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MBA 3.32

(Total Quality Management)

TOTAL QUALITY MANAGEMENT

MBA 3.32

Curriculum Design Committee

Prof Omji Gupta   **Coordinator**
Director,
School of Management Studies, UPRTOU, Allahabad
Dr Gyan Prakash Yadav
Asst Professor   **Member**
School of Management Studies, UPRTOU, Allahabad
Dr Devesh Ranjan Tripathi
Asst Professor   **Member**
School of Management Studies, UPRTOU, Allahabad
Dr Gaurav Sankalp   **Member**
School of Management Studies, UPRTOU, Allahabad

Course Preparation Committee

DR SHIV BHUSHAN GUPTA   **Author**
ASSOCIATE PROFESSOR
M M P G COLLEGE KALAKAKAR UP

Prof P.B.SINGH   **Editor**
Professor, MJPU BAREILLY

Dr Gaurav Sankalp   **Coordinator MBA SLM**
writing
School of Management Studies, UPRTOU

UNIT - 1

DEFINITION OF TOTAL QUANTITY MANAGEMENT FRAMEWORK, BENEFITS, AWARENESS AND OBSTACLE

OBJECTIVES

After going through this unit you should be able to know about the-

- ➤ **Concept of Total Quality Management**
- ➤ **Framework the TQM**
- ➤ **Benefits of the TQM**
- ➤ **Awareness about the TQM**
- ➤ **Obstacles in TQM**

STRUCTURE

1.1. **Introduction**
1.2. **Principle of TQM**
1.3. **Implementation Principle and Process**
1.4. **Importance of TQM**
1.5. **Elements of TQM**
1.6. **Benefits of TQM**
1.7. **Implementation of TQM**
1.8. **Advantages of TQM**
1.9. **Framework of TQM**
1.10. **Awareness about TQM**
1.11. **Obstacles in TQM**
1.12. **Conclusion**
1.13. **Further Study**

1.1. Introduction

Total Quality Management (TQM) is a management framework based on the belief that an organization can build long-term success by having all its members, from low-level workers to its highest ranking executives, focus on improving quality and, thus, delivering customer satisfaction.

Total Quality Management as a term to describe an organization quality policy and procedure as fallen out of favor as a international standard for quality management has been developed.

TQM requires organizations to focus on continuous improvement,, or Kaizen. It focuses on process improvements over the long term, rather than simply emphasizing short-term financial gains.

Definition of TQM

A core definition of Total Quality Management describes a management approach to long run success through customer satisfaction. In a TQM effort, all members of an organization participate in improving process, services and the culture in which they work.

1.2. Principles of TQM

TQM prescribes a series of ways for organizations to accomplish this, with the pathway to successful continuous improvement centered on the use of strategy, data and effective communication to instill a discipline into the organization's culture and processes.

More specifically, TQM puts a spotlight on the processes that organizations use to produce their products, and it calls for organizations to define those processes, continuously monitor and measure their performance. and use that performance data to drive improvements. Furthermore, it calls for all employees, as all organizational departments, to be part of this process.

TQM's objectives are to eliminate waste and increase efficiencies by ensuring that the production process of the organization;s product (or service) is done right the first time This management framework was initially appied to companies in the manufacturing sector, but, over the decades, organizations in other sectors have adopted it. as well.

Benefits

The benefits of TQM include the following—

   (i) **Less product defects.** One of the principles of TQM is that creation of products and services is done right the first time. This means that products ship with fewer defects, which reduce product recalls, future customer support overhead and product fixes.

(ii) **Satisfied customers.** High-quality products that meet customers' needs results in higher customer satisfaction. High customer satisfaction, in turn, can lead to increased market share, revenue growth via upsell and word-of-mouth marketing initiated by customers.

(iii) **Lower costs.** As a result of less product defects, companies save cost in customer support, product replacements, field service and the creation of product fixes. The cost savings flow to the bottom line, creating higher profit margins.

(iv) **Well-defined cultural values.** Organizations that practice TQM develop and nurture core values around quality management and continuous improvement. The TQM mindset pervades across all aspects of an organization, from hiring to internal processes to product development.

1.3. Implementation principles and processes

TQM dates back to the 1920s, when the science of statistics was applied to quality control in an industrial setting. *Walter A. Shewhart*, an engineer at Western Electric and Bell Telephone Laboratories, created a statistical control chart in the mid-1920s, and then published *Economic Control of Quality of Manufactured Product* in 1931. Many still refer to his statistical quality control method as the Shewhart cycle. It is also called the *Deming cycle*, or the PDCA (plan, do, check. act) model. Quality control methods evolved in subsequent decades, with industrial engineer Joseph Juran first employing Shewhart's methods and, later, in 1951, publishing his influential book *Juran's Quality Control Handbook*.

W. Edwards Deming further developed Shewhart's ideas in post-World War II Japan, where the U.S. government had positioned him to advise Japanese leaders on the rebuilding efforts taking place there in the late 1940s and 1950s. Working with the Union of Japanese Scientists and Engineers, Deming taught and lectured on statistical quality control, while adding his own ideas about quality control in the process. Among these teachings was Deming's belief that ordinary workers had a role to play in quality control.

Juran also lectured in Japan during the 1950s. The method that evolved during the 1950s and 1960s eventually became known as Total Quality Management. Many credit the Japanese application of TQM as a significant contributor to the country's economic recovery following World War II, as well as its midcentury industrial successes. Organizations worldwide took note of Japan's successes using TOM. United States producers throughout the 1970s and 1980s adopted quality and productivity methods, including TQM, to better compete in the increasingly global market place.

Although Deming, Juran, Shewhart and others published numerous papers and books on TQM, many organizations adopted only parts of the TQM principles, and evolved some of TQM's ideas to meet their own needs.

Moreover, as business needs for efficiency, productivity and quality have further evolved, many organizations have adopted other. more modern management techniques. So, although TQM is still influential, other management techniques, such as Six Sigma and lean manufacturing, which better address organizational goals for the 21st century, have replaced it in many businesses.

1.4. Importance of TQM

TQM can have an important and beneficial effect on employee and organizational development. By having all employees focus on quality management and continuous improvement, companies can establish and uphold cultural values that create long-term success to both customers and the organization itself. TQM's focus on quality helps identify skills deficiencies in employees, along with the necessary training, education or mentoring to address those deficiencies. With a focus on teamwork, TQM leads to the creation of cross-functional teams and knowledge sharing. The increased communication and coordination across disparate groups deepens institutional knowledge and gives companies more flexibility in deploying personnel.

SOME IMPORTANT EXAMPLES OF TQM

The following examples of TQM are given below—

(1) Automobile manufacturer Toyota is one example of TQM. The adoption of TQM and kaizen at Toyota led to higher product and work quality at all levels of the organization. Toyota adopted a related practice statistical quality control (SQC) in 1949. In 1951, Toyota launched the Creative Idea Suggestion System, which was based on a suggestion system used at ford. In 1965, Toyota was awarded the Deming Application Prize for major advances in quality improvement. In 1994, the "Toyota Group Executive TQM Training Course" was established, providing TQM training for new executives. Toyota's TQM initiatives continue to the current day. In 2011, Toyota announced that more than 40 million suggestions (to date) were generated by the Creative Idea Suggestion System.

(2) Another example of TQM is Tata Steel, a steel-making company based in India and a subsidiary of the Tata Group. Tata Steel adopted TQM in the 1980s. The company was awarded the Deming Application Prize in 2008. Tata Steel used TQM methodologies to gain a deep understanding of customers. They sought to ensure value creation in a system that covered customers and suppliers. In 2008, Tata Steel created the Performance Improvement Committee (PIC) to drive continuous performance improvement. Performance Improvement (PI) Groups were established for iron making, steel making, flat rolling, long rolling, maintenance and more. As part of their 2008 2009 annual report, Tata Steel reported that their TQM initiatives resulted in a $ 150 MM bottom line impact on their business.

1.5. Primary Element of TQM

TQM can be summarized as a management system for a customer-focused organization that involves all employees in continual improvement. It uses strategy , data, and effective communications to integrate the quality discipline into the culture and activities of the organization .Many of these concepts are present in modern quality management system , the successor to TQM. Here are the principles of total quality management :

(1) **Customer-focused :** The customer ultimately determines the level of quality. No matter what an organization does to foster quality improvement—training employees, integrating quality into the design process, or upgrading computers or software—the customer determines whether the efforts were worthwhile.

(2) **Total employee involvement :** All employees participate in working toward common goals. Total employee commitment can only be obtained after fear has been driven from the workplace, when empowerment has occurred, and when management has provided the proper environment. High performance work systems integrate continuous improvement efforts with normal business operations. Self-managed work systems integrate continuous improvement efforts with normal business operations. Self-managed work teams are one form of empowerment.

(3) **Process-centered :** A fundamental part take inputs from suppliers (internal or external) and transforms them into outputs that are delivered to customers (internal or external). The steps required to carry out the process are defined, and performance measures are continuously monitored in order to detect unexpected variation.

(4) **Integrated system :** Although an organization may consist of many different functional specialties often organized into vertically structured departments, it is the horizontal processes interconnecting these functions that are the focus of TQM.

   * Micro-processes add up to larger processes and all processes aggregate into the business processes required for defining and implementing strategy. Everyone must understand the vision, mission, and guiding principles as well as the quality policies, objectives, and critical processes of the organization. Business performance must be monitored and communicated continuously.

   * An integrated business system may be modeled after the Baldrige Award criteria and/ or incorporate the ISO 9000 standards. Every organization has a unique work culture, and it is virtually impossible to achieve excellence in its products and services unless a good quality culture has been fostered. Thus, an integrated system connects business improvement elements in an

attempt to continually improve and exceed the expectations of customers, employees, and other stakeholders.

(5) **Strategic and systematic approach :** A critical part of the management of quality is the strategic and systematic approach to achieving an organization's vision, mission, and goals. This process, called strategic planning or strategic management, includes the formulation of a strategic plan that integrates quality as a core component.

(6) **Continual improvement :** A large aspect of TQM is continual process improvement. Continual improvement drives an organization to be both analytical and creative in finding in finding ways to become more competitive and more effective at meeting stakeholder expectations.

(7) **Fact-based decision making :** In order to know how well an organization is performing, data on performance measures are necessary. TQM requires that an organization continually collect and analyze data in order to improve decision making accuracy, achieve consensus, and allow prediction based on past history.

(8) **Communications :** During times of organizational change, as well as part of day-to-day operation, effective communications plays a large part in maintaining morale and in motivating employees at all levels. Communications involve strategies, method, and timeliness.

1.6. Benefits of Total Quality Management

Benefits of TQM are as follows :

* Strengthened competitive position

* Adaptability to changing or emerging market conditions and to environmental and other government regulations

* Higher productivity

* Enhanced market image

* Elimination of defects and waste

* Reduced costs and better cost management

* Higher profitability

* Improved customer focus and satisfaction

* Increased customer loyalty and retention

* Increased job security

* Improved employee morale

* Enhanced shareholder and stakeholder value

     *   Improved and innovative processes

Total Quality Management (TQM) is a general philosophy of gradually improving the operations of a business. This is done through the application of rigorous process analysis by every involved employee and business partner. TQM is usually applied at the tactical, front-line level, where production, clerical, and low-level managers are deeply involved. There are a number of tools available to assist in a TQM effort, such as:

     *   Benchmarking

     *   Failure analysis

     *   Plan-do-check-act (PDCA) cycle

     *   Process management

     *   Product design control

     *   Statistical process control

There is some debate regarding which tools fall within the umbrella of TQM, so there are a number of other tools not mentioned here that could be of assistance.

1.7. Implementation of Total Quality Management

TQM can be implemented successfully in any part of a business, such as:

     *   Accounting

     *   Field servicing

     *   Finance

     *   Legal and administration

     *   Maintenance

     *   Manufacturing

     *   Materials management

     *   Research and development

     *   Sales and marketing

1.8. Advantages of Total Quality Management

The advantage of Total Quality Management are as follows:-

(i) **Cost reduction.** When applied consistently over time, TQM can reduce costs throughout an organization, especially in the areas of scrap, rework, field service, and warranty cost reduction. Since these cost reductions follow straight through to bottom-line profits without any additional costs being incurred, there can be a startling increase in profitability.

(ii) **Customer satisfaction.** Since the company has better products and services, and its interactions with customers are relatively error-free, there should be fewer customer complaints. Fewer complaints may also mean that the resources devoted to customer service can be reduced. A higher level of customer satisfaction may also lead to increased market share, as existing customers act on the company's behalf to bring in more customers.

(iii) **Defect reduction.** TQM has a strong emphasis on improving quality within a process, rather than inspecting quality into a process. This not only reduces the time needed to fix errors, but makes it less necessary to employ a team of quality assurance personnel.

(iv) **Morale.** The ongoing and proven success of TQM, and in particular the participation of employees in that success can lead to a noticeable improvement in employee morale, which in turn reduces employee turnover, and therefore reduces the cost of hiring and training new employees.

However, TQM also requires a significant training period for those employees involved in it. Since the training can take people away from their regular work, this can actually have a negative short-term effect on costs. Also, since TQM tends to result in a continuing series of incremental changes, it can generate an adverse reaction from those employees who prefer the current system, or who feel that they may lose their jobs because of it .

TQM works best in an environment where it is strongly supported by management, it is implemented by employee teams, and there is a continual focus on process improvement that prevents errors from occurring .

1.9. Total Quality Management framework

It begins with the knowledge provided by quality gurus-Shewhart, Deming, Juran, Feigenbaum, Ishikawa, Crosby and Taguchi. As the figure shows, they contributed to the development of principles and practices and/or the tools and techniques. Some of these tools and techniques are used in the product and/or service realisation activity. Feedback from internal/external customers or interested parties provides information to continually improve an organisations's system, product and/or service.

1.10. Awareness

An organisation will not begin the transformation to TQM until it is aware the fact that the quality of product or service should be improved. Awareness comes when an organisation loses market share or realises that quality and productivity go hand in-hand. It also occurs if TQM is mandated by a customer or if management realises that TQM is a better way to run a business and compete in domestic and world markets.

Automation and other productivity enhancements might not help a corporation if it is unable to market its products or services because of their poor quality. The Japanese learned this fact from practical experience. Prior to World War II, they could sell their

products only at ridiculously low prices and even then it was difficult to secure repeat sales. Until recently. corporations have not recognised the importance of quality.q However, a new attitude has emerged-quality first among the equals of cost and service. To sum it up, a customer wants value.

Quality and productivity are not mutually exclusive. An improvement in quality this concept. In the table, the improved quality results in a 5.6% improvement in productivity, capacity and profit. Many quality improvement projects are achieved with the same workforce, same overhead and no investment in new equipment.

Recent evidence shows that more and and more corporations are recognising the importance and necessity of quality improvement in order to survive the domestic and worldwide competition. Quality improvement is not limited to the conformance of a product or service to specifications. It also involves an inherent quality in the design of a system. The prevention of product, service and process problems is a more desirable objective than taking corrective action after the product is manufactured or a service rendered.

TQM does not occur overnight. There are no quick remedies. It takes a long time to build an appropriate emphasis and technique into the culture. Overemphasis on short-term results and profits should be set aside and long-term planning and constancy should be allowed to prevail.

1.11. Obstacle in TQM

Many organisations, especially small ones with a niche, feel comfortable with with their current state. They are satisfied with the amount of work being performed, the profits realised and the perception that the customers are satisfied. Organisations with this culture see little need for TQM until they begin to lose market share. Once an organisation embarks on TQM, it faces some obstacles to its successful implementation. Some of the obstacles are as follows:

(i) **Lack of Management Commitment**

In order to make an organisational effort successful, there should be substantial management commitment of management time and organisational resources. The purpose should be clearly and continuously communicated to all personnel.

Management should consistently apply the principles of TQM.

Robert Galvin of Motorola said that only the CEO can ensure, even in times of great pressure, that quality and customer satisfaction are preserved. In a survey, out of 188 quality professionals, 66% reported that management's compensation is not linked to quality goals such as failure costs, customer complaints and cycle time reduction. [TQM Framework]

(ii) Inability to Change Organizational Culture

Changing an organisation's culture is difficult and requires as much as five years. Individuals resist changing as they become accustomed to doing a particular process and it becomes the preferred way. Management should understand and utilise the basic concepts of change which are as follows:

People change when they want to and to meet their own needs.

Never expect anyone to engage in behaviour that serves an organisation's values unless adequate reason (way) has been given.

For change to accepted, people should be moved from a state of fear to trust. It is difficult for individuals to change their way of doing things. It is much more difficult for an organisation to make cultural changes. Management by exhortation and inspiration fails. Speeches, slogans and copings to motivate people to remain effective for a short period of time. Impediments a cultural change are ineffective communication and emphasis on short-term results. Organisations that spend more time in planning for the cultural aspects aspects of implementing a TQM program will improve their chances of success.

1.12. Conclusion

Total Quality Management can be summarized as a management system for a customer focused organization that involves all employees in continual improvement. It uses strategic date and effective communication to integrate the quality discipline in to culture and activities of the organization. Many of these concept are present in modern quality management system.

1.13. Further study

For further study you can opt. the following sites and books given below:

1. www.wikipedia. com

2. Phillips Kotlar

3. John S. Oakland - Quality management

UNIT II

QUALITY, VISION, MISSION AND POLICY STATEMENTS OF TQM

OBJECTIVES:

After going through this unit you should be able to know about:

- ➢ **Concept of Quality**
- ➢ **Concept of Vision**
- ➢ **Concept of Mission**
- ➢ **Meaning of Policy Statements**

To achieve these objectives this unit is sectioned in the following sub-chapters:

STRUCTURE

2.1. Introduction

2.2. Concept of Quality

2.3. What are vision and its importance?

2.4. Meaning of mission in regard to TQM

2.5. Importance of Mission

2.6. Meaning of Policy statements

2.7. Implication of Policy statements

2.8. Conclusion

2.9. Further Study

2.1. Introduction

Total Quality Management is a management approach that originated in the 1950s and has steadily become more popular since the early 1980s. Total Quality is a description of the culture, attitude and organization of a company that strives to provide customers with products and services that satisfy their needs. The culture requires quality in all aspects of the company's operations, with processes being done right the first time and defects and waste eradicated from operations.

Total Quality Management, TQM) , is a method by which management and employees can become involved in the continuous improvement of the production of goods and services. It is a combination of quality and management tools aimed at increasing business and reducing losses due to wasteful practices.

TQM is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering, and production, customer service, etc.) to focus on meeting customer needs and organizational objectives. TQM views an organization as a collection of processes. It maintains that organizations must strive to continuously improve these processes by incorporating the knowledge and experiences of workers. The simple objective of TQM is "Do the right things, right the first time, every time." TQM is infinitely variable and adaptable. Although originally applied to manufacturing operations, and for a number of years only used in that area, TQM is now becoming recognized as a generic management tool, just as applicable in service and public sector organizations. There are a number of evolutionary strands, with different sectors creating their own versions from the common ancestor. TQM is the foundation for activities, which include:

- Commitment by senior management and all employees
- Meeting customer requirements
- Reducing development cycle times
- Just in time/demand flow manufacturing
- Improvement teams
- Reducing product and service costs
- Systems to facilitate improvement
- Line management ownership
- Employee involvement and empowerment
- Recognition and celebration
- Challenging quantified goals and benchmarking
- Focus on processes / improvement plans
- Specific incorporation in strategic planning

Principles of TQM
The key principles of TQM are as following:

Management Commitment
- Plan (drive, direct)
- Do (deploy, support, participate)

- Check (review)
- Act (recognize, communicate, revise)

Employee Empowerment
- Training
- Suggestion scheme
- Measurement and recognition
- Excellence teams

Fact Based Decision Making
- SPC (statistical process control)
- DOE, FMEA
- The 7 statistical tools
- TOPS (Ford 8D – team-oriented problem solving)

Continuous Improvement
- Systematic measurement and focus on CONQ
- Excellence teams
- Cross-functional process management
- Attain, maintain, improve standards

Customer Focus
- Supplier partnership
- Service relationship with internal customers
- Never compromise quality
- Customer driven standards

TQM is mainly concerned with continuous improvement in all work, from high level strategic planning and decision making, to detailed execution of work elements on the shop floor. It stems from the belief that mistakes can be avoided and defects can be prevented. It leads to continuously improving results, in all aspects of work, as a result of continuously improving capabilities, people, processes, technology and machine capabilities.

2.2. Concept of Quality

Quality means providing our external and internal customers with innovative products and services that fully satisfy their requirements. Quality is the job for every employee. The quality is a guide for everyone in the organization as to how they should provide products and services to the customers. The process starts with the principles that quality and customer satisfaction are the centre of an organization future. It brings together the entire key stakeholder. The strategic planning can be performed by any organization to do the right things at right time.

A core definition of total quality management (TQM) describes a management approach to long term success through customer satisfaction. In a TQM effort, all members of an organization participate in improving processes, products, services, and the culture in which they work.

PRIMARY ELEMENTS OF TQM

TQM can be summarized as a management system for a customer-focused organization that involves all employees in continual improvement. It uses strategy, data, and effective communications to integrate the quality discipline into the culture and activities of the organization. Many of these concepts are present in modern quality management systems, the successor to TQM. Here are the 8 principles of total quality management:

1. **Customer-focused:** The customer ultimately determines the level of quality. No matter what an organization does to foster quality improvement—training employees, integrating quality into the design process, or upgrading computers or software—the customer determines whether the efforts were worthwhile.

2. **Total employee involvement:** All employees participate in working toward common goals. Total employee commitment can only be obtained after fear has been driven from the workplace, when empowerment has occurred, and when management has provided the proper environment. High performance work systems integrate continuous improvement efforts with normal business operations. Self-managed work teams are one form of empowerment.

3. **Process-centered:** A fundamental part of TQM is a focus on process thinking. A process is a series of steps that take inputs from suppliers (internal or external) and transforms them into outputs that are delivered to customers (internal or external). The steps required to carry out the process are defined, and performance measures are continuously monitored in order to detect unexpected variation.

4. **Integrated system:** Although an organization may consist of many different functional specialties often organized into vertically structured departments, it is the horizontal processes interconnecting these functions that are the focus of TQM.

   - Micro-processes add up to larger processes, and all processes aggregate into the business processes required for defining and implementing strategy. Everyone must understand the vision, mission, and guiding principles as well as the quality policies, objectives, and critical processes of the organization. Business performance must be monitored and communicated continuously.

