in the production process.

This model of a technology-enabled firm shows the extent to which managers can apply IT to transforming the organization. The firms that succeed in the turbulent environment of the 21st century will take advantage of information technology to create innovative organizational structures. They will use IT to develop highly competitive products and services, and will be connected in a network with their customers and suppliers. The purpose of this book is to prepare you to manage in this technologically sophisticated environment of the 21st century.

The Challenge of Change

A major feature of information technology is the change that IT brings. Those who speak of a revolution from technology are really talking about change. Business and economic conditions change all the time; a revolution is a discontinuity, an abrupt and dramatic series of changes in the natural evolution of economies. In the early days of technology, change was gradual and often not particularly significant. The advent of personal computers accelerated the pace of change, and when the Internet became available for profit-making activities around 1992, change became exponential and revolutionary. To a great extent, your study of

information technology is a study of change.

In what way can and does technology change the world around us? The impact of IT is broad and diverse; some of the changes it brings are profound. Information technology has demonstrated an ability to change or create the following:

- Within Organizations

Create new procedures, workflows, the knowledge base, products and services, and communications.

- Organizational structure

Facilitate new reporting relationships, increased spans of control, local decision rights, supervision, the formation of divisions, geographic scope, and "virtual" organizations.

- Interorganizational relations

Create new customer-supplier relations, partnerships, and alliances.

- The economy

Alter the nature of markets through electronic commerce, disintermediation, new forms of marketing and advertising, partnerships and alliances, the cost of transactions, and modes of governance in customer-supplier relationships.

- Education

Enhance "on campus" education through videoconferencing, e-mail, electronic meetings, groupware, and electronic guest lectures.

Facilitate distance learning through e-mail, groupware, and videoconferencing. Provide access to vast amounts of reference material; facilitate collaborative projects independent of time zones and distance.

- National development

Provide small companies with international presence and facilitate commerce.

Make large amounts of information available, perhaps to the consternation of certain governments.

Present opportunities to improve education.

Information technology today

Today, the term Information Technology has ballooned to encompass many aspects of computing and technology, and the term is more recognizable than ever before. The Information Technology umbrella can be quite large, covering many fields. IT professionals perform a variety

of duties that range from installing applications to designing complex computer networks and information databases. A few of the duties that IT professionals perform may include:

- Data Management
- Computer Networking
- Database Systems Design
- Software design
- Management Information Systems
- Systems management

A more extensive list of related topics is provided below.

Worldwide

World Information Technology and Services Alliance (WITSA) is a consortium of over 60 information technology (IT) industry associations from economies around the world. Founded in 1978 and originally known as the World Computing Services Industry Association, WITSA has increasingly assumed an active advocacy role in international public policy issues affecting the creation of a robust global information infrastructure.

5.13 COMPUTER AND QUALITY FUNCTIONS

This section examines the extent to which computer-based systems are organized to enhance or degrade the quality of working life for clerks, administrative staff, professionals, and managers. Worklife merits a lot of attention for four reasons.

First, work is a major component of many people's lives. Wage income is the primary way that most people between the ages of 22 and 65 obtain money for food, housing, clothing, transportation, etc. The United States' population is about 260,000,000, and well over 110,000,000 work for a living. So, major changes in the nature of work the number of jobs, the nature of jobs, career opportunities, job content, social relationships at work, working conditions of various kinds can affect a significant segment of society.

Second, in the United States, most wage earners work thirty to sixty hours per week-a large fraction of their waking lives. And people's experiences at work, whether good or bad, can shape other aspects of their

lives as well. Work pressures or work pleasures can be carried home to families. Better jobs give people some room to grow when they seek more responsible, or complex positions, while stifled careers often breed boredom and resentment in comparably motivated people. Although people vary considerably in what kinds of experiences and opportunities they want from a job, few people would be thrilled with a monotonous and socially isolated job, even if it were to pay very well.

Third, computerization has touched more people more visibly in their work than in any other kind of setting--home, schools, churches, banking, and so on. Workplaces are good places to examine how the dreams and dilemmas of computerization really work out for large numbers of people under an immense variety of social and technical conditions.

Fourth, many aspects of the way that people work influence their relationships to computer systems, the practical forms of computerization, and their effects. For example, in our last section, Steven Hodas argued that the tenuousness of many teachers' classroom authority could discourage them from seeking computer supported instruction in their classes. Also, Martin Baily and Paul Attewell argued that computerization has had less influence on the productivity of organizations because people integrate into their work so as to provide other benefits to them, such as producing more professional-looking documents and enhancing their esteem with others, or managers becoming counterproductive control-freaks with computerized reports.