   - An integrated business system may be modeled after the Baldrige Award criteria and/or incorporate the ISO 9000 standards. Every organization has a unique work culture, and it is virtually impossible to achieve excellence in its products and services unless a good quality culture has been fostered. Thus, an integrated system connects business improvement elements in an attempt to continually improve and exceed the expectations of customers, employees, and other stakeholders.

5. **Strategic and systematic approach:** A critical part of the management of quality is the strategic and systematic approach to achieving an organization's vision, mission, and goals. This process, called strategic planning or strategic

management, includes the formulation of a strategic plan that integrates quality as a core component.

6. **Continual improvement:** A large aspect of TQM is <u>continual process improvement</u>. Continual improvement drives an organization to be both analytical and creative in finding ways to become more competitive and more effective at meeting <u>stakeholder</u> expectations.

7. **Fact-based decision making:** In order to know how well an organization is performing, data on performance measures are necessary. TQM requires that an organization continually collect and analyze data in order to improve decision making accuracy, achieve consensus, and allow prediction based on past history.

8. **Communications:** During times of organizational change, as well as part of day-to-day operation, effective communications plays a large part in maintaining morale and in motivating employees at all levels. Communications involve strategies, method, and timeliness.

Primary Elements of Total Quality Management (TQM)

These elements are considered so essential to TQM that many organizations define them, in some format, as a set of core values and principles on which the organization is to operate. The methods for implementing this approach come from the teachings of such quality leaders as <u>Philip B. Crosby</u>, <u>W. Edwards Deming</u>, <u>Armand V. Feigenbaum</u>, <u>Kaoru Ishikawa</u>, and <u>Joseph M. Juran</u>.

Implementation Principles and Processes

A preliminary step in TQM implementation is to assess the organization's current reality. Relevant preconditions have to do with the organization's history, its current needs, precipitating events leading to TQM, and the existing employee quality of working life. If the current reality does not include important preconditions, TQM implementation should be delayed until the organization is in a state in which TQM is likely to succeed.

If an organization has a track record of effective responsiveness to the environment, and if it has been able to successfully change the way it operates when needed, TQM will be easier to implement. If an organization has been historically reactive and has no skill at improving its operating systems, there will be both employee skepticism and a lack of skilled change agents. If this condition prevails, a comprehensive program of

management and leadership development may be instituted. A management audit is a good assessment tool to identify current levels of organizational functioning and areas in need of change. An organization should be basically healthy before beginning TQM. If it has significant problems such as a very unstable funding base, weak administrative systems, lack of managerial skill, or poor employee morale, TQM would not be appropriate.[5]

However, a certain level of stress is probably desirable to initiate TQM. People need to feel a need for a change. Kanter (1983) addresses this phenomenon be describing building blocks which are present in effective organizational change. These forces include departures from tradition, a crisis or galvanizing event, strategic decisions, individual "prime movers," and action vehicles. Departures from tradition are activities, usually at lower levels of the organization, which occur when entrepreneurs move outside the normal ways of operating to solve a problem. A crisis, if it is not too disabling, can also help create a sense of urgency which can mobilize people to act. In the case of TQM, this may be a funding cut or threat, or demands from consumers or other stakeholders for improved quality of service. After a crisis, a leader may intervene strategically by articulating a new vision of the future to help the organization deal with it. A plan to implement TQM may be such a strategic decision. Such a leader may then become a prime mover, who takes charge in championing the new idea and showing others how it will help them get where they want to go. Finally, action vehicles are needed and mechanisms or structures to enable the change to occur and become institutionalized.

Steps in Managing the Transition

Beck hard and Pritchard (1992) have outlined the basic steps in managing a transition to a new system such as TQM: identifying tasks to be done, creating necessary management structures, developing strategies for building commitment, designing mechanisms to communicate the change, and assigning resources.

Task identification would include a study of present conditions (assessing current reality, as described above); assessing readiness, such as through a force field analysis; creating a model of the desired state, in this case, implementation of TQM; announcing the change goals to the organization; and assigning responsibilities and resources. This final step would include securing outside consultation and training and assigning someone within the organization to oversee the effort. This should be a responsibility of top management. In fact, the next step, designing transition management structures, is also a responsibility of top management. In fact, Cohen and Brand (1993) and Hyde (1992) assert that management must be heavily involved as leaders rather than relying on a separate staff person or function to shepherd the effort. An organization wide steering committee to oversee the effort may be appropriate. Developing commitment strategies was discussed above in the sections on resistance and on visionary leadership.[6]

To communicate the change, mechanisms beyond existing processes will need to be developed. Special all-staff meetings attended by executives, sometimes designed as input or dialog sessions, may be used to kick off the process, and TQM newsletters may be an effective ongoing communication tool to keep employees aware of activities and accomplishments.

Management of resources for the change effort is important with TQM because outside consultants will almost always be required. Choose consultants based on their prior relevant experience and their commitment to adapting the process to fit unique organizational needs. While consultants will be invaluable with initial training of staff and TQM system design, employees (management and others) should be actively involved in TQM implementation, perhaps after receiving training in change management which they can then pass on to other employees. A collaborative relationship with consultants and clear role definitions and specification of activities must be established.

2.2.1. Quality Statements

There are three elements of quality statements:-

(i)   Vision statements
(ii)   Mission statement
(iii)   Quality policy statement

2.3. The vision statement.

TQM should be purpose driven and there should be a clear vision for the organization's future. Proper communication is a key element of a successful TQM implementation. The entire organization should have a clear vision of the mission and goals of implementing TQM. It is the responsibility of the leadership team to communicate the plan, purpose, goals and benefits of implementing TQM methodology. Organizational management should draft a plan for implementation including the assignment of responsibilities, formation of improvement teams and allocation of adequate resources. This often includes acquiring external consulting and training resources.

 The vision statement is on follows:

(i)   A vision statement is a short declaration of what an organization aspires to be tomorrow.
(ii)   It is the ideal state that might never be reached a n one will work hard continuously to achieve successful visions provide a brief guideline for decision making.
(iii)   The vision statement should be coined in such a way that the leaders and the employees working in the organization should work towards the achievements for the vision statement.

The vision statements can be clear with help of given example To continuously enrich knowledge base on the practical knowledge in mobility industry and institutions in service of humanity.

The vision statement is a short declaration what an organization aspires to be tomorrow. A vision statement, on the other hand, describes how the future will look if the organization achieves its mission.

Successful visions are timeless, inspirational, and become deeply shared within the organization, such as:

*   IBM's Service

- Apple's Computing for the masses

- Disney theme park's the happiest place on the earth, and

- Polaroid's instant photography

A vision is an expression of what the organization wants to become, what it wants to be, to be known as or to be known for. It is the long-term objective of the organization.

The vision comes from the leaders it is how they express the future for the organization or its strategic direction. However, it must be practical and feasible while representing a challenge for the organization. The vision must also be shared by the members of the organization so that everyone clearly understands what the organization is striving to become. To create a vision for the organization top management should identify the key potential influences on the organization over the next ten years in terms of the economic, political, social and technological influences.

2.4. Mission.

A mission is a quest, a journey to a destination in which the whole organization is engaged. The mission statement tells us what our goal is where are we going. It provides the compass setting for the organization. It is the foundation of effective leadership. It is how the organization is going to achieve its vision.

Without customers there is no business therefore the basic purpose of a business is to satisfy a particular want in society and so create a customer. Its mission is related to these wants and is expressed in specific terms.

The mission statement should:

- Give clear and unambiguous direction to all who serve the organization

- Relate to the organizations current and future customers/markets

- Express the benefits the organization's products or services are to bring to the targeted customer/markets

- Always look outside the business not inside. For example a mission that is focused on increasing market share is an inwardly seeking mission whereas a mission that is focused on bringing cheap digital communication to the community is an outwardly seeking mission statement

- Express a shared belief. There is no point in publishing a mission statement in which people have not been involved in its development.

- Remain constant despite changes in top management. Too many changes to the mission causes people to pull in different directions

- Take into account all stakeholders

- Take the medium term view (business objectives take the short term view and vision the long term view)

Only a clear definition of the business purpose and mission makes possible clear and realistic business objectives. It is the starting point for strategies, structures and processes. Processes will not cause the right results unless the process objectives have been derived from the mission. Find out how to do this here.

Our mission is to improve continually our products and services to meet our customers need allowing us to provide them with the better facility to prosper as a business and to provide a reasonable return on to our shareholder the owners of our business. The mission statement describes the functions of the organization. It provides clear statement of purpose for employees, customers and suppliers. The mission statement answers the following statement such as:

- Who are you?

- Who were our customers?

- What we do?

- How we do it?

A mission statement concerns what an organization is all about. The statement answers the questions such as: who we are, who are our customers, what do we do and how do we do it. This statement is usually one paragraph or less in length, easy to understand, and describes the function of the organization. It provides clear statement of purpose for employees, customers, and suppliers.

An example of mission statement is:

Ford Motor Company is a worldwide leader in automatic and automotive related products and services as well as the newer industries such as aerospace, communications, and financial services. Our mission is to improve continually our products and services to meet our customers' needs, allowing us to prosper as a business and to provide a reasonable return on to our shareholders, the owners of our business.

2.5. Importance of Mission

Mission provides clear statement of purpose for employees, customers and suppliers. It concern for the ultimate customers, millions of customers concern for the intermediate customers. The most valued asset of the mission statement is suppliers (suppliers of raw materials). Vision statement answers the following questions-

- Who we are?

- Who are the customers?

- What we do?

- How we do it?

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

2.6. Policy Statement

Policy is a guide for everyone in the organization as how they should provides product and services to the customers. It should be written by the CEO with feedback from the

workforce and approved by the quality council. A quality policy is a requirement of ISO 9000. A simple quality policy is Xerox and it is a quality company. Quality is the basic business principle for Xerox. Quality means providing our external and internal customers with innovative products and services that fully satisfy their requirements. Quality is the job for every employee.

The process of strategic quality planning starts with the principles that quality and customers satisfaction are the cntre of an organizations future. It brings together all the key stakeholders strategic planning can be start performed by any organization. It can be highly effective. It allows the organization to do the right thing at the right time, every time.

Values are the principles or beliefs that will guide the organization in fulfilling its purpose (achieving its objectives, accomplishing its mission and realizing its vision). Values are the things that are important to the organization.

An organization adopts certain values and not others depending on its vision. Values are the key to effective management. They are at the core of every decision, every action and channel the thought processes in making decisions and taking actions   they condition the behavior of the people in the organization and the way internal and external relationships are handled. Values characterize the culture of an organization. Values may be expressed as principles, beliefs or policies, but not all principles and policies are value statements. For an organization to be successful it needs a common set of shared values. Values should not be sacrificed to achieve an objective or accomplish a mission. Such action sends out the signal that it is OK to bend the rules. In the long term, such action becomes endemic and acts like a disease throughout the organization and leads ultimately to its downfall.

Values might include:

- Customer focus

- Leadership

- Involvement of people

- Process approach

- System approach to management

- Continual improvement

- Factual approach to decision making

- Mutually beneficial supplier relationships

- Honesty, integrity, and trust

- Responsibility, respect, and loyalty

- Relationships, privacy, openness, individual contribution

- Freedom, confidentiality and financial security, life, environment and equality

- Diversity, innovation, growth and competitiveness

These are all positive values but there are equally negative values depending on ones point of view. Fear, tension, pressure, duplicity, uniformity, exploitation, secrecy and discrimination may be appropriate values for some organizations to fulfill their vision!

2.7. Implication of Policy Statement

Policy statements are a guide for everyone in the organization as to how they should provide products and services to the customers.

The common characteristics of the policy statements are: on follows:-

(i)   Quality is first among equals
(ii)   Meet the needs of the internal and external customers
(iii)   Equals or exceed competitions
(iv)   Continuously improve the quality
(v)   Utilize the entire workforce

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

A simple quality policy is:

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

How an organization can do strategic quality planning?

The process starts with the principles that quality and customer satisfaction are the center of an organization's future. It brings together all the key stakeholders. The strategic planning can be performed by any organization. It can be highly effective, allowing the organizations to do the right thing at the right time, every time.

There are seven steps to strategic Quality Planning:

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

1. Customer Needs: The first step is to discover the future needs of the customers. Who will they be? Will your customer base change? What will they want? How will they want? How will the organization meet and exceed expectations?

2. Customer Positioning: Next, the planners determine where organization wants to be in relation to the customers. Do they want to retain, reduce, or expand the customer base. Product or services with poor quality performance should be targeted for

breakthrough or eliminated. The organization's needs to concentrate its efforts on areas of excellence.

3. Predict the future: Next planners must look into their crystal balls to predict the future conditions that will affect their product or service. Demographics, economics forecasts, and technical assessments or projections are tools that help predict the future.

4. Gap Analysis: This step requires the planner to identify the gaps between the current state and the future state of the organization. An analysis of the core values and concepts is an excellent technique for pinpointing gaps.

5. Closing the Gap: The plan can now be developed to close the gap by establishing goals and responsibilities. All stakeholders should be included in the development of the plan.

6. Alignment: As the plan is developed, it must be aligned with the mission, vision, and core values and concepts of the organization. Without this alignment, the plan will have little chance of success.

7. Implementation: This last step is frequently the most difficult. Resources must be allocated to collecting data, designing changes, and overcoming resistance to change. Also part of this step is the monitoring activity to ensure that progress is being made. The planning group should meet at least once a year to assess progress and take any corrective action.

2.8. Conclusion

Quality is the basic business principle. Quality means providing our external and internal customers with innovative products and services that fully satisfy their requirements.

TQM encourages participation amongst shop floor workers and managers. There is no single theoretical formalization of total quality, but Deming, Juran and Ishikawa provide the core assumptions, as a "…discipline and philosophy of management which institutionalizes planned and continuous… improvement … and assumes that quality is the outcome of all activities that take place within an organization; that all functions and all employees have to participate in the improvement process; that organizations need both quality systems and a quality culture."

2.9. Further study

For further study you can opt the following sites and books given below:

1. www.wikipedia.com

2. Philips Kotler book for Marketing Managements

3. Kelvin Lane Keller book for Brand Managements

4. Gilbert, G. (1992). "Quality Improvement in a Defense *Organization.*" *Public Productivity and Management Review*, 16(1), 65-75.

5. Hyde, A. (1992). "The Proverbs of Total Quality Management: Recharting the Path to Quality Improvement in the Public Sector." *Public Productivity and Management Review*, 16(1), 25-37.

6. Martin, L. (1993). "Total Quality Management in the Public Sector," *National Productivity Review*, 10, 195-213.

7. Swiss, J. (1992). "Adapting TQM to Government." *Public Administration Review*, 52, 356-362.

8. Tichey, N. (1983). *Managing Strategic Change*. New York: John Wiley & Sons.

9. Hill Stephen, 1991. "Why Quality Circles Failed but Total Quality Management Might Succeed." *British Journal of Industrial Relations*, 29(4), 541-568.

10. Ishikawa, K, 1985.*What Is Total Quality Control? The Japanese Way*. Englewood Cliffs, New Jersey, Prentice- Hall.

11. Smith, AK, 1993. "Total Quality Management in the Public Sector." *Quality Progress*, June 1993, 45-48.

UNIT 3

CUSTOMER FOCUS, CUSTOMER PERCEPTION OF QUALITY TRANSLATING NEEDS INTO REQUIREMENTS, CUSTOMER RETENTION

OBJECTIVE

After going through this unit you should be able to know about:

- ➢ Concept of customer focus
- ➢ Customer relation management
- ➢ Importance of customer focus
- ➢ Implementing customer focus
- ➢ Concept of customer retention

To achieve these objectives this unit is sectioned in to following sub chapters.

STRUCTURE:

3.1. Introduction

Stakeholders have explored new ways of implementing student's performance especially at the university level, where big proportion of students with poor performance are placed. It is after witnessing the success that comes with customer oriented business approaches that resulted into improvements in service delivery and better customer awareness in other businesses that education and other stakeholder in field of education have come together to try and implement the customer oriented approach in to education system. It has come to the realization of education stakeholder that parent and students need to be treated as valued customer who are constantly seeking services from universities as organization one of the key scholars who discussed the core importance of customer focus and its application in the school setting was Deming 1954 the reviewed the important aspect of customer focus movement and carefully related them to education. He was of the opinion that there should be a partnership between the government and the education the stressed on the importance of students being treated as customer.

3.2. Concept of Customer Focus

Customer focus is just one aspect of Top Quality Management and refers to paying keen attention to improving customer satisfaction which is aimed at customer retention, increasing customer loyalty, while at the same time increasing profits in the business, company or organization. It is about incorporating the customer's opinion into creation of a service or product and getting employees to look at the process of service or product creation through the eyes of the customer. Customer satisfaction does not come easy and calls for application of customer relations management. There is a common saying that customer is always king and true to it, businesses thrive depending on how well they treat their customers. Satisfied customers will not only keep coming back for more, but they will also bring along other customers, hence making the business popular and helping it to gain a competitive advantage over competitors (Adrian, 2010, p. 1).

In order to bring the meaning of customer focus and related terms closer home, this first chapter will look at definition of terms that will be referred to time and again throughout the paper.

3.3. Customer Relations Management (CRM)

Customer relations management is a term that is used in referring to a strategy that combines technological approaches and business strategies in trying to understand who a customer is, what they do and what their needs are, in order to create products and services designed to meet the specific needs of clients. Customer relations management in relation to customer focus serves to bring out the best in customer value and behaviour which in turn influences their loyalty to and satisfaction from the business, company or organization in quest on (American Association of School Administrators, p. 1).

CRM is a strategy which, when well implemented, goes a long way in managing the interactions between a company and its customers, both existing and potential. CRM in relation to improving customer focus in universities plays a crucial role in understanding the customer in this case the student, and what their needs are, and tailoring the services (teaching services) to suit the needs of the client. The overall goals of CRM is to find, attract, nurture and retain customers at the same time reducing the costs of customer service without compromising the quality of services offered. However, implementation of CRM in a university setting cannot be successful unless the employees are fully convinced about the necessity of the organization's alignment towards its customers. Employees have to do away with the mentality that their customers come and go and hence it does not matter much the quality of services they receive from the organization. If need be, there needs to be training for the employees in regard to how to deal with customers, whether it is for one time encounter or for a life-long process(American Association of School Administrators, p. 1).

3.3.1. Top Quality Management (TQM)

In any business that hopes to stand out above the rest in the industry, Top Quality Management is a factor that they cannot afford to overlook. It is the broader component that encompasses customer focus and refers to a participatory management strategy that lays emphasis on total staff commitment and dedication to customer satisfaction, which is the whole essence of customer focus. TQM is a holistic approach that has helped bring down the top down managerial systems and promote a more decentralised customer-driven approach to decision making and management. TQM approaches are developed around the assumption that 90 percent of problems arising in any business enterprise or venture are as a result of weaknesses in service delivery processes, and not necessarily as a result of employee mistakes or incompetence TQM. when applied in the right way can improve efficiency and effectiveness in an organization (Brent 1995, p. 41).

3.3.2. Customer satisfaction and loyalty

Customer satisfaction refers to a situation where the customer's needs are met in a manner that is way beyond his specifications. It implies that a company or organization has got to go an extra mile to please the customer. In any competitive market customer satisfaction is a key differentiator and is a crucial component of business strategy.

This paper aims at establishing the importance of customer focus in education, especially at the university level. It seeks to understand how customer focus can be implemented in universities and the problems faced by students as a result of lack of customer focus, as well as to make a recommendation on what can be done to improve the situation (Bradshaw, 2010, p. 5).

3.4. Importance of customer focus

In his book 'Oakland on quality management', John S. Oakland 2004, p49 says that top quality management is a matter of delivering quality services and products to

customers, based on customer's specifications. In other words, it refers to fitness for purpose or use. This means that means that the company or business has to focus on the customer in order to be able to understand and completely be able to meet the specific needs. Strategies towards TQM should be guided by a number of factors that are directed towards upholding the reputation of the company. These aspects are : competitive elements of quality and reliability as well as competitive and affordable prices, the most important of them being quality, ability to remember that once an organization gains a negative reputation, restructuring it into something positive takes a very long while, reputation, whether positive or negative, has the ability too cross borders and the final aspect is that management of competitive weapons like quality can effectively be used to turn around poor reputation into positive one. When thinking about reputation, organizations are basically putting their focus on what they think their customers think about them. This said, when TQM is referred to, the biggest component behind it is customer focus.

How then is Customer Focus relevant to universities? Universities have over time been known to be the biggest producers of human resource, but unfortunately, students in universities are still faced with problems that hindering them from attaining quality education that will land them the jobs they claim to be qualified for. The services they receive from the said universities do not meet the standards for fitness for purpose, the problem being that there are loopholes in issues like the range of assessment methods used to evaluate the students, the quality of library stock as well as the course subjects offered do not meet the required standards. This has become an issue of concern for many parents, educators, business and government leaders (Jennifer 2006, p. 35).

3.5. Implementing customer focus

Stakeholders have explored new ways of improving student performance especially at the university level, where a big proportion of students with poor performance are placed. It is after witnessing the success that comes with customer-oriented business approaches that resulted into improvements in service delivery and better customer awareness in other businesses that educators and other stakeholders in the field of education have come together to try and implement the customer-oriented approach into education systems. It has come to the realization of education stakeholders that parents and students need to be treated as valued customers who are constantly seeking services from universities as organizations.

One of the key scholars who discussed the core importance of customer focus and its application in the school setting was Deming (1958 p. 45). He reviewed the important aspects of customer focus movement and carefully related them to education. He was of the opinion that there should be a partnership between the government and the education system in order to improve education. He stressed on the importance of students being treated as customers, their importance in the whole system and the quality of education offered to them being based on the requirements of jobs the

students seek after graduating. Deming argues that consumer research should be done every one in a while and findings used to consider the most important strategies in implementing quality and customer focus movements, with the belief that appropriate responses to customer needs can go a long way in guaranteeing customer satisfaction. Feedback from customers should be the basis upon which teachers can achieve their educational goals where students are concerned, while at the same time increasing their own job satisfaction.

A research study carried out by one Coulson (1996 p. 57) showed that teachers have a positive attitude towards the concept of customer focus, and this would form a good basis on which to start the implementation of customer focus. Despite the increased levels of awareness among teachers, parents, students and community leaders are still critical of the quality of university education.

The implementation process of customer focus is as simple as having the customer in mind in all levels of policy and decision making as well as incorporating them in the simple day to day activities that are rather taken for granted or ass obvious. Some of the steps of the steps that would make the implementation process as easy as it sounds are;

3.5.1. Encouraging face to face dealings

According to Adrian Thompson 2010 in his article 'Customer Satisfaction in 7 steps,' face to face dealings are the most crucial part of interacting with a customer. However, he acknowledges that it is not always easy to have a one on one interaction with clients at all times, However, in his findings, Adrian discovered that customers find it easier to work with a person they have met in person, rather than one they have only spoken to over the phone or communicated with over the internet. Face to face dealings pride one with opportunity to know their customer in person and to take time to understand what it is that the customer really needs since feedback is instant.

3.5.2. Responding to messages promptly and keeping clients informed

We all know that it is quite annoying to keep waiting for a response for days on end. When it comes to customers, nothing annoys them more than to be denied immediate feedback, especially to information considered really important. Even though dealing with customers queries within few hours may not always be possible, but it is always advisable to at least call back or send an email and let the customer know that their concern has been received and is being worked on. Even if the customer may not receive a response right away, it is only fair to let them know that their request is being worked on. This way, the customer is likely to stick with you and not move their business elsewhere (Arthur and Carrie, 2009, p. 79).

3.5.3. Being friendly and approachable

Have you ever considered the truth in the saying that one can hear a smile through the phone? it is very important to be friendly and courteous, even to customers who cannot see you physically. Make them feel that you are there to help them out and to respond to

their needs accordingly. Always keep a clear head and respond to your clients needs to the best of your ability as politely and courteously as possible (Sehmoker and Wilson 1993, p. 46).

3.5.4. Having a clearly defined customer service policy

In the universities, having policies that are well formulated on the services that are offered to students and what course of action the customer (student) can take in case the quality and standards are not met is very crucial. This goes a long way in helping the students realize that their interests are held dearly and safeguarded and that they can always achieve the best they want to. This is especially in regard to library stock, quality of lecture notes and grading of assignments. Policies should also clearly define what happens in case the first course of cation taken does not work, and they should not merely be policies, but must be felt to work practically (William, 1996, p. 113).

3.5.5. Honoring promises

Customers hate to be disappointed and so when a business or organization promises something, it should honor that promise and be sure to deliver. In the case of universities for example, suppose the promise to upgrade the library stock, or increase the number of lecture hours for a given discipline, they should see to it that this is done within the shortest time possible and if not, the students (customers) should be updated on an ongoing basis on the progress being made (Robert, 2004, p. 74).

3.6. Impacts of customer focus

As earlier mentioned, focusing on the customer while designing or delivering products or services means that processes used in ensuring customer satisfaction are generated from the feedback that the customer gives to the organization regarding the said processes, services and products. When customers are put at the centre stage during implementation of service delivery, positive impacts are bound to be felt and these include a change in for example the library's mission, planning and policies, which become focused on supporting the customers' need in terms of information and communication, since all written documents acknowledge customer focus as the driving force.

Leadership becomes crucial, in that the library's director and top management become committed to supporting assessment in ensuring that customer focus holds up Assessment becomes part of the normal process of service delivery.

Through needs assessment, quality outcome and satisfaction measures, continuous communication with customers become easier to maintain. All library programs and services are evaluated on an ongoing basis, such that quality and impacts are maintained at the required level. Furthermore, staff members are made to understand that evaluation is more process-focused rather than individual-centred. With this understanding, provision of services aimed at customer satisfaction is enhanced, as it becomes easier to spot loopholes and deal with them accordingly. With such evaluation,

staff members also have the opportunity and resources to improve their skills in order to deliver more customer-oriented services (Mitts an Robin, 1998, p. 57).

Nevertheless, there are negative impacts that can arise as a result of customer focus. These may either be on the side of the organization or of the students/customer. On the part of the organization, customer focus may lead to over-stretching of resources. In the implementation process it was mentioned that constant face to face communication should be central. These means that the organization will require to employ more than enough staffs in order to reach out to the overwhelming numbers of customers at the university, for example. In some cases, the organization may find itself overdoing customer focus and as a guide to establishing the limits, the following questions can act as a guide to setting the limits is the organization overly responsive to customer demands, is it too willing to adjust timetables and established process all with an aim of responding to customers' unreasonable needs, are the policies consistent in some cases and not in others, does the organization get overwhelmed by negative comments and does the organization stick too close to customer needs that it misses out on overall objectives When these negative impacts can be felt within the organization, it is time to consider alternative approaches to quality service delivery (teaching), assessment methods and response to customer issues or complaints (Marmar, 2005, p. 165).

3.7. Analysis and discussion

The one major challenge that still faces the education sector the world over despite implementation of customer-oriented service delivery approaches is to prepare students to aim competitive advantage in the world marketplace. To overcome this challenge, universities as the centre of focus in this paper need to identify the needs and wants of their customers and customize their service delivery strategies into meeting these needs, yet this needs to be done in a professional manner. Keith (1993, p. 49 51) are of the opinion that customer focus movement has to put into consideration continuous improvement, customer satisfaction, quality education and positive return on investment in establishment of universities that are focused on producing well-armed to compete for jobs in the world market.

There is a lot that needs to be done in achievement of the above and some of the strategies that can be acquired are creative constancy of purpose. The biggest and most important purpose of the organization should be creation of the vision of what education should deliver, all for the success of the learner. Organizations also need to adopt a new philosophy that will enable them to move from school-centred approach to learning to a learner-centred approach to success. In the words of Joseph (2007, p 98), the success of the student/customer should be placed before the success of the organization as a whole. The organization also ought to cease from depending on mass inspection as a means to attainment of quality. Instead, let organizations shift from evaluating teachers and students on the basis of grading and performance tests and instead shift to self-pacing and self-evaluation. A customer should be trained to gauge

their own performance against their previous performance, rather than against other customers' performance.

The practice of rewarding individual learners in a classroom performance should be discouraged and instead rewarding of the total understanding and achievements of the collective customer cluster. This will help the customer establish a winning mentality collectively. By being genuinely interested in the collective customer cluster, the teachers will be able to establish methods trough which they can constantly improve the system of teaching to benefit everyone. Another very important aspect of teaching that ought to be incorporated in universities as a teaching strategy is institute training on the job. School curriculum should incorporate in service experiences with the theoretical topics learnt in class so as to provide competence, empower the students and encourage growth and self-development. Such approaches to learning will drive out fear, especially where considerable risk is involved and undertaken successfully (James, William and Edwin, 1994, p. 69).

This is especially true where the risk were undertaken to achieve educational objectives. In addition to institute raining on the job, the organizations need to take a step towards braking down barriers between classes, departments, specialities and schools within the organization. By so doing, students will be free to consult and have their needs attended to, without fear of breach of boundaries. This goes hand in hand with elimination of slogans, numerical targets and exhortations that otherwise tend to pull down performance of students consciously or otherwise. Numerical targets especially have the tendency to make students work towards the targets to please the ones setting the targets without necessarily putting real value or attachment to the work they do. On the part of the organization staff or employees, there is need to eliminate irrelevant work standards like performance contracts and instead focus on mastery of the job and competence, more than attendance and compliance. Isn't it obvious that employees could sign the attendance register on a daily basis, yet deliver nothing for the day? there is need to focus on the input that teachers make regardless of the amount of hours spent making that input (Henry, 1951, p. 47).

Quality should be the focus, more than quantity. Furthermore, there is need to remove barriers that deprive learners, administrations and educators of their right to celebrate their accomplishments. In addition, a vigorous process of result oriented service education should be geared towards self improvement of all staff members and customers. Evaluation should used for improvement purposes as opposed to finding blame and pointing fingers at people. As such, everyone should be enrolled into the system to work together in order to achieve total transformation. (Schmoker and Wilson, 1993, p. 17).

3.8. Problems faced by students despite customer focus approaches

Scholars are interested in finding out what other issues could be causing a mismatch between skills acquired during training at the university. It is in this regard that the

Working Group on Retention comprising a number of crucial stakeholders in the education sector came together to compile a report on the findings about the problems faced by students. The research was carried out at one of the universities at Brownsville and the objectives aimed at after compilation of the report included providing a setting in which students are able to expand and enrich their knowledge, understanding and values, as well as gain a deeper understanding of their society. Students also ought to be encouraged to become more mature individuals who are self directed and responsible in local and global participation (Glasser, 1993, p. 215).

Among the problems identified as the most nagging and which in most cases lead to dropping out by students despite implementation of customer focused approach include job versus class conflicts. Most of the students at the university levels juggle between a part time job and their regular classes, and yet the work schedules are quite inflexible that they conflict with classes. Change in work schedules and challenges of managing a full job while taking full time classes are also some of the challenges that make the efforts of customer focus futile in many instances (Glasser, 1993, p. 215).

Dissatisfaction with instructions given in class leads to conflicts between lecturers and students, hence the is perceived lack student-centeredness, which may not be necessarily by the case. Students were also seen to have a lot of unfulfilled expectations from their classes and lecturers. There are also personal problems which are not tackled through customer focus approaches. Some of these problems which affect performance in school include lack of family support. emotional factors, stress, childcare issues among others. Looking at them closely, they are issues that may not be tackled in any way through customer focus.

Financial difficulties which render students unable to attend school regularly have a final impact on the way students perform in schools. Boling and Evans (2008, p. 58), report that another major problem that is rooted within the students, and which has nothing to do with the approaches to service delivery, is the reading epidemic. A majority of students are rarely reading on grade level and have been found to be lacking the literary skills that are needed to attain basic level of education. In their research, they established that more than seven thousand students drop out of school every year because they lack basic reading and writing skills.

In addition, teachers have been fooled to believe that students who read out coherently also comprehend what they are reading, while in many cases this is not the case. With the increased emphasis that is being laid on phonics in the primary level grades, many students are merely memorizing words, but not paying keen attention to the importance of comprehension. As these students progress to higher levels, transition from work calling to text comprehension proves to be quite a challenge that customer focus alone may not be able to wipe out successfully. This is a problem that needs the input of teachers, right from the elementary levels to the higher levels of education, with an aim of giving individualized attention to individual students, and encouraging them to lay

emphasis on understanding, more than memorizing (Geoff 2003, p. 59).

Alif 1998 argued that adoption of TQM and in particular Customer Focus would go a long way in enhancing customer satisfaction the many advantages that come with application of TQM include but are not limited to increased student empowerment, which mean that students will be in a better position to understand themselves, know where their weaknesses lies and know where to seek help to work on the weaknesses. In addition, TQM ensures improved delivery of student services, both in continuing and vocational education, which would ensure that students are able to receive the type of skills that assure them that they will be able to create jobs, as compared to scrambling for the few available employment opportunities. TQM also comes with decreased compartmentalization, which sees to it that students can seek help with their studies from any lecturer in any lecturer in any department without many major constraints. In addition, introduction of use of technology in the learning process with focus on mastering learning skills goes a long way in enhancing the quality of education because it emphasizes on understanding concepts, more than recalling of the same (Edward, 2003, p. 118).

3.9. Conclusion and recommendations

From the discussion and literature review above, it goes without saying that student need to be treated as the most important customers, both for the success of the organization and for their organization as well. It therefore means that customer focus should be central in formulation of strategies aimed at service delivery in educational institutions. Education can open doors to opportunities that are otherwise difficult to come by without the said education. With the ever fluctuating economic times and uncertainty in the job market, there is a greater need than ever before to provide children with proper education that will guarantee them job security and more so the ability to generate revenue which is crucial for survival. What then can universities do in order to influence the requirements of customer focus?

Alan, Phil and Peter, 2006, p. 43 say that great service is what differentiates one company from another in this competitive world. Universities need to hire service providers in this case teachers, who posses or can be trained to acquire some sets of skills that would influence customer focus positively. Some of these skills are communication skills, listening skills, problem solving skills, professionalism. flexibility, initiative and proactive-ness and task orientation, meaning that they should be trained specifically on handling students and all their dynamisms. Some of the requirements of customer focus that universities may want to put into consideration in the process of adoption of customer focus are identification of the main elements of the service offered.

This means that in the education sector, there is need to identify the most important elements of the service in the eyes of the customers/students. For example, is it the lecture sessions, the assignments or the library services? This can be done by engaging

the students in a survey to establish the facts on the ground and the process may comprise the steps; determination of the relative significance of each service element, establishing the organization's competitiveness for those services, identification of distinct service requirements for different types of customers/students and development of specific customer service packages. This way, customer focus will not only be aimed at giving customers what they want, but also at creating sustainable systems that will serve generations and generations to come (Donald, 1999, p. 28).

3.10. Recommendations

Customer focus at the university levels ought to concentrate on students as the primary customers and their parents, taxpayers and other partners to the institutions as secondary customers. This is to say in other words that focus should shift from partners, board of governors and the government to the students, who are the primary beneficiaries of the services offered at the university. After all, it is because of the money they pay to the universities that all other stakeholders, especially teachers and governors are able to get their pay. Mentality ought to change from customer, 'you are here because of us' to we are here because of you (David, 1990, p.93).

Universities should be encouraged to assist students every step of the way in the learning process. For example, in order for students to acquire the required skills for a given job, universities should be able to liaise with such companies in the specific industry to offer internship programs for three to six months to students, so that they can learn the theory in class and the practical on the real job. This would go a long way in eliminating the need for students to juggle between a job and classes, which contributes to poor performance and waters down the efforts made through customer focus approaches. This would especially serve the purpose if the students are paid some stipend in the course of the internship (Randy and Norman, 2008, p. 69).

On the issue of dissatisfaction with instructions given in class, there is need to always consult with the customers and explain why things have to be done the way they are done. By so doing, the customers and service providers will be able to find agreement points. If the customers see the service providers as being on the same side with them, they are more likely than not to cooperate than to react in anger or rebellion.

Most importantly, customer services should always be provided in plain language that a customer can understand. This may not necessarily be applicable in the class setting, but it is crucial in making the customer feel important and needed (Alan, Phil and Peter, 2006, p. 17).

Customer focus is more about finding out what the customer knows and feels about their needs and establishing the gaps between their needs and actually attaining them. This mostly applies to handling customer complaints. It is always best to understand what it is s that a customer wants by putting statements into questions.

For example, when responding to a customers' complaint there are two approaches that one can use, but one which would sound cooperative, and the other more demanding

and demeaning, For example, plainly telling a customer to walk to particular office and see a particular person may sound harsher than asking them if they have information that they could actually talk to a given person and have their problem resolve more quickly. Again the tone of the voice used greatly matters (Bren995, p.99).

3.11. What is Customer Retention?

The customer retention definition in marketing is the process of engaging existing customers to continue buying products or services from your business. It's different from customer acquisition or lead generation because you've already converted the customer at least once. The best customer retention tactics enable you to form lasting relationships with consumers who will become loyal to your brand. They might even spread the word within their own circles of influence, which can turn them into brand ambassadors. But let's start at the beginning. You've sold a product or service to a consumer, so what next? That's when you build and implement customer retention strategies.

The Importance of Customer Retention for an Online Business:-

You might have heard that it's easier and less expensive to retain customers than to acquire them. The most recent statistics indicate that it's true. For one thing, you'll spend five times less money on customer retention.

Additionally, at best, your probability of selling to an existing customer is at least 40 percent more likely than converting someone who has never bought from you before.

Existing customers also spend 31 percent more than new leads, and when you release a new product, your loyal customers are 50 percent more likely to give it a shot. Those statistics should prove sufficient to compel you to build and test out a customer retention strategy.

How to Calculate Your Customer Retention Rate

Companies can calculate their customer retention rates in different ways. It all depends on what period of time you're examining, but many marketers use too many variables. Let's say that you have 2,000 existing customers over a period of two months. During that same period, 900 of them return to buy something else from you. Those are the two numbers that will allow you to calculate your customer retention rate.

However, you have to discount any new customers you bring on during those two months. They're not part of the equation. You should only count the people who bought something from you prior to the two month start date among your existing customers. If you're measuring your customer retention rate from January 1 to February 28, you would take into consideration the customers who bought from you prior to January 11. If a new customer buys from you on January 15, he or she doesn't count.

3.12. Importance of customer retention

Customer retention-the act of keeping current customers that you have already spent money acquiring-is extremely important for any business. Attracting a new customer costs, on average, five times as much as keeping an existing one, and depending on the industry you are in, in can cost up to 30 times as much to acquire a new customer vs. retaining an existing customer! Increasing customer retention rates by just 5% increases profits by 25% to 95%. Many companies don't realize how important retention is, focusing more on acquisition and sometimes leaving their current-and loyal-customers unsatisfied.

Customer retention helps increase the profitability of your business in a number of ways that you might not realize. Here are five reasons why customer retention is key to your business' success.

(1) Save Money on Marketing

As we mentioned above, it costs significantly more to acquire a new customer than it does to retain an existing one. So save your money and reduce your marketing expenses by keeping your old customers who are already familiar with your products and services. Familiarization with your products and services also means your business needs to spend less time on customer support.

(2) Repeat Purchases from Repeat Customers Means Repeat Profit

Loyal customers will use your business regularly for purchases and tend to spend more money. Existing customers are 3 to 10x more likely to buy than a cold lead (Mar Tech). They are 50% more likely to buy new products and spend 33% more than new customers. A valued customer trusts your business and believes that you offer a superior service compared to competitors. This customer believes that your company listens to their needs and requests so it is important that you do so! Pay attention to which brands, products and purchases this customer prefers, as they are more likely to make additional purchases at your business.

(3) Free Word-Of-Mouth Advertising

We have said it before, and we'll say it again: word of-mouth is the most cost-effective advertising you can have and only comes from your loyal, happy customers. Repeat customers are more likely to tell their friends and family about your business and its products, and customers respect the opinion of those close to them. Customers are happy to tell people about excellent service they received or a product that they enjoyed.

Just look at some of the numbers:

49% of U.S. consumers say friends and family are their top sources of brand awareness.

People who are referred by a friend are 4x more likely to buy from a business, and one offline word of mouth impression drives sales at least 5x more than a paid impression.

92% of people trust recommendations from family and friends more than all other forms of marketing.

A successfully retained customer is much more likely to refer other customers. These referees cost less to acquire and have a higher lifetime value than customers gained from other ways.

(4) **Retained Customers Will Provide Valuable Feedback**

Customers that you retain provide valuable feedback, and it's important that you listen. 97% of consumers said they are somewhat likely to become more loyal to a company that implements their feedback, while 55% of consumers said they are not likely to continue being a customer of a company that ignores their feedback (Apptentive).

Customers who make frequent purchases from your business will know which areas of your business could be improved. How can you improve your business if you are only dealing with new customers? Ask your repeat customers how your business can serve them better. This will lead to new opportunities that you may have overlooked, and lead to increased rates and sales.

(5) **Previous Customers Will Pay Premium Prices**

Long-time, loyal customers are far less price-conscious than new customers because they value your company already and, thus, are willing to pay the price for your services. Many customers associate higher prices with quality service and retained customers trust that your company can deliver this quality over competitors.

3.13. Summary

Customer retention doesn't improve overnight. However, if you have a few solid strategies up your sleeve, you can coax your existing customers back for more. First, know your customers. Figure out what they want and where their pain points lie. Next, find ways to surprise, delight, and motivate them. Get in touch. Ask for feedback and testimonials. Help them realize you appreciate their patronage. Using tools like Crazy Egg, you can test every strategy you try and continuously refine your approach. The more you test, the stronger your customer retention program becomes.

3.14. Further study

For further study you can opt the following sites and books given below :

1. www.wikipedia.com
2. https://www.crazyegg.com/blog/customer-retention/
3. https://www.derstrategies.com/5-reasons-customer-retention-business/
4. www.wikipedia.com
5. Kelvin Keller Book for Brand Management
6. Philligs Kotler's
7. Oakland on Quality Management John S. Oakland, 2004.

UNIT IV
DIMENSION OF PRODUCTS AND SERVICE QUALITY, COST OF QUALITY

OBJECTIVES

After going through this unit you should be able to know about:

- ➢ **Concept of Dimensions of Product**
- ➢ **Performance of Dimensions of Product**
- ➢ **Concept of Service Quality**
- ➢ **Meaning of Cost of Quality**

To active these objectives this unit is sectioned into the following sub-chapters.

STRUCTURE

4.1. Introduction

Performances refer to a products primary operating characteristics. This dimension of quality involve measurable attribute so brand can usually be ranked objectively on individual aspects of performance overall performance ranking, however are more difficult to develop, specially when they involve benefits that net every consumer needs. Performance is often a source of contention between customers and suppliers particularly when deliverables are not adequately defined with in specifications. The Performance of products often influences the profitability or reputation of the end user. As such many contacts or specification include damages related to influences the profitability or reputation of the end user. As such many contracts or specification include damages related to inadequate performance. The question of whether performance difference are quality difference may depend on circulational performances but preferences based on functional requirements not taste. Same performance standard are based on subjective preferences but the preferences are so universals that they have the force of an objective standard. Features are additional characteristics that enhance the appeal of the product or service to the user. Similar thinking can be applied to features a seemed dimensions of quality that is often a secondary aspects of performance features are the 'bells and whistles' of a products and services those characteristics that supplement their basic functioning. Example-free drink in a plane permanent-press cycle as a washing machine and automatic tuners as a color television set. The line separately primary performance characteristic from secondary features is often difficult to draw.

4.2. Concept of Dimensions of Product

4.2.1. Reliability

Reliability is the likelihood that a product will not fail within a specific time period. This is a key element for users who need the product to work without fail. This dimension reflects the probability of a product malfunctioning or failing within a specified period. Among the most common measures of reliability are the mean time to first failure, the mean time between failures, and the failure rate per unit time. Because these measures require a product to be in use for a specified period, they are more relevant to durable goods than to products and services that are consumed instantly.

Reliability normally becomes more important to consumers as downtime and maintenance become more expensive. Farmers, for example, are especially sensitive to downtime during the short harvest season. Reliable equipment can mean the difference between a good year and spoiled crops. But consumers on other markets are more attuned than ever to product reliability too. Computers and copying machines certainly compare on this basis.

Reliability may be closely related to performance, for instance, a product specification may define parameters for up-time, or acceptable failure rates. Reliability is a major contributor to brand or company image, and is considered a fundamental dimension of

quality by most end users. For example, recent market research shows that, especially for women, reliability has become an automobile's most desired attribute.

4.2.2. Conformance

The dimension of conformance depicts to what extent a product's design and operating characteristics meet established standards. This dimension owes the most to the traditional approaches to quality pioneered by experts like Juran.