When specialists discuss computerization and work, they often appeal to strong implicit images about the transformations of work in the last one hundred years, and the role that technologies have played in some of those changes. In nineteenth century North America, there was a major shift from farms to factories as the primary workplaces. Those shifts--often associated with the industrial revolution--continued well into the early twentieth century. Industrial technologies such as the steam engine played a key role in the rise of industrialism. But ways of organizing work also altered significantly. The assembly line with relatively high-volume, low-cost production and standardized, fragmented jobs was a critical advance in the history of industrialization. During the last 100 years, farms also were increasingly mechanized, with motorized tractors, harvesters and other powerful equipment replacing horse-drawn plows and hand-held

tools. The farms also have been increasingly reorganized. Family farms run by small groups have been dying out, and have been bought up (or replaced by) huge corporate farms with battalions of managers, accountants, and hired hands.

Our twentieth century economy has been marked by the rise of human service jobs, in areas such as banking, insurance, travel, education, and health. And many of the earliest commercial computer systems were bought by large service organizations such as banks and insurance companies. (By some estimates, the finance industries bought about 30% of the computer hardware in the United States in the 1980s.) During the last three decades, computer use has spread to virtually every kind of workplace, although large firms are still the dominant investors in computer-based systems. Since offices are the predominant site of computerization, it is helpful to focus on offices in examining the role that these systems play in altering work.

Today, the management of farms and factories is frequently supported with computer systems in their offices. Furthermore, approximately 50% of the staff of high tech manufacturing firms are white collar workers who make use of such systems--engineers, accountants, marketing specialists, etc. There is also some computerization in factory production lines through the introduction of numerically controlled machine tools and industrial robots. And certainly issues such as worklife quality and managerial control are just as real on the shop floor as in white collar areas (See Shaiken, 1986; Zuboff, 1988). While the selections here examine white collar work, the reader can consider the parallels between the computerization of TCP is responsible for breaking up the message into datagrams, reassembling the datagrams at the other end, resending anything that gets lost, and putting things back in the right order. IP is responsible for routing individual datagrams. The datagrams are individually identified by a unique sequence number to facilitate reassembly in the correct order. The whole process of transmission is done through the use of routers. Routing is the process by which two communication stations find and use the optimum path across any network of any complexity. Routers must support fragmentation, the ability to subdivide received information into smaller units where this is required to match the underlying network technology. Routers operate by recognizing that a particular network number relates to a specific area within the interconnected networks. They keep track of the numbers

throughout the entire process.

Domain Name System

The addressing system on the Internet generates IP addresses, which are usually indicated by numbers such as 128.201.86.290. Since such numbers are difficult to remember, a user-friendly system has been created known as the Domain Name System (DNS). This system provides the mnemonic equivalent of a numeric IP address and further ensures that every site on the Internet has a unique address. For example, an Internet address might appear as crito.uci.edu. If this address is accessed through a Web browser, it is referred to as a URL (Uniform Resource Locator), and the full URL will appear as <http://www.crito.uci.edu>.

The Domain Name System divides the Internet into a series of component networks called domains that enable e-mail (and other files) to be sent across the entire Internet. Each site attached to the Internet belongs to one of the domains. Universities, for example, belong to the "edu" domain. Other domains are gov (government), com (commercial organizations), mil (military), net (network service providers), and org (nonprofit organizations).

World Wide Web

The World Wide Web (WWW) is based on technology called hypertext. The Web may be thought of as a very large subset of the Internet, consisting of hypertext and hypermedia documents. A hypertext document is a document that has a reference (or link) to another hypertext document, which may be on the same computer or in a different computer that may be located anywhere in the world. Hypermedia is a similar concept except that it provides links to graphic, sound, and video files in addition to text files.

In order for the Web to work, every client must be able to display every document from any server. This is accomplished by imposing a set of standards known as a protocol to govern the way that data are transmitted across the Web. Thus data travel from client to server and back through a protocol known as the HyperText Transfer Protocol (http). In order to access the documents that are transmitted through this protocol, a special

Technological features

The Internet 's technological success depends on its principal communication tools, the Transmission Control Protocol (TCP) and the Internet Protocol (IP). They are referred to frequently as TCP/IP. A protocol is an agreed-upon set of conventions that defines the rules of communication. TCP breaks down and reassembles packets, whereas IP is responsible for ensuring that the packets are sent to the right destination.

Data travels across the Internet through several levels of networks until it reaches its destination. E-mail messages arrive at the mail server (similar to the local post office) from a remote personal computer connected by a modem, or a node on a local-area network. From the server, the messages pass through a router, a special-purpose computer ensuring that each message is sent to its correct destination. A message may pass through several networks to reach its destination. Each network has its own router that determines how best to move the message closer to its destination, taking into account the traffic on the network. A message passes from one network to the next, until it arrives at the destination network, from where it can be sent to the recipient, who has a mailbox on that network. See also Electronic mail; Local-area networks; Wide-area networks.