All products and services involve specifications of some sort. When products are developed, these specifications are set and a target is set, for instance the materials used or the dimension of the product. Not only the target but also the tolerance (the range of permitted deviation from the target) is defined. One problem with this approach is that there is little interest in whether the specifications have been met exactly as long as the tolerance limits are met.

On the one hand, this can lead to the so called 'tolerance stack-up'. When two or more parts are to be fit together, the size of their tolerances often determine how well they will match. Should one part fall at a lower limit of its specification and a matching part at its upper limit, a tight fit is unlikely. link is likely to wear more quickly than one made from parts whose dimensions have centered more exactly.

This problem can be addressed by taking a different approach to measuring quality. Instead of measuring a simple conformance to specifications, the degree to which parts or products diverge from the ideal target is measured. Using this approach, process 1 (see picture) is better even though some items fall beyond specification limits. The traditional approach would have favored process 2 because it produces more items within the specification limit. It was demonstrated that the problem of 'tolerance stack-up' is worse when the dimensions of parts are more distant from the target than when they cluster around it, even if some parts fall outside the tolerance. This approach requires a fresh look at the common process quality factor of' defect rate; to take into account the fact that two parts may each pass the tolerance test' separately but be unusable when the attempt is made to join them together. In service businesses, measures of conformance normally focus on accuracy and timeliness and include counts of processing errors, unanticipated delays and other frequent mistakes.

4.2.3. Durability

Durability measures the length of a product's life. When the product can be repaired, estimating durability is more complicated. As well The item will be used until it is no longer economical to operate it. This happens when the rate and the associated costs increase significantly. Technically, durability can be defined as the amount of use one gets from a product before it deteriorates. After so many hours of use, the filament of a light bulb burns up and the bulb must be replaced. Repair is impossible. Economists call such products 'one-hoss shays' (Oliver Wendel Holmes poem).

In other cases, consumers must weigh the expected cost, in both dollars and personal inconvenience, of future repairs against the investment and operating expenses of a newer, more reliable model. Durability, then, may be defined as the amount of use one gets from a product before it breaks down and replacement is preferable to continued repair.

This approach to durability has two important implications. First, it suggests that durability and reliability are closely linked. A product that often fails is likely to be scrapped earlier than one that is more reliable; repair costs will be correspondingly higher and the purchase of a competitive brand will look that much more desirable. Second, this approach implies that durability figures should be interpreted with care. An increase in product life may not be the result of technical improvements or the use of longer-lived materials. Rather, the underlying economic economic environment simply may have changed.

4.2.4. Serviceability

Serviceability involves the consumer's ease of obtaining repair service (example: access to service centers and/or ease of self-service), the responsiveness of service personnel(example: ease of getting an appointment, willingness of repair personnel to listen to the customer), and the reliability of service (example; whether the service is performed right the first time). Competence and ease of repair is the speed with which the product can be put into service when it breaks down, as well as the competence and the behavior of the service personnel.

Consumers are concerned not only about a product breaking down but also about the time before service is restored, the timeliness with service appointment are kept, the nature of dealings with service personnel, and the frequency with service personnel, and the frequency with which service calls or repairs fail to correct outstanding problems. In those cases where problems are not immediately resolved and complaints are filed, a company's complaint handing procedures are also likely to affect customer's ultimate evaluation of product and service quality.

Some of these variables reflect differing personal standards of acceptable service, while others can be measured quite objectively. Customers may remain dissatisfied even after completion of repairs. How these complaints are handled is important to a company's reputation for quality and service. Eventually, profitability is likely to be affected as well. Companies differ widely in their approaches to complaint handling and in the importance they attach to this element of serviceability. Some do their best to resolve complaints; others use legal gimmicks, the silent treatment and similar ploys to rebuff dissatisfied customers.

For example, recently, General Electric, Procter & Gamble and other companies have sought to pre-empt consumer dissatisfaction by installing toll-free telephone hot lines to their customer relations departments.

Important attributes for the serviceability, parts warranty, parts availability, distance to dealer service centers. distance to service parts center-dealer, distance to service parts center individual, length of wait for service appointment, schedule of preventive maintenance, employees listen to customers, information regarding repairs, courteous service centers, repaired correctly first time, service time relative to other dealers, warranty claims handled without argument, average repair cost/year, extended warranty, underestimation of service cost and provision of loan car.

4.2.5. Aesthetics or Style

The aesthetic properties of a product contribute to the identity of a company or a brand. Faults or defects in a product that diminish its aesthetic properties, even those that do not reduce or alter other dimensions of quality, are often cause for rejection.

Aesthetics refers to how the product looks, feels, sounds, tastes, or smells. It is clearly a matter of personal judgment and a reflection of individual preference. Nevertheless, there appear to be some patterns in consumers' rankings of products on the basis of taste.

A recent study of quality in 33 food categories, for example, found that high quality was most often associated with attributes such as 'rich and full flavor, tastes natural, tastes fresh, good aroma, appetizing looks'. Aesthetics also refers to the 'outside' feel of the product.

The aesthetics dimension differs from subjective criteria pertaining to 'performance' in that aesthetic choices are not nearly universal. Not all people prefer 'rich and full' flavor or even agree on what that means. Companies therefore have to search for a niche. On this dimension of quality, it is impossible to please everyone.

Quality in Japanese culture

In Japanese culture, there are two types of quality *atarimae hinshitsu* and *miryokuteki hinshitsu*.

* *atarimae hinshitsu* –The idea that things will work as they are supposed to (e.g. a pen will write).The functional requirement actually. For example, a wall or flooring in a house have functional parts in the house as a product; when the functionality is met, the 'atarimae' quality requirement is met.

* *miryokuteki hinshitsu* – The idea that things should have an aesthetic quality which is different from 'atarimae hinshitsu' (e.g. a pen will write in a way that is pleasing to the writer, and leave behind ink that is pleasing to the reader). The floor and wall example can be expanded to include the color, texture, shine, polish, etc., which are the 'miryokuteki' aspects. Such aspects comprise a very important part of the quality, and add value to the product.

In the design of goods or services, *atarimae hinshitsu* and *miryokuteki hinshitsu* together ensure that a creation will both work to customers' expectations and also be desirable to have.

4.2.6 Perceived Quality

Perception is not always reality. Consumers do not always have complete information about a product's or service's attributes; indirect measures may be their only basis for comparing brands.

A product's durability for example, can seldom be observed directly; it usually must be inferred from various tangible and intangible aspects of the product. In such circumstances, images, advertising and brand names inferences about quality rather than the reality itself-can be critical. For this reason, both Honda-which makes cars in Marysville, Ohio-and Sony-which builds color televisions in San Diego have been reluctant to publicize that their products are 'made in America'.

Reputation is the primary stuff of perceived quality. Its power comes from an unstated analogy: that the quality of products today is similar to the quality of products of yesterday, or the quality of goods in new product line is similar to the quality of a company's established products.

4.3. Structure of Service Quality and Definitions

Service Quality (SQ), in its contemporary conceptualisation, is a comparison of perceived expectations (E) of a service with perceived performance (P), giving rise to the equation $SQ = P - E$. this conceptualization of service quality has its origins in the expectancy-disconfirmation paradigm. A business with high service quality meet or exceed customer expectations whilst remaining economically competitive. Evidence from empirical studies suggests that improved service quality increases profitability and long term economic competitiveness. Improvements to service quality may be achieved by improving operational processes; identifying problems quickly and systematically; establishing valid and reliable service performance measures and measuring customer satisfaction and other performance outcomes.

Definition

From the viewpoint of business administration, service quality is an achievement in customer service. It reflects at each service encounter. Customers form service expectations from past experiences, word of mouth and marketing communications. In general, customers compare perceived service with expected service, and if the former falls short of the latter the customers are disappointed.

For example, in the case of Taj Hotels Resorts Resorts and Palaces. Wherein TAJ remaining the old world, luxury brand in the five-star category, the umbrella branding was diluting the image of the TAJ brand because although the different hotels such as *Vivanta by Taj-* the four star category,*Gateway* in the three star category and*Ginger* the two star economy brand, were positioned and categorised differently, customers still

expected high quality of Taj. The measurement of subjective aspects of customer service depends on the conformity of the expected benefit with the perceived result. This in turns depends upon the customer's expectation in terms of service, they might receive and the service provider's ability and talent to present this expected service. Successful companies add benefits to their offering that not only satisfy the customers but also surprise and delight them. Delighting customers is a matter of exceeding their expectations.

Pre-defined objective criteria may be unattainable in practice, in which case, the best possible achievable result becomes the ideal. The objective ideal may still be poor, in subjective terms.

Service quality can be related to service potential (for example, worker's qualifications); service process (for example, the quickness of service) and service result (customer satisfaction).

Individual service quality states the service quality of employees as distinct from the quality that the customers perceived.

Evolution of service quality concept :

Historically, scholars have treated service quality as very difficult to define and measure, due to the inherent intangible nature of services, which are often experienced subjectively.

One of the earliest attempts to grapple with the service quality concept came from the so- called Nordic School . In this approach, service quality was seen as having two basic dimensions;

Technical quality : What the customer receives as a result of interactions with t service firm (e.g. a meal in a restaurant, a bed in a hotel)

Functional quality : How the customer receives the service ;the expressive nature of the service delivery (e.g. courtesy, attentiveness, promptness)

The technical quality is relatively objective and therefore easy to measure. However, difficulties arise when trying to evaluate functional quality.

4.4. Dimensions of Service Quality

A customer's expectation of a particular service is determined by factors such as recommendations, personal needs and past experiences. The expected service and the perceived service sometimes may not be equal, thus leaving a gap . The service quality model or the GAP model' developed in1985, highlights the main requirements for delivering high service quality. it identifies five gaps' that cause unsuccessful delivery. Customers generally have a tendency to compare the service they 'experience' with the service they 'expect'. If the experience does not match the expectation , there arises a gap. Given the emphasis on expectation, this approach the measuring service quality is

known as the expectancy-disconfirmation paradigm and is the dominant model in the consumer behaviour and marketing literature.

A model of service quality, based on the expectancy-disconfirmation paradigm, and developed by A. Parasuraman. Valarie A. Zeithaml and Len Berry, identifies the principal dimensions (or components) of service quality and proposes a scale for measuring service quality, known as SERVQUAL. The model's developers originally identified ten dimensions of service quality that influence customer's perceptions of service quality. However, after extensive testing and retesting, some of the dimensions were found to be autocorrelated and the total number of dimensions was reduced to five, namely-reliability, assurance, tangibles, empathy and responsiveness. These five dimensions are thought to represent the dimensions of service quality across a range of industries and settings. Among students of marketing, the mnemonic, RATER, an acronym formed from the first letter of each of the five dimensions, is often used as an aid to recall.

In spite of the dominance of the expectancy-disconfirmation paradigm, scholars have questioned its validity. In particular scholars have pointed out the expectancy-disconfirmation approach had its roots in consumer research and was fundamentally concerned with measuring customer satisfaction rather than service quality. In other words, questions surround the face validity of the model and whether service quality can be comceptualised as a gap.

4.4.1. Measuring service quality

Measuring service quality may involve both subjective and objective processes. In both cases, it is often some aspect of customer satisfaction which is being assessed. However, customer satisfaction is an indirect measure of service quality.

E-service quality: The next frontier

Given the widespread use of internet and e-commerce, researchers have also sought to define and measure e-service quality. Parasuraman, Zeithaml, and Malhotra (2005, p5) define e-service quality as the 'extent to which a website facilitates efficient and effective shopping, purchasing, and delivery.'

Wolfinbarger and Gilly (2003, p. 183) define e-service quality as 'the beginning to the end of the transaction including information search, website navigation, order, customer service interactions, delivery, and satisfaction with the ordered product.' A recent paper examined research on e-service quality. The author identified four dimensions of e-service quality: website design, fulfillment, customer service, and security and privacy.

4.4.2. Measuring subjective elements of service quality

Subjective processes can be assessed in characteristics (assessed be the SERVQUAL method); in incidents (assessed by Frequenz Relevanz Analyes a German term. The most important and most used method with which to measure subjective elements of service quality is the Servqual method.

4.4.3. Measuring objective elements of service quality

Objective processes may be subdivided into primary processes and secondary processes. During primary processes, silent customers create test episodes of service or the service episodes of normal customers are observed. In secondary processes, quantifiable factors such as numbers of customer complaints or numbers of returned goods are analysed in order to make inferences about service quality.

4.4.4. Approaches to the improvement of service quality

In general, an improvement in service design and delivery helps achieve higher levels of service quality. For example, in service design, changes can be brought about in the design of service products and facilities. On the other hand, in service delivery, changes can be brought about in the service delivery processes, the environment in which the service delivery takes place and improvements in the interaction processes between customers and service providers.

Various techniques can be used to make changes such as: Quality function deployment (QFD); failsafing; Recovering; Setting standards and measuring; Statistical process control and Customer involvement.

4.4.5. Service quality and customer satisfaction

The relationship between service quality and customer satisfaction has received considerable attention in academic literature. The results of most research studies have indicated that the service quality and customer satisfaction are indeed independent but are closely related that and a rise in one is likely to result in an increase in another construct.

4.5. Meaning of Cost of Quality

Cost of quality (COQ) is defined as a methodology that allows an organization to determine the extent to which its resources are used for activities that prevent poor quality, that appraise the quality of the organization's products or services, and that result from internal and external failures. Having such information allows an organization to determine the potential savings to be gained by implementing process improvements.

* Cost of poor quality (COPQ)

* Appraisal costs

* Internal failure costs

* External failure costs

* Prevention costs

* COQ and organizational objectives

* COQ resources

WHAT IS COST OF POOR QUALITY (COPQ)?

Cost of poor quality (COPQ) is defined as the costs associated with providing poor quality products or services. There are three categories:

1. Appraisal costs are costs incurred to determine the degree of conformance to quality requirements.

2. Internal failure costs are costs associated with defects found before the customer receives the product or service.

3. External failure costs are costs associated with defects found after the customer receives the product or service.

Quality-related activities that incur costs may be divided into prevention costs, appraisal costs, and internal and external failure costs.

Appraisal costs

Appraisal costs are associated with measuring and monitoring activities related to quality. These costs are associated with the suppliers' and customers' evaluation of purchased materials, processes, and services to ensure that they conform to specifications. They could include:

* Verification: Checking of incoming material, process setup, and products against agreed specifications

* Quality audits: Confirmation that the quality system is functioning correctly

* Supplier rating: Assessment and approval of suppliers of products and services

Internal failure costs

Internal failure costs are incurred to remedy defects discovered before the product or service is delivered to the customer. These costs occur when the results of work fail to reach design quality standards and are detected before they are transferred to the customer. They could include:

* *Waste* : performance of unnecessary work or holding of stock as a result of errors, poor organization, or communication

* *Scrap* : Defective product or material that cannot be repaired, used, or sold

* *Rework or rectification* : Correction or defective material or errors

* *Failure analysis*: Activity required to establish the causes of internal product or service failure

External failure costs

External failure costs are incurred to remedy discovered by customers. These costs occur when products or services that fail to reach design quality standards are not detected until after transfer to the customer. They could include:

* *Repairs and servicing* : Of both returned products and those in the field

* *Warranty claims* : Failed products that are replaced or services that are reperformed under a guarantee

* *Complaints* : All work and costs associated with handling and servicing customers; complaints

* *Returns* : Handling and investigation of rejected or recalled products, including transport costs

Prevention Costs

Prevention costs are incurred to prevent of avoid quality problems. These costs are associated with the design, implementation, and maintenance of the quality management system. They are planned and incurred before actual operation, and they could include:

* *Product or service requirements* : Establishment of specifications for incoming materials, processes, finished products, and services

* *Quality planning* : Creation of plans for quality, reliability operations, production, and inspection

* *Quality assurance* : Creation and maintenance of the quality system

* *Training* : Development, preparation, and maintenance of programs

4.6. Cost of Quality and Organizational Objectives

The costs of doing a quality job, conducting quality improvements, and achieving goals must be carefully managed so that the long-term effect of quality on the organization is a desirable one.

These costs must be a true measure of the quality effort, and they are best determined from an analysts of the costs of quality. Such an analysis provides a method of assessing the effectiveness of the management of quality and a means of determining problem areas, opportunities, savings, and action priorities.

Cost of quality is also an important communication tool. Philip Crosby demonstrated what a powerful tool it could be to raise awareness of the importance of quality. He referred to the measure as the 'price of nonconformance' and argued that organizations choose to pay for poor quality.

Many organizations will have true quality-related costs as high as 15-20% of sales revenue, some going as high as 40% of total operations. A general rule of thumb is that costs of poor quality in a thriving company will be about 10 15% of operations.

Effective quality improvement programs can reduce this substantially, thus making a direct contribution to profits.

The quality cost system, once established, should become dynamic and have a positive impact on the achievement of the organization's mission, goals, and objectives.

4.7. Cost of Quality Resources

Using Cost of Quality to Improve Business Results (PDF) Since centering improvement efforts on cost of quality, CRC Industries has reduced failure dollars as a percentage of sales and saved hundreds of thousands of dollars.

Cost of Quality : Why More Organizations Do Not Use It Effectively (PDF) Quality managers in organizations that do not track cost of quality cite as reasons a lack of management support for quality control, time and cost of COQ tracking, lack of knowledge of how to track data, and lack of basic cost data.

The Tip of the Iceberg (PDF) A Six Sigma initiative focused on reducing the costs of poor quality enables management to reap increased customer satisfaction and bottom-line results.

Cost of Quality (COQ): Which Collection System Should Be Used? (PDF) This article identifies the various COQ systems available and the benefits and disadvantages of using each system.

4.7.1. Definition of cost of Quality

It's a term that's widely used-and widely misunderstood.

The 'cost of quality' isn't the price of creating a quality product or service. It's the cost of NOT creating a quality product or service.

Every time work is redone, the cost of quality increases. Obvious examples include:

* The reworking of a manufactured item.

* The retesting of an assembly

* The rebuilding of a tool

* The correction of a bank statement

The reworking of a service, such as the reprocessing of a loan operation or the replacement of a food order in a restaurant

4.7.2. Historical Views of Quality Gurus about cost of quality

Historically, business managers have assumed that increased quality is accompanied by increased cost; higher quality meant higher cost.

This concept was questioned by quality pioneers like Juran and Feigenbaum. Juran examined economics of quality and concluded the benefits outweighed the costs. Feigenbaum introduced 'total quality control' and developed the principles that quality

is everyone's job, thus expending the notion of quality cost beyond the manufacturing function. In 1979 Crosby introduced the new popular concept that 'quality is free'.

Three different views held by the management professionals about Cost of Quality

Today view of quality cost among practitioners seems fall into three categories:

(i) *Higher quality means higher cost* : Quality attributes such as performance and features cost more in terms of labor, material, design, and other costly costly resources. The additional benefits from improved quality do not compensate for the additional expenses.

(ii) *The cost of improving quality is less than the resultant savings* : Deming promoted this view, which is still widely accepted in Japan. The savings result from less rework, scrap, and other direct expenses related to defects. This paved the way of continuous process improvement among Japanese firms.

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

This view is held by adherents of the TQM philosophy. Costs include not only those that are direct, but also those resulting from lost customers, lost market share, and many hidden costs and foregone opportunities not identified by modem cost accounting systems.

4.8. Categorizations of Quality Costs

The cost of quality is generally classified into four categories:

1. External Failure Cost

2. Internal Failure Cost

3. Inspection (appraisal) Cost

4. Prevention Cost

1. External Failure Cost : Cost associated with defects found after the customer receives the product or service. Example: Processing customer complaints, customer returns, warranty claims, product recalls.

2. Internal Failure Cost Cost associated with defects found before the customer receives the product or service. Example: Scrap, rework, re-inspection, re-testing, material review, material downgrades

3. Inspection (appraisal) Cost : Cost incurred to determine the degree of conformance to quality requirements (measuring, evaluating or auditing). Example: Inspection, testing, process or service audits, calibration of measuring and test equipment.

4. Prevention Cost : Cost incurred to prevent (keep failure and appraisal cost to a minimum) poor quality. Example: New product review, quality planning, supplier surveys, process reviews, quality improvement teams, education and training.

4.9. Conclusion

Performance is often a source of contention between customers and suppliers while service quality is an achievement in customer service encounter.

The cost of quality is a methodology that allows an organization to determine the extent to which its resources are used for activities that prevent poor quality that appraise the quality of the organizations products or services and that result from internal and external failures.

In light of above the study of above mentioned concepts are very important.

4.10. References/Further Study

For further study you can opt the following sites and books given below :

1. www.wikipedia.com

2. Philips Kotler book of Marketing Management

3. Kevin Kane Keller book of Brand Management

BLOCK II
PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT

UNIT - I.   Overview of the Contributions, Juran Crosby, Masaaki   Imai, Feigenbaum, Ishikawa, Taguchi Techniques, Introduction, Loss Functions, Parametre and Tolerance design, Signal to Noise ratio.

UNIT - II.   Concepts of Quality Circle, Japanese 5S Principles and 8D Methodology.

UNIT I

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Tshikawa, Taguchi techniques- introduction, loss function, parameter and tolerance design, signal to noise ratio.

OBJECTIVES:

After going through this unit you should be able to know about the-

- ➢ Concept of Quality/Quality of Design:-
- ➢ Definition of Total Quality Management:-
- ➢ Concept from Quality Gurus. (Deming Approach)
- ➢ Contribution to Phillip B. Crosby.

STRUCTURE:

To achieve these objectives this unit is sub-sectioned into the following sub chapters:-

1.1. Introduction

1.2. Definition of Total Quality Management

1.3. Concept from Quality Gurus

1.4. Contribution to W. Edwards Deming.

1.5. Joseph M. Juran contribution

1.6. Contribution to Philip B Crosby

1.7. Contribution to Masaaki Imai

1.8. Elements of JIT

1.9. Contribution of Armand V. Feigenbaum

1.10. Hidden plant

1.11. Crucial Elements of Total Quality

1.12. Contribution to Kauru Ishikanta

1.13. Conclusion

1.14. References/Further study

1.1. Introduction

In the present competitive environment, survival of the organizations depends on their ability to continuously improve as per the expectations of the customers. Quality is critical in achieving competitiveness in domestic and global market.

Though there are wide variety of concepts surrounding the term 'quality', all writers agree that quality is one of the important 'critical success factors' to achieve competitiveness in organizations. Quality has expanded beyond the concept of 'customer satisfaction with products and services' to the concept of 'creation of worth for all stakeholders'.

In this context, overall business excellence is replacing the narrow objective of meeting customer specifications to improving the performance of the whole system. This includes array of issues, including environment, occupational health and safety, and social responsibility.

The success of TQM mainly depends on the achievement of internal as well as external customer satisfaction. Internal customer satisfaction is a prerequisite to achieve external customer satisfaction. Quality is journey starting from design, to conformance, and ends at better performance. This process considers quality as a never ending' improvement (Gitlow, 1989) .

Quality of design conformance performance

a. **Quality of design** : This is the degree of achievement of purpose by the design itself. It starts with market research, sales feedback analysis and continues the development of a product/service that would satisfy the customer.

b. **Quality of conformance** : It is the extent to which a firm, its processes and its suppliers are able to surpass are able to surpass the design specifications required to service the needs of the customer.

c. **Quality of performance**: This identifies the extent to which customer needs are satisfied by performance of a product/service over a period of time.

Total - The responsibility for achieving Quality rests with everyone a business no matter what their function. It recognises the necessity to develop processes across across the business, that together lead to the reliable delivery of exact, agreed customer requirements. This will achieve the most competitive cost position and a higher return on investment.

Quality - The prime task of any business is to understand the needs of the customer, then deliver the product or service at the agreed time, place and price, on every occasion. This will retain current customers, assist in acquiring new ones and lead to a subsequent increase in market share.

Management - Top management lead the drive to achieve quality for customers, by communicating the business vision and values to all employees; ensuring the right business processes are in place: introducing and maintaining a continuous improvement culture. To gain an understanding to TQM, it is worth looking at how it developed and the impact of some of the main management 'gurus' over the years.

1.2. Definition of Total Quality Management

Total quality management is a business philosophy that seeks to encourage both individual and collective responsibility at every stage of the production process from initial design and conception through to after sales services.

TQM is a management philosophy, a paradigm, a continuous improvement approach to doing business through a new management model. The TQM philosophy evolved from the continuous improvement philosophy with a focus on quality as the main dimension of business.

TQM is a comprehensive management system which:

* Focuses on meeting owners'/customers' needs by providing quality services at a cost that provides value to the owners/customers

* Is driven by the quest for continuous improvement in all operations

* Recognizes that everyone in the organization has owners/customers who are either internal or external

* Views an organization as an internal system with a common aim rather than as individual departments acting to maximize their own performances

* Focuses on the way tasks are accomplished rather than simply what tasks are accomplished

* Emphasizes teamwork and a high level of participation by all employees.6

1.3. Concepts from Quality Gurus

(a) Deming's approach.

Deming had made a highly significant contribution during the war in increasing America's industrial efficiency.

After the war was won, although well received by engineers and scientists, top management did not respond to his ideas. Industry went back to the old established ways of trying to meet consumer market opportunities.

In Japan however Deming found a much more receptive audience, his ideas once implemented led during the 80s, to American business being battered by Japan's superior industrial practices.

In order to compete and survive, the rest of the world were forced to take his ideas seriously, adopting : Japanese methods such as TQM and Lean Manufacturing.

Deming proposed few points as the principles of TQM (Deming, 1986), which are listed below:

PRINCIPLE 1: "Create a constancy of purpose"

    * Define the problems of today and the future

    * Allocate resources for long-term planning

    * Allocate resources for research and education

    * Constantly improve design of product and service

PRINCIPLE 2 : "Adopt the new philosophy"

    * Quality costs less not more

    * Superstitious learning

    * The call for major change

    * Stop looking at your competition and look at your customer instead

PRINCIPLE 3 : "Cease dependence on inspection"

    * Quality does come from inspection

    * Mass inspection is unreliable, costly, and ineffective

* Inspectors fail to agree with each other

* Inspection should be used to collect date for process control

PRINCIPLE 4 : "Do not award business based on price tag alone"

* Price alone has no meaning

* Change focus from lowest initial cost to lowest total cost

* Work toward a single source and long term relationship

* Establish a mutual confidence and aid between purchaser and vendor

PRINCIPLE 5 : "Improve constantly the system of production and service"

* Quality starts with the intent of management

* Teamwork in design is fundamental

* Forever, continue to reduce waste and continue to improve

* Putting out fires is not improvement of the process

PRINCIPLE 6 : "Institute training"

* Management must provide the setting where workers can be successful

* Management must remove the inhibitors to good work

* Management needs an appreciation of variation

* This is management's new role.

The future thrust of quality movement in India would be based on:

1. Application Research (Industry and Academics)
2. Experience Sharing
3. ISO certificates
4. Environmental protection, safety and consumer protection for quality enhancement.

1.4. Contribution of W. Edwards Deming

Deming 14 principles

1. Create and publish the aims and purposes of the organization.
2. Learn the new philosophy.
3. Understand the purpose of inspection.
4. Stop awarding business based on price alone.
5. Improve constantly and forever.
6. Institute training.
7. Teach and institute leadership.
8. Drive out fear, create trust and create a climate for innovation.
9. Optimize the efforts of teams, groups and staff areas.
10. Eliminate Management by Objective.
11. (a) Eliminate numerical quotas the work force.

    (b) Eliminate Management by Objective.
12. Remove barriers that rob people of pride of workmanship.

13. Encourage education and self-improvement of everyone.

14. Take action to accomplish the transformation.

1.5. Joseph M Juran Contribution

Quality planning	* Identify who are the customers.
	* Determine the needs of those customers.
	* Translate those needs into our languages into our languages.
	* Develop a product that can respond to those needs.
	* Optimize the product features so as to meet our needs and customer needs.
Quality improvement	* Develop a process which is able to produce the product.
	* Optimize the process.
Quality control	* Prove that the process can produce the product under operating conditions with minimal inspection.
	* Transfer the process to operations.

Juran's 10 steps for quality improvement

According to him, Quality means -Fitness for use

1. Build awareness for the need and opportunity for improvement.

2. Set goals for improvement.

3. Organize people to reach the goals.

4. Provide training throughout the organization.

5. Carry out projects to solve the problems.

6. Report projects to solve the problems.

7. Give recognition,

8. Communicate results.

9. Keep score.

10. Maintain momentum by making annual improvement part of the regular system.

1.6. Contribution to Philip B Crosby

Worked to significantly advance the cause of the world wide quality movement through his many personal contributions over the past four decades. He developed four absolutes of quality management;

• Quality means conformance to requirements, not goodness.

• Quality is achieved by prevention, not appraisal.

• Quality has a performance standard of Zero Defects. Not acceptable quality levels.

• Quality is measured by the Price of non-conformance, not indexes.

1.7. Contribution to Masaki Iami:

Founder and President of Kaizen Institute threw the work 'Kaizen'. Kaizen

- Kaizen refers to continuous or -On going improvement' in Japanese, is an inseparable aspect of Total Quality Management is required in all activities of the organization.

- Kaizen has to basically do with small, step-by-step continuous improvement, smaller and continuous improvements are more realizable, predictable, controllable, and acceptable.

- Kaizen philosophy believes that people at all levels including the lowermost levels in the organizational hierarchy, can contribute to improvements, possible because kaizen asks for only small improvements.

- To survive in an increasingly competitive world, top management must adopt a just-in-time (JIT) approach and drive change down the hierarchy without yielding to resistance.

- The key ideas associated with JIT were developed at the Toyota Motor Company under the leadership of founder EIJI TOYOTO whose father had founded the successful Toyota Spinning and weaving company.

- JIT is the management philosophy that strives to eliminate sources of manufacturing waste producing the right part in the right place at the right time.

1.8. Elements of JIT

- Stabilize and level the MPS with uniform plant loadingcreate a uniform load on all work centers through constant daily production and mixed model assembly.

- Reduce or eliminate set up times. Aim for single digit set up times less than 10 minutes or one touch setup. Done through better planning, process, re-design, and product re-design.

- Reduce lot sizes, Reducing set up times allows economic production of smaller lots, close cooperation with suppliers is necessary to achieve reduction.

- Reduce lead times. Production lead times can be reduced by moving work stations closer together, applying group technology and cellular manufacturing concepts, reduce queue length and improving the coordination and cooperation between successive processes. Delivery lead times can be reduced through close cooperation with suppliers, possibly by inducing suppliers to be located closer to the factory.

- Preventive maintenance. Use machine and worker idle time to maintain equipment and prevent breakdown.

- Flexible work force. Workers should be trained to operate several machines, to perform maintenance tasks, and to perform quality inspections.

- Require supplier quality assurance and implement a zero defect quality program.

- Small lots (single unit) conveyance. Use a control system such as Kanban system (or its larger sense, JIT with MRP system is used to convey the parts between workstations.

Reasons for a move from batch mode to Just-in-time(JIT)

- Batch production system is the most inefficient way to make products.

- Difficult to meet customer requirements, which come in different orders, like different volumes indifferent time frames and soon.

- The batch system derives from the agricultural mentality. The batch system, purchase material and produce in big batches and there are many processes. At every process, accumulate the batch and at the end accumulate the finished product in a batch, which is stored in the warehouse.

- This kind of production system is based on market forecast, is good when there is demand.

- End up with huge inventory of unsold products and excess capacity, and then borrow money to carry that inventory. By that time, acquired too many people for every process.

1.9. Contribution of Armand V Feigenbaum

Defined as quality as 'Total quality control' is an effective system for integrating the quality development, quality maintenance, and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow full customer satisfaction.

Industrial cycle:-

- Ongoing sequence to bring products or services to the customer including the activities like marketing, purchasing, design, engineering, manufacturing, production, inspection, packaging, delivery, installation and service.

- Maintained that responsibility of quality was not the sole preserve of the quality professional but was the responsibility of all.

The Fundamental concept is everybody's job Management and Operators cannot totally delegate authority and responsibility and still expect a satisfactory product.

The two basic responsibilities are:

1. 'Provide quality assurance for the business's products'.

2. 'Assist in assuring optimum quality costs for those products'.

1.10. Hidden Plant

One of the more well known concepts developed by Feigenbaum was that of the 'hidden plant'. He maintained that within every company or factory a proportion of the capacity was wasted by not getting it right first time.

Quality control

- Emphasizing that human relation was a basic issue in Quality control activities, and such things as statistics and preventive measures were only a part of the whole equation.

- "Quality" is what suits the customer at the right price for both the provider and customer and a common sense approach to quality standards, conformance, corrective actions, and planning for improvement is the control required to gain that quality.

- By stimulating and encouraging everyone in an organization to realize their responsibilities and potential effects on the quality of a product or service.

1.11. Crucial elements of Total Quality

The elements of total quality to enable a totally customer focus (internal and external)

1. Quality is the customers' perception of what quality is, not what company think it is.

2. Quality and cost are the same no different.

3. Quality is an individual and team commitment.

4. Quality and innovation are interrelated and mutually beneficial.

5. Managing Quality is managing the business.6.

6. Quality is a principal.

7. Quality is not a temporary or quick fix but a continuous process of improvement.

8. Productivity gained by cost effective demonstrably beneficial Quality investment.

9. Implementing Quality by encompassing suppliers and customers in the system.

1.12. Contribution of Kaoru Ishikawa

• Biggest contribution is in simplifying statistical techniques for quality control in an industry.

• Ishikawa sees the Cause and-effect diagram or Ishikawa Diagram, like other tools, as a device to assist groups or quality circles in quality improvement.

• Other than technical contributions to quality, Ishikawa is associated with the Company-wide Quality control (CWQC) movement as implies that quality does not only mean the quality of product, but also of after sales service, quality of management, the company itself and the human life.

• The outcomes of such an approach are (Company-Wide Quality benefits):

  ➢ Product quality is improved and becomes uniform. Defects are reduced.

  ➢ Reliability of goods is improved.

  ➢ Cost is reduced.

  ➢ Quantity of production is increased.

  ➢ Wasteful work and rework are reduced.

  ➢ Technique is established and improved.

  ➢ Expenses for inspection and testing are reduced.

  ➢ Contracts between vendor and vendee are rationalized.

  ➢ The sales market is enlarged.

  ➢ Better relationships are established between departments.

  ➢ False data and reports are reduced.

  ➢ Discussions carried out more freely and democratically.

  ➢ Meetings are operated more smoothly.

  ➢ Repairs and installation of equipment and facilities are done more rationally.

  ➢ Human relations are improved.

1.13. Conclusion

Quality is critical in achieving competitiveness in domestic and global market. Quality is a journey starting from design, to conformance, and ends at better performance. This process considers quality as a never ending' improvement. The success of TQM mainly depends on the achievement of internal as well as external customer satisfaction. Internal customer satisfaction is a prerequisite to achieve external customer satisfaction. If Employees are to identify and correct quality problems, problems, then they have to use some quality tools. Quality circles are also known as work improvement of quality

teams. The quality circle is a small group of employees who voluntarily meet at regular times to identify, analyse and solve quality and other problems in their working environment.

1.14. References/Further study

For Further study you may opt the following Books and sites which are given below-

1. ale H. Besterfield, Carol Besterfield- Michna, Glen H. Besterfield, Mary Besterfield -Sacre, Hermant- Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011

2. Shridhara Bhat K, Total Quality Management- Text and cases, Himalaya Publishing House, II Edition, 2010

3. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008.

4. James R. Evans and William M. Lindsay, The Management and Control of Quality, Sixth Edition, Thomson, 2005.

5. Poornima M. Charantimath, Total Quality Management, Pearson Education, Second Edition, 2011.

6. Indian Standard- Quality Management Systems - Guidelines for Performance Improvement (Fifth Revision), Bureau of Indian Standards, New Delhi.

Unit II

Concept of Quality Circle Japanese 5S Principles and 8D Methodology.

OBJECTIVES

After going through this unit you should be able to know about the-

➤ **Concept of Quality Circle**

➤ **5S House Keeping**

➤ **Origin of 5S**

➤ **8D Methodology**

➤ **8D and Root Course Analysis**

STRUCTURE

To achive these objectives this, unit is sub-divided into the following sub-chapters-

2.1. **Concept of Quality Circle**

2.2. **Concept of 5S House keeping**

2.3. **The Origin of 5S**

2.4. **The Phases of 5S**

2.5. **Variety of 5S applications**

2.6. **8D Methodology**

2.7. **What is 8D of problem solving**

2.8. **The 8 steps of the 8D Methodology**

2.9. **How does the 8D Methodology works**

2.10. **8D and Root Course Analysis**

2.11. **Problems**

2.12. **Conclusion**

2.13. **Further Study**

2.1. Concept of Quality Circles

* Is a main ingredient of Ishikawa's company-wide quality control consisting typically 5-10 personnel who meet at regular interval.

* Led by supervisor to team leader, aim to contribute to and improve processes and activities, build-up job satisfaction and company loyalty and utilize existing and hidden resource potential.

Ishikawa's PDCA Model is given below-

* Plan: There are two methods of Plan like

    (i)   Determine goals and targets

    (ii) Determine methods of reaching goals.

* Do

    (i)   Engage in education and training

    (ii) Implement work

* Check: For check there are two methods :-

    (i)   Check the effects of implementation

    (ii) Take appropriate action.

2.2. Concept of 5S House Keeping : means everything in its place like

(i)	SEIRI	- CLEARING
(ii)	SEITON	- ARRANGING
(iii)	SEIKETSU	- SWEEPING
(iv)	SEISO	- CLEANLINESS
(v)	SHITSUKE	- DISCIPLINE

* There can be no TQM without 5-S.

* A dirty factory cannot produce quality products.

* Clutter hides problems. A neat workplace promotes easy discovery of abnormalities.

5-S CONTRIBUTES TO SAFETY	SAFETY
	QUALITY
	PRODUCTIVITY
5-S FACILITIES	VISUAL CONTROL

5.S is a workplace organization method that uses a list of five Japanese words: seiri (///) seiton (////) seiso (////) seiketsu (/////) , 'Standardize' and 'Sustain' [1] The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order. The decision making process usually comes from a dialogue about standardization, which builds understanding among employees of how they should do the work.

In some quarters, 5S has become 6S, the sixth element being safety(Safe).

Other than a specific stand-alone methodology, 5S is frequently viewed as an element of a broader construct known as visual control, visual workplace, or visual factory. Under those (and similar) terminologies, Western companies were applying underlying concepts of 5S before publication, in English, of the formal 5S methodology. For

example, a workplace-organization photo from Tennant Company (a Minneapolis-based manufacturer) quite similar to the œaccompanying this article appeared in a manufacturing-management book in 1986.

2.3. The origins of 5S

The scheme 'Correct Arrangement of the Tool' from a Central Institute of Labour instruction sheet, 1920-1924.

5S was developed in Japan and was identified as one of the techniques that enabled Just in Time manufacturing.

Two major frameworks for understanding and applying 5S to business environments have arisen, one proposed by Osada, the other by Hiroyuki Hirano. Hirano provided a structure to improve programs with a series of identifiable steps, each building on its predecessor. As noted by John Bicheno, Toyota's adoption of the Hirano approach was 4S', with Seiton and Seiso combined.

A precursor development to the Japanese system of management was outlined by Alexey Gastev's development and the Central Institute of Labour (CIT) in Moscow.

2.4. The Phases of 5S

The Phases of 5S are as follows ™

There are five 5S phases. They can be translated from the Japanese as 'sort', 'set in order', 'shine', 'standardize', and 'sustain', Other translations are possible.

Sort (Seiri)

1S - a red tag area containing items waiting for removal.

Seiri is sorting through all items in a location and removing all unnecessary items from the location.

Goals:

* Reduce time loss looking for an item by reducing the number or items.
* Reduce the chance of distraction by unnecessary items.
* Simplify inspection.
* Increase the amount of available, useful space.
* Increase safety by eliminating obstacles.

Implementation :

* Check all items in a location and evaluate whether or not their presence at the location is useful or necessary.
* Remove unnecessary items as soon as possible. Place those that cannot be removed immediately in a red tag area' so that they are easy to remove later on.
* Keep the working floor clear of materials except for those that are in use to production.

Set In Order (Seiton) [edit]

2S -simple floor marking.

(Sometimes shown as Straighten)

Seiton is putting all necessary items in the optimal place for fulfilling their function in the workplace.

Goal :

* Make the workflow smooth and easy.

Implementation :

* Arrange work stations in such a way that all tooling/equipment is in close proximity, in an easy to reach spot and in a logical order adapted to the work performed. Place components according to their uses, with the frequently used components being nearest to the workplace.

* Arrange all necessary items so that they can be easily selected for use. Make it easy to find and pick up necessary items.

* Assign fixed locations for items. Use clear labels, marks or hints so that items are easy to return to the correct location and so that it is easy to spot missing items.

Shine (Seiso)

3S-cleanliness point with cleaning tools and resources.

Seiso is sweeping or cleaning and inspecting the workplace, tools and machinery on a regular basis.

Goals :

* Improves the production process efficiency and safety, reduces waste, prevents errors and defects.

* Keep the workplace safe and easy to work in .

* Keep the workplace clean and pleasing to work in .

* When in place, anyone not familiar to the environment must be able to detect any problems within 50 feet in 5 sec.

Implementation :

* Clean the workplace and equipment on a daily basis, or at another appropriate (high frequency) cleaning interval .

* Inspect the workplace and equipment while cleaning.

Standardize (Seiketsu)

Seiketsu is to standardize the processes used to sort , order and clean the workplace.

Goal :

* Establish procedures and schedules tooensure the repetition of the first three S' practices.

Implementation :

* Develop a work structure that will support the new practices and make it part of the daily routine. .

* Ensure everyone knows their responsibilities of performing the sorting, organizing and cleaning.

* Use photos and visual controls to help keep everything as it should be.

* Review the status of 5S implementation regularly using audit checklists.

Sustain/Self-discipline (Shitsuke)

Shadow Board (with tolls outline) and worker's movement that is being used in Production floor

Shitsuke or sustain the developed processes by self-discipline of the workers. Also translates as 'do without being told'.

Goal :

*   Ensure that the 5s approach is following

Implementation :

*   Organize training sessions.

*   Perform regular audits to ensure that all defined standards are being implemented and followed.

*   Implement improvements whenever possible . Worker inputs can be very valuable for identifying improvements.

*   When issues arise, identify their cause and implement the changes necessary to avoid recurrence.

2.5. Variety of 5S Applications

5s methodology has expanded from manufacturing and is now being applied to a wide variety of industries including health care, education , and government . Visual management and 5S can be particularly beneficial in health care because a frantic search for supplies to treat an in-trouble patient (a chronic problem in health care) can have dire consequences. Although the origins of the 5S methodology are in manufacturing , it can also be applied to knowledge economy work, with information, software, or media in the place of physical product.

5S in lean product and process development

The output of engineering and design in a lean enterprise is information, the theory behind using 5S here is Dirty , cluttered , or damaged surfaces attract the eye, which spends a fraction of a second trying to pull useful information from them every time we glance past. Old equipment hides the new equipment from the eye and forces people to ask which to use.

2.6. Methodology

The 8D methodology (8D=eight disciplines) was developed in Ford Motor Company in the mid-1980s to be used by their suppliers to improve the resolution of problems. It appears in a variety of forms used to define eight disciplines.

Sometimes it is defined as a nine-step problem-solving process.

Because the 8D model is designed to solve specific problems that arise, more emphasis is placed on containing the problem (discipline 3) than in most other frameworks. The idea is to implement intermediate actions that will protect the customer from the problem until a permanent solution can be developed and implemented.

Introduction to Eight Disciplines of Problem Solving (8D)

The Eight Disciplines of Problem Solving (8D) is a problem solving methodology designed to find the root cause of problem, devise a short-term fix and implement a long-term solution to prevent recurring problems. When it's clear that your product is defective or isn't satisfying your customers, an 8D is an excellent first step to improving Quality and Reliability.

Ford Motor Company developed this problem solving methodology, then known as Team Oriented Problem Solving (TOPS), in the 1980s. The early usage of 8D proved so

effective that it was adopted by Ford as the primary method of documenting problem solving efforts, and the company continues to use 8D today.

8D has become very popular among manufacturers because it is effective and reasonably easy to teach. Below you'll find the benefits of an 8D, when it is appropriate to perform and how it is performed.

2.7. What is Eight Disciplines of Problem Solving (8D)

The 8D problem solving process is a detailed, team oriented approach to solving critical problems in the production process. The goals of this method are to find the root cause of a problem, develop containment cations to protect customers and take corrective action to prevent similar problems in the future.