TCP/IP

TCP/IP is a set of protocols developed to allow cooperating computers to share resources across the networks. The TCP/IP establishes the standards and rules by which messages are sent through the networks. The most important traditional TCP/IP services are file transfer, remote login, and mail transfer.

The file transfer protocol (FTP) allows a user on any computer to get files from another computer, or to send files to another computer. Security is handled by requiring the user to specify a user name and password for the other computer.

The network terminal protocol (TELNET) allows a user to log in on any other computer on the network. The user starts a remote session by specifying a computer to connect to. From that time until the end of the

session, anything the user types is sent to the other computer.

Mail transfer allows a user to send messages to users on other computers. Originally, people tended to use only one or two specific computers. They would maintain "mail files" on those machines. The computer mail system is simply a way for a user to add a message to another user's mail file.

Other services have also become important: resource sharing, diskless workstations, computer conferencing, transaction processing, security, multimedia access, and directory services program known as a browser is required, which browses the Web. See also World Wide Web.

Commerce on the Internet

Commerce on the Internet is known by a few other names, such as e-business, Etailing (electronic retailing), and e-commerce. The strengths of e-business depend on the strengths of the Internet. Internet commerce is divided into two major segments, business-to-business (B2B) and business-to-consumer (B2C). In each are some companies that have started their businesses on the Internet, and others that have existed previously and are now transitioning into the Internet world. Some products and services, such as books, compact disks (CDs), computer software, and airline tickets, seem to be particularly suited for online business.

Internet

The **Internet** is a worldwide, publicly accessible network of interconnected computer networks that transmit data by packet switching using the standard Internet Protocol (IP). It is a "network of networks" that consists of millions of smaller domestic, academic, business, and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked Web pages and other documents of the World Wide Web.

The USSR's launch of Sputnik spurred the United States to create the Advanced Research Projects Agency, known as ARPA, in February 1958 to regain a technological lead. [1][2] ARPA created the Information Processing Technology Office (IPTO) to further the research of the Semi Automatic Ground Environment (SAGE) program, which had networked

country-wide radar systems together for the first time. J. C. R. Licklider was selected to head the IPTO, and saw universal networking as a potential unifying human revolution.

Licklider had moved from the Psycho-Acoustic Laboratory at Harvard University to MIT in 1950, after becoming interested in information technology. At MIT, he served on a committee that established Lincoln Laboratory and worked on the SAGE project. In 1957 he became a Vice President at BBN, where he bought the first production PDP-1 computer and conducted the first public demonstration of time-sharing.

At the IPTO, Licklider recruited Lawrence Roberts to head a project to implement a network, and Roberts based the technology on the work of Paul Baran who had written an exhaustive study for the U.S. Air Force that recommended packet switching (as opposed to circuit switching) to make a network highly robust and survivable. After much work, the first node went live at UCLA on October 29, 1969 on what would be called the ARPANET, one of the "eve" networks of today's Internet. Following on from this, the British Post Office, Western Union International and Tymnet collaborated to create the first international packet switched network, referred to as the International Packet Switched Service (IPSS), in 1978. This network grew from Europe and the US to cover Canada, Hong Kong and Australia by 1981.

The first TCP/IP-wide area network was operational by January 1, 1983, when the United States' National Science Foundation (NSF) constructed a university network backbone that would later become the NSFNet.

It was then followed by the opening of the network to commercial interests in 1985. Important, separate networks that offered gateways into, then later merged with, the NSFNet include Usenet, BITNET and the various commercial and educational networks, such as X.25, CompuServe and JANET. Telenet (later called Sprintnet) was a large privately-funded national computer network with free dial-up access in cities throughout the U.S. that had been in operation since the 1970s. This network eventually merged with the others in the 1990s as the TCP/IP protocol became increasingly popular. The ability of TCP/IP to work over these pre-existing communication networks, especially the international X.25 IPSS network, allowed for a great ease of growth. Use of the term

"Internet" to describe a single global TCP/IP network originated around this time.

Growth

The network gained a public face in the 1990s. On August 6, 1991, CERN, which straddles the border between France and Switzerland, publicized the new World Wide Web project, two years after Tim Berners-Lee had begun creating HTML, HTTP and the first few Web pages at CERN.