The strength of the 8D process lies in its structure, discipline and methodology. 8D uses a composite methodology, utilizing best practices from various existing approaches. It is a problem solving method that drives systemic change, improving an entire process in order to avoid not only the problem at hand but also other issues that may stem from a systemic failure.

8D has grown to be one of the most popular problem solving methodologies used for Manufacturing, Assembly and Services around the globe. Read on to learn about the reasons why the Eight Disciplines of Problem Solving may be a good fit for your company.

Why Apply Eight Disciplines of Problem Solving (8D)

The 8D methodology is so popular in part because it offers your engineering team a consistent, easy-to-learn and thorough approach to solving whatever problems might arise at various stages in your production process. When properly applied, you can expect the following benefits:

* Improved team oriented problem solving skills rather than reliance on the individual

* Increased familiarity with a structure for problem solving

* Creation and expansion of a database of past failures and lessons learned to prevent problems in the future

* Better understanding of how to use basic statistical tools required for problem solving

* Improved effectiveness and efficiency at problem solving

* A practical understanding of Root Cause Analysis (RCA)

* Problem solving effort may be adopted into the processes and methods of the organization

* Improved skills for implementing corrective action

* Better ability to identify necessary systemic changes and subsequent inputs for change

* More candid and open communication in problem solving discussion, increasing effectiveness

* An improvement in management's understanding of problems and problem resolution

8D was created to represent the best practices in problem solving. When performed correctly, this methodology not only improves the Quality and Reliability of your products but also prepares your engineering team for future problems.

When to Apply Eight Disciplines of Problem Solving (8D)

The 8D problem solving process is typically required when :

* Safety or Regulatory issues has been discovered

* Customer complaints are received

* Warranty Concerns have indicated greater-than-expected failure rates

* Internal rejects waste, scrap, poor performance or test failures are present at unacceptable levels

2.8. The Eight Steps of the 8D Methodology

The 8D Methodology was originally composed of eight 'disciplines' or steps. In the 1980's Ford added a ninth discipline, planning, but the name '8D' was retained. The disciplines are:

* D0- Plan

* D1-Put Together A Team

* D2-Define the Problem

* D3 -Implement a Temporary Fix

* D4-Identify Root Causes and Chose a Solution

* D5-Confirm The Solution Resolves The Problem

* D6-Fully Implement the Solution

* D7-Prevent Recurrence

* D8-Recognize the Team

The 8D Methodology is based on the PDCA Cycle (Plan, Do, Check, Act). Each step in PDCA roughly corresponds to two steps in 8D Methodology:

* Plan-Define a problem and hypothesize possible causes and solutions (8D steps D0-D2).

* Do-Implement a solution (8D steps D3-D4).

* Check-Evaluate the results (8D steps D5-D6).

* Act-Either return to the planning step, or standardize the solution, depending on the results (8D steps D7-D8).

2.9. How Does the 8D Methodology work?

The strength of the 8D Methodology is its ability to identify, correct, and permanently eliminate recurring problems in an ongoing system, by applying a quick fix and then addressing the root cause of the problem.

D0-Plan

The 8D Methodology often starts with a customer complaint about a problem with a product. In some cases a problem may be identified by management, or production workers. However the problem is first identified, the first step is to establish an initial plan. The plan includes a report on the problem, with an initial evaluation of its scope. This plan forms the basis for defining a team, identifying needed resources, and establishing a schedule for resolution.

D1-Put Together a Team

The team should be multidisciplinary, and include expertise in the product, process, or equipment being investigated. In the case of a problem with a product,understanding the customer's needs is critical, and having a peresentative from marketing or even a

customer on the team is helpful. When processes and staff need to shift, it may be helpful to have an HR representative on the team.

The team's first task will be to write a purpose statement. This written document defines why the team exists, and what it is supposed to do. Having the team discuss this and create the document in their first meeting helps to get everyone on the same page.

D2-Define the Problem

What, specifically, is going wrong? The problem needs to be defined using quantifiable terms. The customer's complaint may be, 'This product doesn't work!' How is it not working? Defining the problem may require establishing test methods and collecting data, interviewing customers, or talking with the workers who are involved with making the product.

'Gemba' is an important principle to apply when defining the problem. Gemba means to go to the physical location where the problem is- the real place and look for yourself. The objective is to get first-hand information.

At this point, the team is not looking for the cause of the problem, or 'where it comes from;' instead, they are collecting as much information as possible to determine the characteristics of the problem. or 'what it is.'

D3-Implement a Temporary Fix

If the problem is affecting customers, impacting productivity or costs, or is creating an injury, health, or environmental hazard, it needs to be addressed immediately. A temporary fix should be identified, evaluated, and implemented. These fixes may involve reworking the product, adding additional quality checks, or inspecting and sorting incoming parts from your suppliers.

If no temporary fix is feasible, it will be necessary to stop shipping the project or to shut down the process that has the problem.

Do not implement a temporary fix without an evaluation. The team needs to be sure the temporary fix is safe, will truly address the current problem, and is easy and cost effective to implement-without causing new problems or its own.

D4-Identify Root Causes

With the temporary fix in place, the next step is to identify the root cause of the problem. The overall goal of the 8D Methodology is to permanently eliminate the problem. That can only be done if the root cause is identified and eliminated.

Techniques such as the 'Five Whys' can be used to identify the root cause. This approach involves asking the question 'Why?' over and over (often five times) until the root cause is revealed. Other methods, such as fish bone diagrams, Parent Analysis, or Fault Tree Analysis are also available to help identify the root cause. However the root cause is identified, the team should then decide how to eliminate it.

D5-Confirm the Solution Resolves The Problem

One of the best ways to test a solution is to implement it in a small way, and monitor what happens. For example, if a manufacturing process involves a number of cells, the solution can be implemented in one cell and the results monitored. If it is successful in the one cell, it can then be implemented in all cells. If the solution cannot be tested in a small way, then techniques such as Failure Mode and Effect Analysis can be used to analyze proposed changes to a system or product.

The team needs to be careful to ensure they have not missed something.

Conducting a Blind Spot Analysis can be useful for identifying things that have been overlooked. Look for unintended consequences and negative side-effects that may result from implementing the solution.

D6-Fully Implement the Solution

Once the solution has been verified -it will eliminate the root cause without staring new problems -it can be fully implemented by making permanent changes.

D7-Prevent Recurrence

Once changes have been made, steps need to be taken to ensure those changes remain in effect, and that any new procedures continue to be followed. This usually involves incorporating the changes in written standards. Training may be required to bring people up to speed on new methods, procedures, and standards, and standards.

D8-Recognize the Team

Recognizing the accomplishments of the team is the final step. It can be a simple 'thank you,' but it should be done in a way such that others in your organization hear about what has been done. A common way to say thank you is with an article in the company newsletter, or with a poster placed on bulletin boards throughout the facility. Be sure that everyone on the team is named so that everyone is recognized for being a part of the team.

2.10. 8D and Root Cause Analysis (RCA)

The 8D process has Root Cause Analysis (RCA) imbedded within it. All problem solving techniques include RCA within their structure. The steps and techniques within 8D which correspond to Root Cause Analysis are as follows:

1. Problem Symptom is quantified and converted to 'Object and Defect'
2. Problem Symptom is converted to Problem Statement using Repeated Whys
3. Possible and Potential Causes are collected using deductive tools (i.e. Fishbone or Affinity Diagram)
4. Problem Statement is converted into Problem Description suing Is/Is Not
5. Problem Description reduces the number of items on the deductive tool (from step 3)
6. Comparative Analysis between the Is and Is Not items (note changes and time)
7. Root Cause theories are developed from remaining possible causes on deductive tool and coupled with changes from Is/Is Not
8. Compare theories with current data and develop experiments for Root Cause Verification
9. Test and confirm the Root Causes

2.11. Problems

The Multiple/Repeated Why (Similar to 5 Why) is an inductive tool, which means facts are required to proceed to a more detailed level. The steps required to determine problem statement are:

1. Problem Symptom is defined as an Object and Defect i.e. 'Passenger Injury'
2. Why? In every case 'SUV's Roll Over'
3. Why? In every case, it was preceded by a 'Blown Tire'
4. Why? Many explanations may be applied, therefore the team cannot continue with another repeated why past 'Blown Tire'
5. Therefore, the Problem Statement is 'Blown Tire'
6. Why? Low (Air) Pressure, Tire Defect (Degradation of an Interface) and High (Ambient) Temperature

7. Counter measures assigned to low pressure and tire defect

This example uses only 4 of the 5 Whys to determine the root causes without going further into the systemic reasons that supported the failure. The Repeated Why is one way to depict this failure chain. Fault Tree Analysis (FTA) could also be used.

2.12. Conclusion

Quality-One offers Quality and Reliability Support for Product and Process Development through Consulting. Training and Project Support. Quality-One provides knowledge, Guidance and Direction in Quality and Reliability activities, tailored to your unique wants, needs and desires. Let us help you Discover the Value of 8D Consulting, 8D Training or 8D Project Support.

2.13. References/Further Study

For further study you may opt the following books written by various authors which are given below :

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13. Graban, Mark. 2012. Lean Hospitals : Improving Quality, Patient Safety and Employee Engagement, Boca Raton, F1: CRC Press.

14. "What Is 5S?.

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Unit 7 STATISTICAL PROCESS CONTROL

Structure

7.0   Introduction

7.1   Factors Affecting Quality

7.2   Ways to Improve Quality

7.3   Quality Control

7.4   Objectives of Quality Control

7.5   Methods of Quality Control

7.6   Controls Charts

7.0 Introduction:

International Organization for Standardization (ISO) defines quality as, "the totality of features and characteristics of product and services that decides whether it will be able to satisfy its stated or implied needs or not." Thus, we can say that a product or service is called as quality product or service, when it is able to satisfy the needs and requirements of its customers effectively and efficiently.

7.1 Factors affecting quality:

There are number of factors which affect the quality of a product that are as follows;

1. **Quality of Inputs:** The quality of raw materials used is one of the prime factors affecting quality of the product. If the inputs used in the form of raw materials are of poor quality then obviously the final product can never be of good quality therefore it is a must for producing quality product for any organization.

2. **Technology:** The technical know-how of the organization is also a crucial factor affecting quality of the final product. If the technology followed by the organization promotes formation of a quality product at a very low wastage then it must be implemented by the organization to produce superior and products appealing to customers.

3. **Human Resource:** Any organization is only as good as is its employees therefore employees or skills of human resource is also one of the deciding factors of quality of any organization. Like ICICI Bank became arguably the second largest bank of India on the basis of its services and the resource which played the instrumental role in this area were its employees.

4. **Availability of Funds:** Financial resources at disposal is also one of the very important factor affecting qualityof a product of any organization obviously those organizations which enjoy financial liberty can invest much more in improving the quality of the their products.

7.2 Ways to improve quality:

1. **Better raw materials:** Any firm can control the quality of its products by using better quality raw materials. Use of better quality raw materials gives confidence to the work force and there by enhances the productivity of the workers also.

2. **Proper training of workforce:** By arranging proper training for the workers an organization can enhance the quality of the products and can also reduce the amount of wastage cause during the production process.

3. **Use of better technology:** By utilization of upgraded and better production techniques and technology also an organization can avoid unnecessary wastage and deviation in quality of the finished products.

4. **Proper working conditions:** Another method of improving quality of the finished work and avoid delays and wastage is providing good and proper working condition to the workers. A congenial working condition is not only an essential requirement for quality improvement but it is also an essential motivational factor also.

7.3 Quality Control:

The word quality means the degree of acceptance or the degree of excellence of the product. The higher is the degree of acceptance of the product; the better is the quality of the product. If a product is highly acceptable to the people they are willing to pay more for that. In other terms, the degree of excellence is related to the characteristics of the product. If a product has better characteristics it is believed to have better quality generally.

On the other hand the word control has to deal with setting of standards of limits thus we can say that quality control is concerned with settingacceptable limits of quality since no two products of the same organization can be exactly similar to each

other there is always going to be some deviation but this deviation has to be within acceptance range for a product to be taken as that of acceptable quality.

"Quality control is the function of ensuring that the product quality conforms to the predetermined standards".

Quality control is concerned with;

a. determination of tolerance limits;

b. performing inspection and tests of materials, products and processes;

c. sorting the defective products out of the good products;

d. finding out the areas which are causing deviation in the quality of the product;

e. issuing proper notification and guide to the management for quality up gradation.

7.4 Objectives of Quality Control:

Quality control programmes followed by the organizations are supposed to achieve the following objectives:

a. To establish such quality standards which are acceptable to the customers and economical to be implemented.

b. To establish standards of judging the quality of raw-materials.

c. To determine the degree of variation that can be acceptable to the organization.

d. To examine the causes of deviation in quality.

e. To suggest methods of improvements in quality from time to time.

7.5 Methods of Quality Control:

There are two methods of quality control:-

a. Inspection

b. Statistical Quality Control (SQC)

   a. Inspection: Physical inspection is a very important part of each and every production system. The inspection carried out in any organization can be either preventive or remedial. The inspection which is carried out at each and every stage of production is called preventive inspection it is carried with the objective of not producing a sub-standard product at all and checking out the sub-

standard products a\t the very stage of production; on the other hand remedial inspection is carried out after the production process is over so it aims at sorting out the sub-standard products from the good quality products once the production is over. Generally in inspection each and everyproduct manufactured is judged on the parameters of quality established by the organization that is why it is often quite time consuming and involves a large amount of man power.

b. **Statistical Quality Control (SQC):** The technique of SQC was developed in other to bring about more accuracy in the process of quality control with a very less amount of human efforts as compared to the inspection. This method was for the first time used by Western Electric Company in the year 1920 however this technique gained popularity and started being used far and wide in the 1940s. SQC uses sample inspection instead of 100 percent inspection which is not only very costly and time consuming but also not very practical to use if the scale of operation of enterprise is very large. Generally, the samples are selected from the manufactured lot (universe) on the basis of random sampling so that each and every unit included in the sample is having equal probability of being selected in the sample. SQC uses techniques of statistics and probability for the purpose of selecting a representative sample. If the characteristics of the sample is within the acceptable limits then it is inferred that the quality of the universe is also good and vice-versa.

Benefits of SQC:

The advantages of Statistical Quality Control (SQC) are as follows:

a. It reduces the cost of quality control quite significantly.

b. It is more scientific in nature and saves time.

c. This method reduces the interruptions in the production process caused by preventive sampling.

d. This method reduces the unnecessary wastage and scraps generated by inspection.

e. SQC utilizes the concept of control charts which makes it much easier for the people involved in quality management at various levels to sort out sub-standard products.
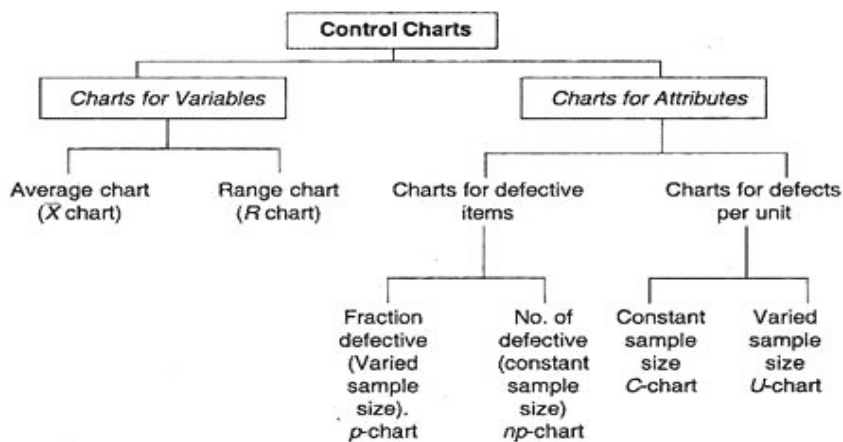
7.6 Control Charts:

A control chart is a graph which shows the expected range of variability or zone of tolerance. If the variation is there in the specifications of the products and it lies within the zone of

tolerance it is said that the variation has occurred due to chance cause and the product is thus accepted and not rejected while on the other hand of the variations in the specification of the product when plotted on the graph paper exceeds the zone of tolerance that is either (Minimum limit or Maximum limit) the variation is said to be due to assignable cause and then it is believed that the product is not fit for acceptance and the management or quality control team then starts working on that assignable cause.

Control charts are of two types:

a. Control Chart for Variables &,

b. Control Chart for Attributes

 a. **Control Chart for Variables:** These charts are used to maintain in control limits the qualitative features which are capable of being measured in quantitative measurements. For example; diameter, length, width etc.

 b. **Control Chart for Attributes:** These charts are used to maintain in control limits the qualitative features of a product which cannot be measured in quantitative terms like finishing, texture, color, brightness etc.

A number of samples of component coming out of the process are taken over a period of time. Each sample must be taken at random and the size of sample is generally kept as 5 but 10 to 15 units can be taken for sensitive control charts. For each sample, the average value X of all the measurements and the range R are calculated. The grand average X (equal to the average value of all the sample average, X) and R (X is equal to the average of all the

sample ranges R) are found and from these we can calculate the control limits for the X and R charts.

Therefore,

For $\overline{X}$ charts :

Upper Control Limit, $\qquad UCL_{\overline{X}} = \overline{\overline{X}} + A_2 \overline{R}$

Lower Control Limit, $\qquad LCL_{\overline{X}} = \overline{\overline{X}} - A_2 \overline{R}$

$\overline{X}$ and $\overline{R}$ are also called centre line values.

For R chart : $\qquad UCL_R = D_4 \overline{R}$

$LCL_R = D_3 \overline{R}$

Here the factors A_2, D_4 and D_3 depend on the number of units per sample. The value of the factors A_2, D_4 and D_3 can be obtained from Statistical Quality Control tables. However for ready reference these are given below in tabular form.

As long as X and it values for each sample are within the control limits, the process is said to be in statistical control.

Summary of Formula used in $\overline{X}$ and R Chart

Chart	Centre line	3 Sigma Control limits
X , Average	$\overline{X}$	$\overline{X} + A_2 R$
R, Range	$\overline{R}$	$D_3 \overline{R}$ and $D_4 \overline{R}$
Estimated spread of individual measurement	$= \overline{X} \pm \dfrac{3\overline{R}}{d_2}$	

Where d_2 is a factor, whose value depends on number of units in a sample. Its value is seen from S.Q.C. Tables 63.1.

Process Out of Control:

After computing the control limits, the next step is to determine whether the process is in statistical control or not. If not, it means there are external causes that throw the process out of control. These causes must be traced and removed so that the process may return to operate under stable statistical conditions.

The various reasons for the process being out of control may

be:

(i) Faulty tools,

(ii) Sudden significant change in properties of new materials in a new consignment,

(iii) Breakdown of lubrication system,

(iv) Faults in timing of speed mechanisms etc.

Tracing of these causes is sometimes simple and straight forward but when the process is subject to the combined effect of several external causes, then it may be lengthy and complicated business.

Table 63.1

No. of units in a sample	A_2	D_3	D_4	d_2
2	1.88	0	3.27	1.13
3	1.02	0	2.57	1.69
4	0.73	0	2.28	2.06
5	0.58	0	2.11	2.33
6	0.48	0	2.00	2.53
7	0.42	0.08	1.92	2.70
8	0.37	0.14	1.86	2.85
9	0.33	0.18	1.82	2.97
10	0.31	0.22	1.78	3.08
11	0.29	0.26	1.74	3.17
12	0.27	0.28	1.72	3.26
13	0.25	0.31	1.69	3.34
14	0.24	0.33	1.67	3.41
15	0.22	0.35	1.65	3.47

Process in Control:

If the process is found to be in statistical control, a comparison between the required specifications and the process capability may be carried out to determine whether the two are compatible. Should the specified tolerances prove to be too tight for the process capability?

There are three possible alternatives:

(a) Re-evaluate the specifications. Whether the tight tolerances are actually needed or they can be relaxed without affecting quality.

(b) If relaxation in specifications is not allowed then a more accurate process is required to be selected.

(c) If both the above alternatives are not acceptable then 100% inspection is carried out to trace out the defectives.

Example 1:

The table 63.2 give record of 5 measurements per sample from lot size of 50 for the critical dimension of jeep valve stem diameter taken every hour, (i) Compare the control limits, make plot and explain plotting procedure, (ii) Interpret plot, make decision regarding quality of product, process control and cost of inspection.

It is given that specifications are (9.492 ɸ + 0.00 – 0.02 mm).

$$UCL_{\bar{X}} = \bar{\bar{X}} + A_2\, \bar{R}$$
$$LCL_{\bar{X}} = \bar{\bar{X}} - A_2\, \bar{R}$$
$$UCL_R = D_4\, \bar{R}$$
$$LCL_R = D_3\, \bar{R}$$

Here

$$\bar{\bar{X}} = \frac{\text{Sum of all } \bar{X}}{\text{Total no. of samples}} = 9.485$$

$$\bar{R} = \frac{\text{Sum of all } R}{\text{Total no. of samples}} = 0.008$$

From S.Q.C. table 63.1 the values of A_2, D_4 and D_3 can be recorded from the 5 measurement sample column.

$A_2 = 0.58$

and

$D_3 = 0$

$D_4 = 2.11$.

<div align="center">Table 63.2</div>

Sample No.	Five Measurement per Samples					$\overline{X}$	R
	a	b	c	d	e		
1	9.484	9.483	9.485	9.485	9.492	9.4876	0.009
2	9.483	9.484	9.490	9.484	9.485	9.4850	0.007
3	9.485	9.492	9.483	9.486	4.490	9.4872	0.009
4	9.486	9.481	9.487	9.490	9.490	9.4868	0.009
5	9.486	9.491	9.484	9.487	9.490	9.4876	0.007
6	9.490	9.491	9.489	9.491	9.483	9.4886	0.008
7	9.482	9.486	9.483	9.484	9.486	9.4842	0.004
8	9.484	9.487	9.487	9.485	9.488	9.4838	0.004
9	9.485	9.488	9.486	9.484	9.487	9.4860	0.003
10	9.484	9.481	9.482	9.485	9.483	9.4830	0.004
11	9.485	9.482	9.490	9.487	9.484	9.4856	0.008
12	9.485	9.487	9.481	9.482	9.478	9.4826	0.009
13	9.488	9.477	9.482	9.485	9.484	9.4832	0.011
14	9.485	9.491	9.477	9.490	9.487	9.4860	0.014
15	9.474	9.483	9.487	9.488	9.490	9.4844	0.016

Therefore,

$$UCL_{\overline{X}} = 9.485 + 0.58 \times 0.008 = 9.4896 \text{ say} = 9.490$$

$$LCL_{\overline{X}} = 9.485 - 0.58 \times 0.008 = 9.480$$

$$UCL_R = D_4 \, \overline{R} = 2.11 \times 0.008 = 0.0169$$

$$LCR_R = D_3 \, \overline{R} = 0 \times 0.008 = 0.$$

Now charts for $\overline{X}$ and R are plotted as shown in Fig. 65.3 taking abscissa as sample number and ordinate as $\overline{X}$ and R. $\overline{X}$ and R charts must be drawn one over the other as shown, i.e. R chart must be exactly under $\overline{X}$ chart.