An early popular web browser was ViolaWWW based upon HyperCard. It was eventually replaced in popularity by the Mosaic web browser. In 1993 the National Center for Supercomputing Applications at the University of Illinois released version 1.0 of Mosaic, and by late 1994 there was growing public interest in the previously academic/technical Internet. By 1996 the word "Internet" was coming into common daily usage, frequently misused to refer to the World Wide Web.

Meanwhile, over the course of the decade, the Internet successfully accommodated the majority of previously existing public computer networks (although some networks, such as FidoNet, have remained separate) During the 1990s, it was estimated that the Internet grew by 100% per year, with a brief period of explosive growth in 1996 and 1997.[3] This growth is often attributed to the lack of central administration, which allows organic growth of the network, as well as the non-proprietary open nature of the Internet protocols, which encourages vendor interoperability and prevents anyone company from exerting too much control over the network.

Today's Internet

A rack of servers

Aside from the complex physical connections that make up its infrastructure, the Internet is facilitated by bi- or multi-lateral commercial contracts (e.g., peering agreements), and by technical specifications or protocols that describe how to exchange data over the network. Indeed, the Internet is essentially defined by its interconnections and routing

policies.

As of June 10, 2007, 1.133 billion people use the Internet according to Internet World Stats. Writing in the Harvard International Review, philosopher NJ.Slabbert, a writer on Chat rooms provide another popular Internet service. Internet Relay Chat (IRC) offers multiuser text conferencing on diverse topics. Dozens of IRC servers provide hundreds of channels that anyone can log onto and participate in via the keyboard. See IRC.

The Original Internet

The Internet started in 1969 as the ARPAnet. Funded by the U.S. government, the ARPAnet became a series of high-speed links between major supercomputer sites and educational and research institutions worldwide, although mostly in the U.S. A major part of its backbone was the National Science Foundation's NFSNet. Along the way, it became known as the "Internet" or simply "the Net." By the 1990s, so many networks had become part of it and so much traffic was not educational or pure research that it became obvious that the Internet was on its way to becoming a commercial venture.

It Went Commercial in 1995

In 1995, the Internet was turned over to large commercial Internet providers (ISPs), such as MCI, Sprint and UUNET, which took responsibility for the backbones and have increasingly enhanced their capacities ever since. Regional ISPs link into these backbones to provide lines for their subscribers, and smaller ISPs hook either directly into the national backbones or into the regional ISPs.

The TCP/IP Protocol

Internet computers use the TCP/IP communications protocol. There are more than 100 million hosts on the Internet, a host being a mainframe or medium to high-end server that is always online via TCP/IP. The Internet is also connected to non-TCP/IP networks worldwide through gateways that convert TCP/IP into other protocols.

Life before the Web

Before the Web and the graphics-based Web browser, the Internet was accessed from Unix terminals by academicians and scientists using command-driven Unix utilities. Some of these utilities are still widely used, but are available in all platforms, including Windows, Mac and Linux. For example, FTP is used to upload and download files, and Telnet lets you log onto a computer on the Internet and run a program. See FTP, Telnet, Archie, Gopher and Veronica.

The Next Internet

Ironically, some of the original academic and scientific users of the Internet have developed their own Internet once again. Internet2 is a high-speed academic research network that was started in much the same fashion as the original Internet (see Internet2). See Web vs. Internet, World Wide Web, how to search the Web, intranet, NAP, hot topics and trends, IAB, information superhighway and online service.

Policy issues for the Washington DC-based Urban Land Institute, has asserted that the Internet is fast becoming a basic feature of global civilization, so that what has traditionally been called "civil society" is now becoming identical with information technology society as defined by Internet use.

The largest network in the world. It is made up of more than 350 million computers in more than 100 countries covering commercial, academic and government endeavors. Originally developed for the u.s. military, the Internet became widely used for academic and commercial research. Users had access to unpublished data and journals on a variety of subjects. Today, the "Net" has become commercialized into a worldwide information highway, providing data and commentary on every subject and product on earth.

E-Mail Was the Beginning

The Internet's surge in growth in the mid-1990s was dramatic, increasing a hundredfold in 1995 and 1996 alone. There were two reasons. Up until then, the major online services (AOL, CompuServe, etc.) provided e-mail, but only to customers of the same service. As they began to connect

to the Internet for e-mail exchange, the Internet took on the role of a global switching center. An AOL member could finally send mail to a CompuServe member, and so on. The Internet glued the world together for electronic mail, and today, SMTP, the Internet mail protocol, is the global e-mail standard.

The Web Was the Explosion

Secondly, with the advent of graphics-based Web browsers such as Mosaic and Netscape Navigator, and soon after, Microsoft's Internet Explorer, the World Wide Web took off. The Web became easily available to users with PCs and Macs rather than only scientists and hackers at Unix workstations. Delphi was the first proprietary online service to offer Web access, and all the rest followed. At the same time, new Internet service providers (ISPs) rose out of the woodwork to offer access to individuals and companies. As a result, the Web grew exponentially, providing an information exchange of unprecedented proportion. The Web has also become "the" storehouse for drivers, updates and demos that are downloaded via the browser as well as a global transport for delivering information by subscription, both free and paid.

Newsgroups

Although daily news and information is now available on countless Web sites, long before the Web, information on a myriad of subjects was exchanged via Usenet (User Network) newsgroups. Still thriving, news group articles can be selected and read directly from your Web browser. Chat Rooms

5.15 ELECTRONIC COMMUNICATION

Electronic communication (e-mail, bulletin boards and newsgroups) comprises a relatively new form of communication. Electronic communication differs from other methods of communication in the following key areas:

- * Speed

The time required to generate, transmit, and respond to messages.

- * Permanence

The methods of storing messages and the permanence of these files.

- * Cost of Distribution

The visible cost of sending messages to one or more individuals.

- * **Accessibility**

The direct communication channels between individuals.

- * **Security and Privacy**

The ability of individuals to access electronically stored mail and files.

- * **Sender Authenticity**

The ability to verify the sender of a message.

In using electronic communications, we may need to reevaluate what to expect in terms of rules, guidelines, and human behavior. Our experiences with paper and telephone communications may not tell us enough. For each of the key areas mentioned, the differences between electronic and other forms of communication are discussed below.

Speed

With electronic mail, written messages are delivered to the recipient within minutes of their transmission. Messages can be read at the recipient's convenience, at any time of the day. Or, the recipient can respond immediately, and an asynchronous dialogue can develop which resembles a telephone conversation or a meeting.

The ease and speed with which messages transmit often changes the writing style and formality of the written communication. These changes can lead to misinterpretation of messages, and a need arises for a new set of standards for the interpretation of message content.

Permanence

Electronic communications appear to be a volatile form of communication in which messages disappear when deleted. However, messages can be stored for years on disks or tapes, or they can be printed and/or stored in standard files.

Unlike paper copy or a telephone message, a message also can be altered, then printed, without evidence that it is not original. Electronic messages may also be reformatted, then printed, as more formal or "official" correspondence.

Cost of Distribution

The associated costs of paper or telephone communication are familiar to most people. The cost of a US Mail message (paper, stamp(s), and the personnel time to prepare the message) are known and visible. Long distance telephone costs are visible in a monthly bill. Due to the cost and effort involved, correspondents often limit their paper or telephone messages to select individuals known to absolutely require the information.

By comparison, electronic communication allows discourse with a large number of correspondents, over a wide geographical area, with no more effort or cost than is required to send a single message locally. This multiple-mailing capability often leads to wider transmission of messages than is necessary, and messages may be distributed to individuals with only a casual interest in the information.

Accessibility

Organizations develop channels of communication to filter paper or telephone messages to ensure that only appropriate individuals receive the information. Comparable mechanisms may not yet be in place for electronic mail. In using electronic communication, organizations may need to reevaluate office procedures to ensure consistent documentation of correspondence and to prevent inappropriate correspondence burdening individuals.

Security and Privacy

Currently, no legal regulations exist regarding the security and privacy of electronic mail. The vast majority of electronic mail messages are delivered to the correct addressee without intervention. However, messages may be intercepted by individuals other than the sender or recipient for reasons discussed below.

Incorrect Address

Routing software uses the address in an electronic mail message to determine the network and protocols for message delivery. Each computer that handles a mail message stamps it with information that allows tracking of the message. This information allows improperly addressed

messages to be sent back to the sender. Occasionally, for technical reasons, an improperly addressed message can not be sent back to the sender. The message then is sent to a system administrator's mailbox. The systems administrator usually attempts to return the message to the sender with an error message indicating the problem with the address.

Perusal by Unauthorized Individuals

Mail delivered to a secure file storage area on a computer is held there until the recipient retrieves it. The file can only be read by the owner of the mail while in storage. Once the mail is in the owner's home directory, security depends on the owner.

One group of users on every system has access to all files on a system. These systems administrators have special privileges required to maintain the system. While these individuals have the ability to peruse private files, it is considered unprofessional to do so. Systems administrators normally access only those files required to perform their job.

Sender authenticity

Standard mail protocols do not test the "From:" portion of a message header for authenticity. A knowledgeable person can modify the "From:" address of messages. This is an extremely common occurrence

Electronic communication in technical sense is deliberated as:

- A transmitter that takes information and converts it to a signal.
- A transmission medium over which the signal is transmitted.
- A receiver that receives the signal and converts it back into usable information.