Fig. 63.3.

Example 2:

The following record taken for a sample of 5 pieces from a process each hour for a period of 24 hours.

S.No.	Time		Measurment				$\overline{X}$	R
1	8 a.m.	995	997	1002	995	1000	0.998	0.007
2	9 a.m.	990	1002	997	1003	1005	0.099	0.015
3	10 a.m.	1003	1005	998	1004	995	1.001	0.005
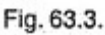
4	11 a.m.	1002	999	1003	995	1001	1.000	0.006
5	12 a.m.	1001	996	999	1006	1001	1.000	0.010
6	1 p.m.	1004	1001	998	1004	997	1.000	0.007
7	2 p.m.	1003	1002	999	1003	1004	1.002	0.006
8	3 p.m.	1001	1007	1006	999	998	1.002	0.009
9	4 p.m.	999	995	994	991	996	0.995	0.008
10	5 p.m.	994	993	991	993	996	0.993	0.005
11	6 p.m.	994	996	995	994	991	0.994	0.005
12	7 p.m.	994	995	998	999	1001	0.097	0.007
13	8 p.m.	1002	1004	1000	994	1000	1.000	0.010
14	9 p.m.	1003	1000	996	1000	1005	1.000	0.009
15	10 p.m.	996	1001	1006	1001	1008	1.103	0.012
16	11 p.m.	995	1003	1004	1006	1008	1.003	0.003
17	12 p.m.	1096	1005	1006	1009	1008	1.006	0.004
18	1 a.m.	996	999	1001	1008	996	0.999	0.012
19	2 a.m.	1001	1004	995	1001	1008	1.002	0.013
20	3 a.m.	1003	995	1002	991	996	0.997	0.012
21	4 a.m.	1004	991	993	997	1008	0.997	0.013
22	5 a.m.	1003	997	998	1000	1001	0.999	0.006
23	6 a.m.	1006	1001	999	996	997	0.999	0.010
24	7 a.m.	1005	1000	1001	998	1000	1.001	0.007

Total							23.976	0.216
Average							0.999	0.009

Design control limits, make plot, and draw inferences regarding quality.

So,

$$\overline{\overline{X}} = 0.999$$

$$\overline{R} = 0.009$$

From S.Q.C. tables for sample size 5 (See table 63.1)

$$A_2 = 0.58 , D_4 = 2.11 \text{ and } D_3 = 0$$

$$UCL_{\overline{X}} = \overline{\overline{X}} + A_2 \overline{R} = 0.999 + (0.58) \times 0.009$$

$$= 1.004$$

$$LCL_{\overline{X}} = \overline{\overline{X}} - A_2 \overline{R} = 0.999 - 0.00522 = 0.994$$

$$UCL_R = D_4 \overline{R} = (2.11) \times (0.009) = 0.019$$

$$LCL_R = D_3 \overline{R} = 0 \times 0.009 = 0.$$
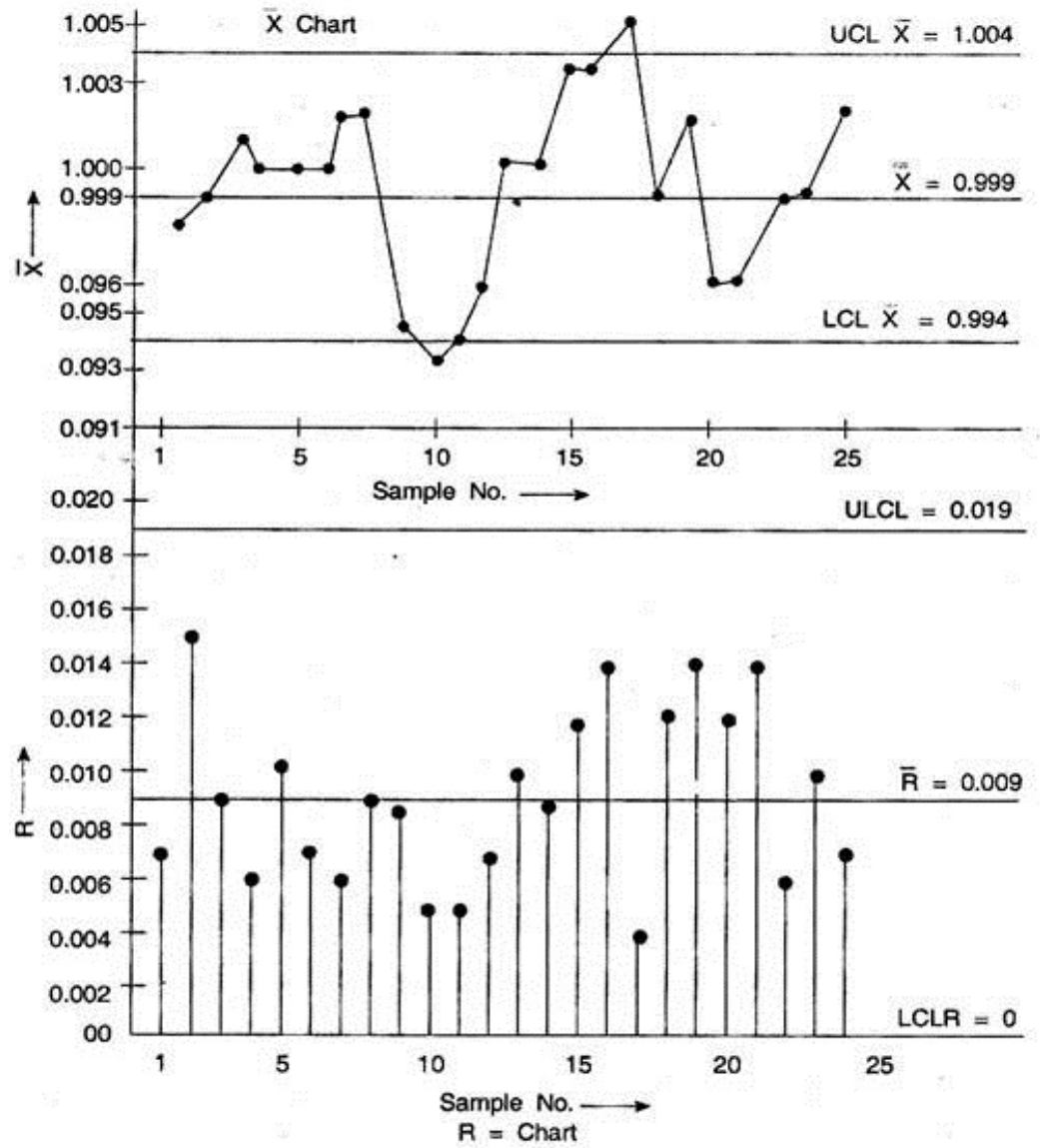
Fig. 63.4.

Control Charts for Attributes:

The $\bar{X}$ and R control charts are applicable for quality characteristics which are measured directly, i.e., for variables. There are instances in industrial practice where direct measurements are not required or possible.

Under such circumstances, the inspection results are based on the classification of products as being defective or not defective, acceptable as good or bad accordingly as that product confirms or fails to confirm the specified specification.

In manufacturing, sometime it is required to control burns, cracks, voids, dents, scratches, missing and wrong components, rust etc. Here, we inspect products only as good or bad but not how much good or how much bad. Furthermore, there are many quality characteristics that come under the category of measurable variables but direct measurement is not taken for reasons of economy.

The various control charts for attributes are explained as under:

1. Attribute Charts for Defective Items: (P-Chart):

This is the control chart for percent defectives or for fraction defectives. This is used whenever the quality characteristics are expressed as the number of units confirming or not confirming to the specified specifications either by visual inspection or by 'GO' and 'NOT GO' gauges.

The Centre Line Value:

It is denoted by $\bar{P}$ (P bar) and may be defined as the ratio between the total number of defective (non-conforming) products observed in all the samples combined and the total number of products inspected. For example, 15 products are found to be defective in a sample of 200, then 15/200 is the value of $\bar{P}$.

Fraction and Percent Defectives:

The fraction defective value is represented in a decimal as proportion of defectives out of one product, while percent defective is the fraction defective value expressed as percentage. As in the above example, fraction defective of 15/200 = 0.075, and percent defective will be 0.075 x 100 = 7.5%.

Standard Deviation:

The standard deviation for fraction defective denoted by $\tilde{A}P$ is calculated by the formula.

$$\sigma P = \sqrt{\frac{\overline{P}(1-\overline{P})}{n}}$$

where n = sample size and P = fraction defective.

Trial Control Limits:

Just as the control limits for the X and R-charts are obtained as + $3\tilde{A}$ values above the average. The two control limits, upper and lower for this chart are also calculated by simply adding or subtracting $3\tilde{A}$ values from centre line value. These trial limits are computed to determine whether a process is in statistical control or not.

So

$$UCL_P = \overline{P} + 3\sigma P . = \overline{P} + 3\sqrt{\frac{\overline{P}(1-\overline{P})}{n}}$$

Similarly,

$$LCL_P = \overline{P} - 3\sqrt{\frac{\overline{P}(1-\overline{P})}{n}}$$

Mostly the control limits are obtained on the basis of about 20-25 samples to pick up the problem and standard deviation from the samples is calculated for further production control.

Sample No.	Sample Size	Defectives	Percentage
1	100	1	1
2	100	1	1
3	100	2	2
4	100	1	1
5	100	1	1
6	100	0	0
7	100	1	1
8	100	0	0
9	100	1	1
10	100	2	2
11	100	3	3
12	100	2	2
13	100	1	1
14	100	2	2
15	100	0	0
16	100	2	2
17	100	7	7
18	100	1	1
19	100.	2	2
20	100	· 0	0

Computation and Construction:

Here the maximum percent defective is 7% and the total number

of samples inspected is 20. On graph paper, make abscissa for

samples number 1, 2, 3, up to 20. Make ordinate as percent

defective so as to accommodate 7%. Next go on marking various

points as shown by the table as sample number vs. percent

defective.

Draw three firm horizontal lines, one each for central line value,

upper limit and lower limit after obtaining by calculations.

Estimated fraction defective

$$\overline{P} = \frac{\text{Sum of defective values}}{\text{Total number of products inspected}}$$

$$= \frac{30}{20 \times 100} = 0.015$$

Percent defective of $\quad \overline{P} = 100\,\overline{P} = 100 \times 0.015 = 1.5\%$

Standard deviation $\quad = \sigma P = \sqrt{\dfrac{\overline{P}(1-\overline{P})}{n}}$

$$= \sqrt{\frac{0.015(1 - 0.015)}{100}} = 0.0121$$

Then, upper control limit $= \bar{P} + 3\,\sigma P$

$\therefore$

$UCL_P = 0.015 + 3 \times 0.0121 = 0.0513$

Lower control limit $= \bar{P} - 3\,\sigma P = 0.015 - 3 \times 0.0121 = 0.015 - 0.0363$

$= -ve$ value, but $-ve$ value is not possible

Therefore, $LCL_P = 0.$

Fig. 63.5.
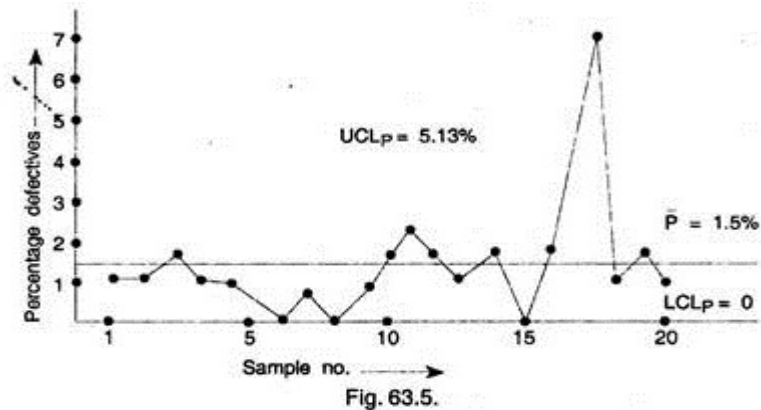
8 Important Questions:

1. What do you mean by Statistical Quality Control? What are the measures of SQC?

2. What are Control Charts and its types? Explain illustrating an example.

3. What are various factors which affect quality of a product?

4. Explain in brief the objectives of quality control.

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Unit 8 Process Capability

Structure

8.0 Introduction

8.1 Process Capability

8.2 Why Process Capability is to be measured?

8.3 How process capability is measured?

8.4 SIX SIGMA

8.5 SIX SIGMA TOOLS

8.6 SIX SIGMA Process

8.7 Important Questions

8.8 Reference

8.0 Introduction:

A process has been defined as a sequence of interdependent procedures, operations or steps that consume resources and convert the inputs into outputs. Each operation or step adds to the next to achieve a goal or desired result. In every process, there exists a certain amount of variation. Variation in a process cannot be eliminated, but it can be measured, monitored, reduced and controlled. If we look at a simple example of making a cup of coffee, we can identify the inputs, steps, equipment and output of the process. Some of the inputs are coffee and water. The steps include turning on the coffee maker, measuring and adding the coffee and water and the output is a pot or cup of coffee. The variation can occur in the amount of coffee or water introduced in the process and the performance of the coffee maker itself. Not every cup of coffee is exactly the same but in most cases, if the measurements are controlled and reasonably consistent, it tastes the same. By utilizing process controls, taking measurements and using reliable, well-maintained equipment, variation in a process can have less effect on the quality of the output. The process can be capable of producing acceptable product on a consistent basis. We can maintain Process Capability.

8.1 Process Capability:

Process Capability (Cp) is a statistical measurement of a process's ability to produce parts within specified limits on a consistent basis. To determine how our process is operating, we can calculate Cp (Process Capability), Cpk (Process Capability Index), or Pp (Preliminary Process Capability) and Ppk (Preliminary Process Capability Index), depending on the state of the process and the method of determining the standard deviation or sigma value. The Cp and Cpk calculations use sample deviation or deviation mean within rational subgroups. The Pp and Ppk calculations use standard deviation based on studied data (whole population). The Cp and Cpk indices are used to evaluate existing, established processes in statistical control. The Pp and Ppk indices are used to evaluate a new process or one that is not in statistical control.

Process capability indices Cp and Cpk evaluate the output of a process in comparison to the specification limits determined by the target value and the tolerance range. Cp tells you if your process is capable of making parts within specifications and Cpk tells you if your process is centered between the specification limits. When engineers are designing parts, they must consider the capability of the machine or process selected to produce the part.

To illustrate, let us use a real world example. Imagine that you are driving your vehicle over a bridge. The width of your vehicle is equivalent to the spread or range of the data. The guardrails on each side of the bridge are your specification limits. You must keep your vehicle on the bridge to reach the other side. The Cp value is equivalent to the distance your vehicle stays away from the guardrails and Cpk represents how well you are driving down the middle of the bridge. Obviously

if the spread of your data is narrower (your car width is smaller), the more distance there is between the vehicle and the guardrails and the more likely you are to stay on the bridge.

The Cp index is a fundamental indication of process capability. The Cp value is calculated using the specification limits and the standard deviation of the process. Most companies require that the process Cp = 1.33 or greater.

The Cpk index of process center goes a step further by examining how close a process is performing to the specification limits considering the common process variation. The larger the Cpk value the closer the mean of the data is to the target value. Cpk is calculated using the specification limits, standard deviation or sigma, and the mean value. The Cpk value should be between 1 and 3. If the value is lower than 1 the process is in need of improvement.

The Cp and Cpk indices are only as good as the data used. Accurate process capability studies are dependent upon three basic assumptions regarding the data:

1. There are no special causes of variation in the process and it is in a state of statistical control. Any special causes must be discovered and resolved.

2. The data fits a Normal distribution, exhibiting a bell shaped curve and can be calculated to plus or minus three sigma. There are cases when the data does not fit a normal distribution.

3. The sample data is representative of the population. The data should be randomly collected from a large production run. Many companies require at least 25 to preferably 50 sample measurements be collected.

8.2 Why Process Capability is to be measured?

 In manufacturing and many other types of businesses, reduction of waste and providing a quality product are imperative if they are to survive and thrive in today's marketplace. Waste exists in many forms in a process. When we look at the bigger picture, process capability is more than just measuring Cp and Cpk values. Process capability is just one tool in the **Statistical Process Control (SPC)** toolbox. Implementing SPC involves collecting and analyzing data to understand the statistical performance of the process and identifying the causes of variation within. Important knowledge is obtained through focusing on the capability of process. Monitoring process capability allows the manufacturing process performance to be evaluated and adjusted as needed to assure products meet the design or customer's requirements. When used effectively this information can reduce scrap, improve product quality and sistency and lower the cost to manufacture and the cost of poor quality.

8.3 How process capability is measured?

The capability indices can be calculated manually, although there are several software packages available that can complete the calculations and provide graphical data

illustrating process capability. For the example in this section, we will utilize a popular statistical software package. For our example, we will utilize data from randomly collected measurements of a key characteristic of a machined part. To better represent the population values, the sample data must be randomly collected, preferably over time from a large production run. A few things to keep in mind:

- Our data is quantitative and variable
- Our data consists of 100 measurements
- The target dimension is 25.4 mm
- USL (Upper Specification Limit) = 25.527 mm
- LSL (Lower Specification Limit) = 25.273 mm
- Range = 0.254 mm

First, we will examine our data with a simple histogram to determine if it could fit a normal distribution. In addition, we can generate a probability plot evaluating our data's best fit to a line further indicating we are 95% confident that our data fits a normal distribution.

Now let us examine the Process capability report:

- Cp (Process Capability = 1.68
- Cpk (Process Capability Index) = 1.66

Using the graph, we can further evaluate process capability by comparing the spread or range of the product specifications to the spread of the process data, as measured by **Six Sigma** (process standard deviation units).

Through examination of the reports, we can determine that our example process is in a state of statistical control. All the data points fall well within the specification limits with a normal distribution. A process where almost all the measurements fall inside the specification limits is deemed a capable process. Process capability studies are valuable tools when used properly. As previously mentioned the information gained is generally used to reduce waste and improve product quality. In addition, by knowing your process capabilities, the design team can work with manufacturing to improve product quality, and processes that are "not in control" may be targeted for improvement. During a typical **Kaizen** event or other quality improvement initiatives, Process Capability is calculated at the start and end of the study to measure the level of improvement achieved. Accurate knowledge of process capability enables management to make decisions regarding where to apply available resources based on data.

8.4 SIX SIGMA

The concept of six sigma is given by Motorola & is basically concerned with Zero Defect (ZD) manufacturing. The program of six sigma is the benchmark for excellence. Quality is a the main concern of the consumer and in today's competitive arena it is even more so important for the organizations who are competing each other hard in order to gain the maximum part of disposable income of the consumers and are also trying hard to retain the consumers. The six sigma approach tries to add mathematical

accuracy to the quality control programs of the organizations. The approach of six sigma deals with preparing a manufacturing flow chart which is free from unnecessary procedures and processes so that by elimination of unnecessary steps perfection can be achieved. Six sigma stands for six standard deviations (sigma is a Greek word that represents statistical term deviation) from average. Six sigma is a process that includes continuous improvement and improvement in design. It is a statistical tool which aims at streamlining the production process and there by eliminating deviations in quality.

"The best six sigma projects begin not inside the business but outside it, focused on answering the question- how can we make the customers more competitive? What is critical to the customer's success? One thing we have discovered with certainty is that anything we do that makes the customer more successful inevitably results in a financial return to us."- **Jack Welch**
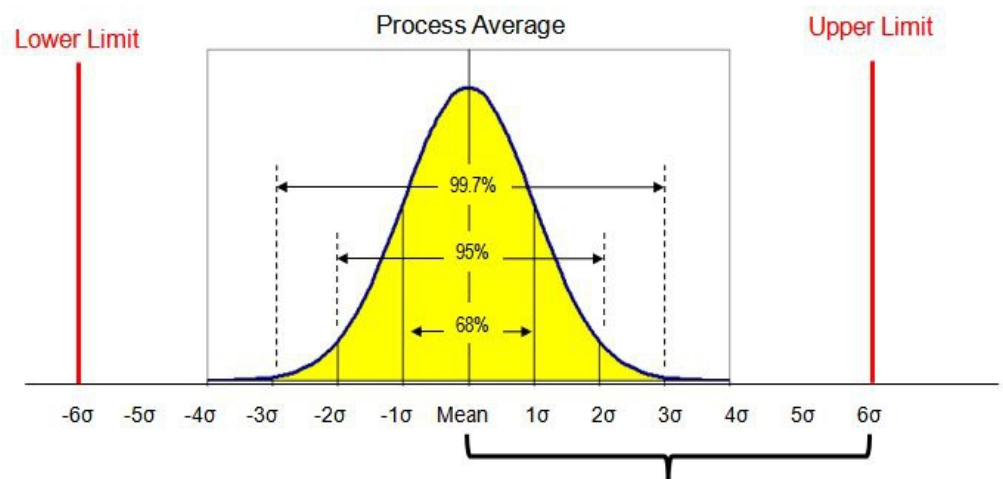
The concept of six sigma (6s) was started in Motorola Company in the manufacturing division where numerous small and medium parts and components were made and assembled. Today, once the concept is successfully implemented and followed by Motorola numerous organizations of world including General Electric (GE), Ford Motor Company & Mumbai Dabbawalas, are using the concept of Zero defect process and reaping benefits of it. Six sigma means once defect in every 3, 00,000 transactions.

QUALITY LEVEL	% Quality
3 Sigma	99.73
4 Sigma	99.9937
5 Sigma	99.999943
6 Sigma	99.9999998

Highly skilled personnel trained in the use of the statistical tools and the techniques of Six Sigma implement the Six Sigma methodologies. The Six Sigma training and

certification levels are borrowed from the martial arts. The certification or belt levels include white, yellow, green, black and master black belt designations.