For example, consider a radio broadcast: In this case the broadcast tower is the transmitter, the radio is the receiver and the transmission medium is free space. Often telecommunication systems are two-way and a single device acts as both a transmitter and receiver, or transceiver. For example, a mobile phone is a transceiver.

Telecommunication over a phone line is called point-to-point communication because it is between one transmitter and one receiver. Telecommunication through radio broadcasts is called broadcast communication because it is between one powerful transmitter and numerous receivers.

Analogue or digital

Signals can either be analogue or digital. In an analogue signal, the signal is varied continuously with respect to the information. In a digital signal, the information is encoded as a set of discrete values (e.g. 1's and 0's). During transmission, the information contained in analogue signals will be degraded by noise. Conversely, unless the noise exceeds a certain threshold, the information contained in digital signals will remain intact. This represents a key advantage of digital signals over analogue signals.

Networks

A collection of transmitters, receivers or transceivers that communicate with each other is known as a network. Digital networks may consist of one or more routers that route data to the correct user. An analogue network may consist of one or more switches that establish a connection between two or more users. For both types of network, a repeater may be necessary to amplify or recreate the signal when it is being transmitted over long distances. This is to combat attenuation that can render the signal indistinguishable from noise.

Channels

A channel is a division in a transmission medium so that it can be used to send multiple streams of information. For example, a radio station may broadcast at 96 MHz while another radio station may broadcast at 94.5 MHz. In this case the medium has been divided by frequency and each channel received a separate frequency to broadcast on. Alternatively, one could allocate each channel a recurring segment of time over which to broadcast - this is known as time-division multiplexing and is sometimes used in digital communication.

Modulation

The shaping of a signal to convey information is known as modulation. Modulation can be used to represent a digital message as an analogue waveform. This is known as keying and several keying techniques exist (these include phase-shift keying, frequency-shift keying and amplitude-shift keying). Bluetooth, for example, uses phase-shift keying to exchange information between devices.

Modulation can also be used to transmit the information of analogue signals at higher frequencies. This is helpful because low-frequency analogue signals cannot be effectively transmitted over free space. Hence the information from a low-frequency analogue signal must be superimposed on a higher-frequency signal (known as a carrier wave) before transmission. There are several different modulation schemes available to achieve this (two of the most basic being amplitude modulation and frequency modulation). An example of this process in action is a DJ's voice being superimposed on a 96 MHz carrier wave using frequency modulation (the voice would then be received on a radio as the channel "96 FM").

Telecommunication

Telecommunications is the transmission of data and information between computers using a communications link such as a standard telephone line. Typically, a basic telecommunications system would consist of a computer or terminal on each end, communication equipment for sending and receiving data, and a communication channel connecting the two users. Appropriate communications software is also necessary to manage the transmission of data between computers. Some applications that rely on this communications technology include the following:

1. Electronic mail (e-mail) is a message transmitted from one person to another through computerized channels. Both the sender and receiver must have access to on-line services if they are not connected to the same network. E-mail is now one of the most frequently used types of telecommunication.
2. Facsimile (fax) equipment transmits a digitized exact image of a document over telephone lines. At the receiving end, the fax machine converts the digitized data back into its original form.

3. Voice mail is similar to an answering machine in that it permits a caller to leave a voice message in a voice mailbox. Messages are digitized so the caller's message can be stored on a disk.
4. Videoconferencing involves the use of computers, television cameras, and communications software and equipment. This equipment makes it possible to conduct electronic meetings while the participants are at different locations.
5. The Internet is a continuously evolving global network of computer networks that facilitates access to information on thousands of topics. The Internet is utilized by millions of people daily.

Actually, telecommunications is not a new concept. It began in the mid-1800s with the telegraph, whereby sounds were translated manually into words; then the telephone, developed in 1876, transmitted voices; and then the teletypewriter, developed in the early 1900s, was able to transmit the written word.

Since the 1960s, telecommunications development has been rapid and wide reaching. The development of dial modem technology accelerated the rate during the 1980s. Facsimile transmission also enjoyed rapid growth during this time. The 1990s have seen the greatest advancement in telecommunications. It is predicted that computing performance will double every eighteen months. In addition, it has been estimated that the power of the computer has doubled thirty-two times since World War II. The rate of advancement in computer technology shows no signs of slowing. To illustrate the computer's rapid growth, Ronald Brown, former U.S. secretary of commerce, reported that only fifty thousand computers existed in the world in 1975, whereas, by 1995, it was estimated that more than fifty thousand computers were sold every ten hours (U.S. Department of Commerce, 1995).

Deregulation and new technology have created increased competition and widened the range of network services available throughout the world. This increase in telecommunication capabilities allows businesses to benefit from the information revolution in numerous ways, such as streamlining their inventories, increasing productivity, and identifying new markets. In the following sections, the technology of modern telecommunications will be discussed.

Communications Networks

When computers were first invented, they were designed as stand-alone systems. As computers became more widespread, practical, useful, and indispensable, network systems were developed that allowed communication between computers. The term "network" describes computers that are connected for the purpose of sharing data, software, and hardware. The two types of networks include local area networks (LANs) and wide area networks (WANs). As the name suggests, LANs cover a limited geographic area, usually a square mile or less. This limited area can be confined to a room, a building, or a group of buildings. Although a LAN can include one central computer connected to terminals, more commonly it connects a group of personal computers. A WAN covers a much larger geographic area by means of telephone cables and/or other communications channels. WANs are often used to connect a company's branch offices in different cities. Some familiar public wide area networks include AT&T, Sprint, and MCI.

Internet, Intranet, and Extranet

"Internet work" is the term used to describe two or more networks that are joined together. The term "Internet" describes the collection of connected networks. The Internet has been made accessible by use of the World Wide Web. The Web allows users to navigate the millions of sites found on the Internet using software applications called Web browsers. People make use of the Internet in numerous ways for both personal and business applications. For instance, an investor is able to access a company directly and set up an investment account; a student is able to research an assigned topic for a class report; a shopper can obtain information on new and used cars.

The Internet concept of global access to information transferred to a private corporate network creates an intranet. In conjunction with corporate Internet access, many companies are finding that it is highly practical to have an internal intranet. Because of the increased need for fast and accurate information, an efficient and seamless communications line enabling all members to access a wealth of relevant information instantaneously is vital.

A company intranet in conjunction with the Internet can provide

various types of information for internal and/or external use. Uses such as instantaneous transfer of information, reduced printing and reprinting, and elimination of out-of-date information can provide great benefits to geographically dispersed groups. Some examples of information that an intranet might include are company and procedures manuals, a company phonebook and e-mail listings, insurance and benefits information, in-house publications, job postings, expense reports, bulletin boards for employee memoranda, training information, inventory lists, price lists, and inventory control information. Putting such applications on an intranet can serve a large group of users at a substantially reduced cost.

Some companies might want to make some company information accessible to preauthorized people outside the company or even to the general public. This can be done by using an extranet. An extranet is a collaborative network that uses Internet technology to link businesses with their suppliers, customers, or other businesses. An extranet can be viewed as part of a company's intranet. Access by customers would allow entering orders into a company's system. For example, a person may order airline tickets, check the plane schedule, and customize the trip to his or her preferences. In addition to time and labor savings, this type of order entry could also decrease errors made by employees when entering manually prepared orders.

Security and privacy can be an issue in using an extranet. One way to provide this security and privacy would be by using the Internet with access via password authorization. Computer dial in and Internet access to many financial institutions is now available. This is an example of limited access to information. While bank employees have access to many facets of institutional information, the bank customers are able to access only information that has to do with their own accounts. In addition to their banking account number, they would have to use their password to gain access to the information.

Transmission Media

The physical devices making up the communications channel are known as the transmission media. These devices include cabling media (such as twisted-pair cable, coaxial cable, and fiber-optic cable) and wireless media (such as microwaves and other radio waves as well as infrared light). Wireless transmission has the advantage of not having to

install physical connections at every point. Microwave stations use radio waves to send both voice and digital signals. The principal drawback to this system is that microwave transmission is limited to line-of-sight applications. Relay antennas are usually placed twenty-five to seventy-five miles apart and can have no interfering buildings or mountains between them. Earth-based microwave transmissions, called terrestrial microwaves, send data from one microwave station to another, similar to the method by which cellular telephone signals are transmitted.

Earth stations receive microwave transmissions and transmit them to orbiting communication satellites, which then relay them over great distances to receiving earth stations. Usually, geosynchronous satellites are placed roughly twenty-two thousand miles above the earth. Being geosynchronous allows the satellites to remain in fixed positions above the earth and to be constantly available to a given group of earth stations.

Many businesses either lease or rent satellite and/or microwave communication services through the telephone company or other satellite communication companies. If a business has only a small amount of information to be transmitted each day, it may prefer to use a small satellite dish antenna instead.

Types of Signals and Their Conversion By Modem

Most telecommunications involving personal computers make use of standard telephone lines at some point in their data transmission. But since computers have been developed to work with digital signals, their transmission presents a non-compatible signal problem. Digital signals are on/off electrical pulses grouped in a manner to represent data. Originally, telephone equipment was designed to carry only voice transmission and operated with a continuous electrical wave called an analog signal. In order for telephone lines to carry digital signals, a special piece of equipment called a modem (Modulator/DE Modulator) is used to convert between digital and analog signals. Modems can be either external to the computer, and thus to be moved from one computer to another, or they can be internally mounted inside the computer. Modems are always used in pairs.

Both the receiving and transmitting modems must operate at the same speed. Multiple transmission speeds allow faster modems to reduce

their speed to match that of a slower modem. The transmission rate and direction are determining factors that influence the speed, accuracy, and efficiency of telecommunications systems.

5.16 INFORMATION QUALITY ISSUES

Information quality (IQ) is a term to describe the quality of the content of information systems. Most information system practitioners use the term synonymously with data quality. However, as many academics make a distinction between data and information, some will insist on a distinction between data quality and information quality. Information quality assurance is confidence that particular information meets some context specific quality requirements.

"Information quality" is a measure of the value which the information provides to the user of that information. 'Quality' is subjective and the quality of information can vary among users and among uses of the information. Furthermore, accuracy is just one element of IQ and this can be source-dependent. Often there is a trade-off between accuracy and other aspects of the information determining its suitability for any given tasks.

Dimensions of Information Quality

The generally accepted list of elements used in assessing subjective Information Quality are those put forth in Wang & Strong (1996).:

- Intrinsic IQ: Accuracy, Objectivity, Believability, Reputation
- Contextual IQ: Relevancy, Value-Added, Timeliness, Completeness, Amount of information
- Representational IQ: Interpretability, Ease of understanding, Concise representation, Consistent representation
- Accessibility IQ: Accessibility, Access security

Researchers should evaluate the quality of information appearing online or in print based on five criteria--scope of coverage, authority, objectivity, accuracy and timeliness. This guide defines the criteria, documents incidents of questionable, false or fraudulent information as reported in the news or trade literature, provides examples of Web sites that illustrate good or bad information, and suggests strategies that help you detect bad information.

Criteria for Quality in Information

To evaluate information, you should understand the significance of scope of coverage, authority, objectivity, accuracy and timeliness.

- Scope of coverage

Refers to the extent to which a source explores a topic. Consider time, periods, geography or jurisdiction and coverage of related or narrower topics.

- Authority

Refers to the expertise or recognized official status of a source. When working with legal or government information, consider whether the source is the official provider of the information

- Objectivity: It is the bias or opinion expressed when a interprets or analyses facts.
 - Accuracy: It describes information that is complete.
 - Time bounds: It refers to information that is available at the time of publication.

The most basic requirements of good information are:

- Objectivity: That the information is presented in a manner free from propaganda or disinformation.
 - Completeness: That the information is a complete, not a partial picture of the subject
 - Pluralism: That all aspects of the information are given and are not restricted to present a particular viewpoint, as in the case of censorship.[1]

To achieve quality in electronic information, it is necessary to be sure that one is retrieving all of the relevant information, and then to determine what of the retrieved information is valuable; what information is free of bias, propaganda, or omissions. To have quality information, three things are necessary:

- Gaining full and appropriate access to the available information
 - Making full use of the retrieval mechanisms, which requires an understanding of how these mechanisms work.
- Evaluation of the quality of the information.

The World Wide Web holds the potential for becoming the greatest repository of knowledge ever created. Different from the traditional library, material on the Web is frequently self-published, stored in quasi-secured repositories, and often, of unknown validity. The government, and it would seem a majority of the American population, favor public access of the Web through public libraries and public schools. Librarians are facing a new set of challenges in helping patrons access and utilize this new medium. Schools and public libraries face three main challenges:

- Providing "safe" access; the major concern here is "appropriate" access for minors.
- Locating useful, quality Information on the Web

Evaluating the information to verify quality

SUMMARY

Standards are important in ensuring the TQM culture in organizations. The Quality Management Systems use various standards and guiding principles for ensuring the adherence to objectives and also to improve the performance. Quality Audit will reveal the local standi of the system. The leadership plays an important and indispensable role to win over the employees in organization through various methods of recognition and reward. The developments in IT helped in defining quality functions and the computers and internet are used to address to the issues related to information quality.

REVIEW QUESTIONS

1. Explain the procedure of establishing quality system in organizations.
2. Describe ISO 9004 : 2000 and state its scope and applications.
3. Enumerate the guidelines for performance improvements in service sector.
4. "Culture place an important role in achieving TQM in organizations" – Discuss.
5. Describe the various types of leaderships and explain their impact on the employees.
6. Trace the developments in Information Technology over the years.
7. "Computers alone do not ensure quality" – Critically examine.
8. Detail the quality issues related to the information and explain the impact of wrong information on quality ensuring process.