Master Black Belt

A Master Black Belt is classically trained in statistical tools, Six Sigma methodology and management processes. Master Black Belts mentor and direct groups of Black Belts and Six Sigma teams through various problems that need to be reviewed. Additionally, Master Black Belts are responsible for the strategy and training of Black Belt level practitioners and below.

Black Belt

A Black Belt receives the highest level of training in the statistical tools of Six Sigma. Black Belts, as a rule, develop the plans for Six Sigma project implementation. Their responsibilities include creating project plans, leading cross-functional projects and directing team members, including Green and Yellow Belts. Black Belts usually train other team members on the proper use of Six Sigma tools and techniques, such as control charts, histograms and **Root Cause Analysis (RCA)**.

Green Belt

Green Belts report to a Black Belt and lead process improvement teams part time. Approximately 25- 50% of their time should be devoted to working on Six Sigma projects, usually within their own functional areas. Green Belts receive training on DMAIC methodology, statistical tools, proper data collection and analysis of the data collected.

Yellow Belt

A Yellow Belt should have a basic understanding of Six Sigma, statistical tools and DMAIC methodology. Yellow Belts are often members of the workforce recognized for their skill, knowledge and experience with the process in question. They often fulfill the role of Subject Matter Expert (SME) for the process. They are valuable during the measure phase of a project, gathering data, measurements and metrics. However, Yellow Belts are not typically involved in the data analysis process.

Six Sigma is more than a quality system, a set of statistical tools, a certification system or a method for process improvement. Some perceive it as a philosophy that embraces the belief that all business processes are measurable and can be improved.

8.5 SIX SIGMA PROCESS

Six sigma methodology aims at improving a business organization by continuous monitoring and upgradtion of existing processes. To achieve this objective six sigma uses a method called as **DMAIC** (Defining opportunities, Measure performance, Analyze opportunity, Improve performance, Control performance).

Defining opportunity: Define the goals and objectives of the improvement project to be implemented which is developed after careful analysis of the existing process so that unnecessary delays and deviations in quality can be avoided.

Measure: Measure the process to find the root causes of variations from the standards set. It covers gathering and sampling of data for testing. It also involves calculation of sigma level as a measure of customer requirements.

Analyze: Analyze the data collected in the measurement phase to identify problems areas in the current process. It is done using sample collected and applying experience of the quality control manager.

Improve: Improve the system by finding ways to do things better, safer, economical & faster. In this phase after the identification of the root cause of deviation an improvement program is implemented.

Control: Control the improvement implemented on continuous basis. Making is possible by making alterations in policies, procedures, polices, budget, instructions and other management systems.

8.6 SIX SIGMA TOOLS

At each step of six sigma process specific tools are used:

No.	Phase	Tools used
1.	Define	Team charter Knowing voice of customer
2.	Measure	SIPOC- Supplier-Input-Process-Output-Customer Data collection Rejection trends Rejection cost Defect matrix MSA
3.	Analyze	Process stratification Pareto analysis Root cause analysis Why-why analysis
4.	Improve	Action plan

| 5. | Control | Training of the workforce |
| | | P-charts |

CRITICISM:

Lack of originality

Quality expert Joseph M. Juran described Six Sigma as "a basic version of quality improvement", stating that "there is nothing new there. It includes what we used to call facilitators. They've adopted more flamboyant terms, like belts with different colors. I think that concept has merit to set apart, to create specialists who can be very helpful. Again, that's not a new idea. The American Society for Quality long ago established certificates, such as for reliability engineers."

Inadequate for complex manufacturing

Quality expert Philip B. Crosby pointed out that the Six Sigma standard does not go far enough customers deserve defect-free products every time. For example, under the Six Sigma standard, semiconductors which require the flawless etching of millions of tiny circuits onto a single chip are all defective.

Role of consultants

The use of "Black Belts" as itinerant change agents has fostered an industry of training and certification. Critics have argued there is overselling of Six Sigma by too great a number of consulting firms, many of which claim expertise in Six Sigma when they have only a rudimentary understanding of the tools and techniques involved or the markets or industries in which they are acting.

Potential negative effects

A Fortune article stated that "of 58 large companies that have announced Six Sigma programs, 91 percent have trailed the S&P 500 since". The statement was attributed to "an analysis by Charles Holland of consulting firm Qualpro (which espouses a competing quality-improvement process)".The summary of the article is that Six Sigma is effective at what it is intended to do, but that it is "narrowly designed to fix an existing process" and does not help in "coming up with new products or disruptive technologies."

Over-reliance on statistical tools

A more direct criticism is the "rigid" nature of Six Sigma with its over-reliance on methods and tools. In most cases, more attention is paid to reducing variation and searching for any significant factors and less attention is paid to developing robustness in the first place (which can altogether eliminate the need for reducing variation). The

extensive reliance on significance testing and use of multiple regression techniques increases the risk of making commonly unknown types of statistical errors or mistakes. A possible consequence of Six Sigma's array of P-value misconceptions is the false belief that the probability of a conclusion being in error can be calculated from the data in a single experiment without reference to external evidence or the plausibility of the underlying mechanism. One of the most serious but all-too-common misuses of inferential statistics is to take a model that was developed through exploratory model building and subject it to the same sorts of statistical tests that are used to validate a model that was specified in advance.

Another comment refers to the often mentioned Transfer Function, which seems to be a flawed theory if looked at in detail. Since significance tests were first popularized many objections have been voiced by prominent and respected statisticians. The volume of criticism and rebuttal has filled books with language seldom used in the scholarly debate of a dry subject. Much of the first criticism was already published more than 40 years ago (see Statistical hypothesis testing & Criticism).

Articles featuring critics have appeared in the November–December 2006 issue of USA Army Logistician regarding Six-Sigma: "The dangers of a single paradigmatic orientation (in this case, that of technical rationality) can blind us to values associated with double-loop learning and the learning organization, organization adaptability, workforce creativity and development, humanizing the workplace, cultural awareness, and strategy making."

8.7 Important Questions:

1. What is process capability & how it is to be measured?
2. Explain Six Sigma & its process.
3. Critically analyze Six Sigma as a process of process control.
4. How process capability is measured?
5. How you criticized the six sigma?

8.8 References

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Unit 9 Reliability Concept

Structure

9.0 Introduction

9.1 Definition

9.2 Reliability and Quality

    9.2.1   Elements of Reliability

    9.2.2 Improving Reliability

    9.2.3 Reliability Programmer

9.3 Failure MODE, EFFECT & CRITICALITY ANALYSIS (FMECA)

    9.3.1 Stages of FMECA

    9.3.2 Measuring Reliability

  9.4 Important questions

  9.5 Reference

9.0 Introduction

Reliability is the probability that a product will perform as expected under given specific conditions and for a given specific time. Reliability can be called as third dimension of quality and it is propounded by David Garvin. Reliability represents the chance of a product failing to perform within a specified time period of its life cycle. Amongst the most common measures which are used for testing reliability of product are mean time to first failure, mean time between failures (MTBF), and the failure rate per unit time. Since all these measures required the product to be used over a period of time therefore they have more utility in case of those products which fall under the category of durables rather than services which are consumed instantly.

Though the concept of reliability is not new but with the advent of science and technology and development of new mathematical tools this concept has become much more meaning and testing oriented. Now, we have Numerical control concepts, Computerized numerical control techniques, computer based optimization techniques, Horizon Machining Center all of which have contributed in the development of reliability as field of quality improvement.

Reliability Engineering plays a key role in diagnosis and on time replacement of failed parts and in keeping the system updated in general. So, the operative cost of these equipments in their lifetime is crucial for the effectiveness of Preventive maintenance, Breakdown maintenance & overhauling practices.

Over a period of time, the Indian economy has witnessed a drastic change in the way business is being governed and managed. Nowadays, there is cut throat competition in the market and none of the companies can call itself secured in terms of market leadership and influence on consumers therefore in such a tough operating environment where the buyers are very much upgraded and aware of the various options available the chances available for the companies are limited; in such a testing environment reliability becomes a very important tool for the organizations to win the confidence of the consumers.

9.1   Definition:

Reliability is the probability of product to perform well, without any failure, under specified conditions & for a specific period of time.

Reliability is the probability of a product functioning in the intended manner over its intended life under the specified conditions.

From the above paragraph we get four factors which are related with probability which are as follows:

Numerical value: It makes the quantitative evaluation of reliability possible.

Intended function: It means satisfactory performance as per the expectation of the consumer.

Longevity: It means the product must be capable of performing satisfactorily through the expected life span of the product.

Environmental condition: The environmental conditions like humidity, temperature, dust etc must be recorded for efficient handling of the product and communicated to the consumer.
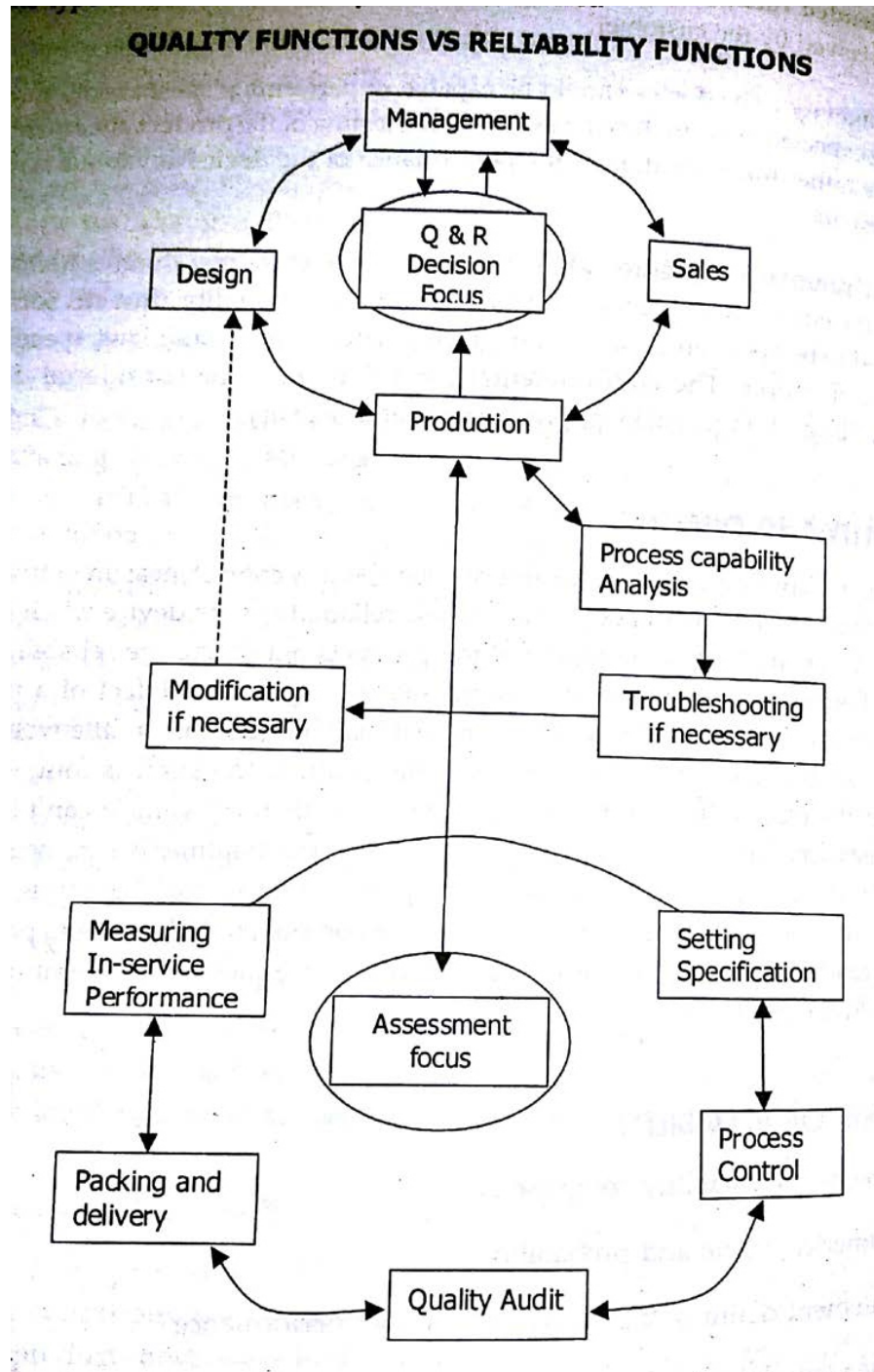
9.2 Reliability & Quality:

The term reliability and quality are interdependent. We can say reliability of the product is an inherent requirement of quality assurance. It is consistency that affects the reliability of the product when it is assembled. Over the long term quality of the products determine the reliability. The task of reliability begins from the stage of product design itself. One defect of a product can cause breakdown of the assembly. As an example it may be cited that a little wobbling in the ball bearing can cause eccentric movement of the shaft. If the shaft is long enough, say 2 meters as in the case of 'torsion bar' of the automobile, then the vehicle can't be in motion after some distance. A part from dimensional accuracy, the treatments eg, heat and surface treatments are also of paramount importance. Industrial history is littered with examples where instead of dimensional accuracy; the component failed due to poor treatment operations as received from defect investigation. As a consequence the assembly also became inoperative.

9.2.1 Elements of Reliability:

The elements of reliability comprise:

a. Numerical value and probability

b. Statement defining the successful product performance

c. Statement defining the environment in which the devices or products must operate

d. Statement of required operating time

The type of distributions likely to be encountered

QUALITY FUNCTIONS VS RELIABILITY FUNCTIONS

9.2.2 Improving Reliability:

Reliability generally refers to an assembly or a system. Reliability can be improved by;

1. Improving the quality of the product, component & equipment.

2. Improving the design of the equipment such that it enables.

    a. Easy diagnosis

    b. Quick fault detection

    c. Hassle free routine maintenance

3. Improving the layout of the equipment facilitating

    a. Easy access to the equipment

    b. Carrying out preventive maintenance

9.2.3 Reliability Programmer

Setting the reliability programme is of the utmost importance. Unless the program is carefully planned, considering the customer expectation, achievable quality levels, utilities and facilities available, skilled workforce etc, assurance of reliable products becomes difficult.

1. Setting the goals of reliability

2. Quality function deployment

3. Identification of critical parts

4. Stress analysis

5. Predicting the reliability

6. Review of designs

7. Evaluating vendors

8. Rating the vendors

9. Defect investigation

10. Reliability testing

11. Failure reporting

12. Initiating corrective actions

13. Initiating preventive actions

9.3   Failure MODE, EFFECT & CRITICALITY ANALYSIS (FMECA)

FMECA is a cluster of activities. The use of FMECA includes:

a. Recognizing & evaluating the potential failure of product or process and its effect

b. Identifying the actions needed to eliminate or reduce the chance of potential failure

c. Documenting the process

FMECA application encompasses a. Safety b. Effect on downtime c. Access d. Planning the repair, & e. Recommendations

a. Safety: Occupational hazards and injury are treated as the most serious of all possible failures. As such, safety is handled through specially structured programmes.

b. Effect on downtime: A machine is productive only when it is in the process of operation & in the rest of the time it is only a cost holding device. Maintenance (preventive) is to be done in off- duty time. To eliminate or reduce the downtime the answer is 'preventive maintenance'.

c. Access: Maintenance engineers must do diagnosis to analyze and prepare list of the critical and vital parts (hardware items) which fail or are 'likely to fail' at higher frequencies. This action is essential for quick replenishment of parts and reducing the downtime.

d. Planning the repair: Whatever be the degree of preventive maintenance, a machine can fail. In case of breakdown, the machines must be quickly repaired. To facilitate quick repairing, 'special maintenance gadgets (including tools)' must be kept ready. Company, in consultation with the machine manufacturer, can develop ' Trouble shooting' charts, flow charts to identify the cause behind the failure to hasten the repairing process.

e. Recommendations: Recommendations, if any must be noted down for future reference.

9.3.1 Stages of FMECA

There are four distinct stages of FMECA viz. a. Specifying possibilities b. Quantifying risk c. Correcting high-risk causes and d. Re-evaluation of risk

a. Specifying possibilities

1. Functions

2. Possible failure modes

3. Root causes

4. Effects

5. Detection/prevention

b. Quantifying risk

1. Probability of cause

2. Severity cause

3. Effectiveness of control to prevent causes

4. Risk priority number (RPN)

c. Correcting High-risk causes

1. Priority fixing

2. Detailing action plan

3. Assigning specific responsibility

4. Check points on completion

d. Re-evaluation of Risk

1. Recalculation of action points

9.3.2 Measuring Reliability

Firstly, a "Failure table" is prepared showing the type of failures, Frequency of failure, Percentage of downtime.

Secondly, the table is rearranged in descending order of frequency of failures.

Thirdly, a column is added at the end of the table showing "Cumulative percentage of downtime".

It can be better clarified with the help of case study.

S	Type of Failure	n	D	P	P_Cum
1	Crusher unavailability due to wet coal	56	23	42.8	42.8
2	Failure of Screen Mesh	21	96	17.7	60.5
3	Failure of crusher due to hammer	18	72	13.3	73.8
4	Failure of liner plate of crusher	10	40	07.4	81.2
5	Failure of cage bar	4	27	05.0	86.2
6	Crusher unavailability due to bearing problem	1	20	03.7	89.9
7	Crusher unavailability to fluid coupling	5	20	03.7	93.6
8	Failure of bearings of screen	2	19	03.5	97.1
9	Non-availability of crusher due to motor problem.	2	16	02.9	100.0

In the above table :

❑ S indicates Serial number

❑ n indicates Frequency of failure

❑ D stands for Downtime

❑ P stands for Downtime (as percentage of total downtime, and

❑ P_Cum indicates Cumulative percentage of downtime.

The table taken from the paper entitled "Reliability Engineering - A Key to improved Productivity & Quality" submitted by Malaya Acharya and Saroj Kumar Nath of NALCO in the 46th National Convention of Indian Institution of Industrial Engineering, Trivandrum.
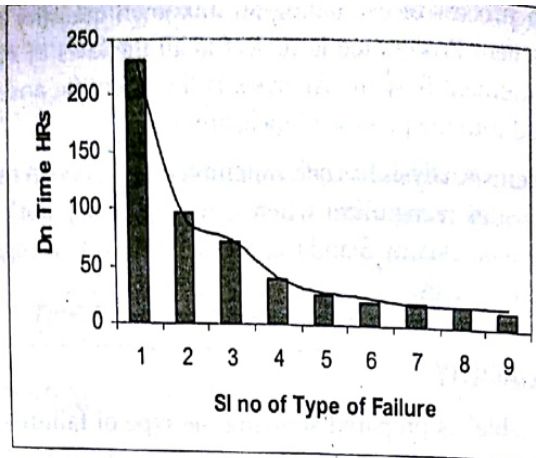
Fig. 17.1. Pareto Chart.

They prepared Pareto Chart corresponding to the nine types of failures.

9.1 Failure Mode and Effects Analysis (FMEA)

From the above Pareto Analysis the vital few and trivial many are segregated. A detailed brain storming session was carried out to find the root causes of failure and a fish bone diagram was drawn.

It was observed that the root causes of failure or crusher unavailability are as follows:

(a) Excessive moisture in incoming coal

(b) Loosening of screen mesh bolts

(c) Quality of material of hammer

(d) Type of material.

Reliability Improvement : The following solutions were implemented to improve the parts failure rate to increase reliability and availability.

(a) Designing of an online cleaning mechanism that reduced the total cleaning time of coal chutes from 232 hrs to 20 hrs.

(b) Fastening of screen mesh bolts along with spring washers. Down time reduced to 18 hrs.

(c) Replacement of crusher hammers of material from Grade – 1 to Grade – 3 type of casting. Down time reduced to 15 hrs.

(d) Installation of polymer liners on the 'tiscral liners' during monsoon to facilitate ease in flow of coal. Down time reduced to 11 hrs.

9.2 Operating Characteristic (OC) Curve

One way of measuring reliability is through the use of OC Curve. OC Curve can be of two types.

Attribute control charts: These types of control charts have the advantage of allowing for quick summaries of various aspects of the quality of a product, that is, the engineer may simply classify the products as acceptable or unacceptable, based on various quality criteria. Thus, attribute charts sometimes bypass the need for

expensive, precise devices and time-consuming measurement procedures. Also these types of charts are much easier for the managers to understand.

Variable control charts: These charts are much more sensitive than attribute control charts. Therefore, variable control charts alert us to quality problems before any actual "unacceptable".

A common support system to the control charts is the operating characteristics or OC curve. One question that generally arises while using control charts is how sensitive is the current quality control procedures? Put in more specific terms, how likely is that one will not find a sample outside the control limits, when in fact it has shifted by a certain amount? This probability or chance is usually referred as beta.

OC curves are extremely useful for exploring the power of our quality control procedure. The actual decision concerning sample size should depend not only on the cost of implementing the plan but also on the costs resulting from not detecting quality problems.

9.4 Important Questions:

1. What do you mean by reliability? How reliability can be improved?

2. What is OC curve?

3. How can reliability be measured?

4. Discuss the process of FMECA.

5. What is failure mode effects and criticality analysis [FMECA]?

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UNIT10 TOTAL PRODUCTIVE MAINTENANCE

Structure

10.0 Introduction

10.1 TQM vs. TPM

10.2 PQCDSM Targets

10.3 Objectives of TPM

10.4 Benefits of TPM

10.5 OEE [Overall Equipment Efficiency]

10.6 Stages in Introduction of TPM

10.7 Pillars of TPM

10.8 Business of re- Engineering Process (BPR)

10.9 Steps in BPR

10.10 Tero Technology

10.11 Important Technology

10.0 Introduction:

Total Productive Maintenance (TPM) aims to markedly increase production while, at the same time, increasing employee morale & their satisfaction. It can be considered as the medical science of the machines. TPM brings maintenance into focus as a necessary and vitally important part of business. It is no longer regarded as a non-profit activity. Down time for maintenance is scheduled as a part of manufacturing day and, in some cases, as an integral part of the manufacturing process. The goal is to hold emergency and unscheduled maintenance to minimum.

TPM was introduced as an important tool to achieve certain organizational objectives in the changing business environment. The important objectives include 1. Avoiding wastage in a quickly changing business environment 2. Producing goods of desired quality 3. Reducing cost 4. Producing low batch quantity at the lowest possible cost 5. Making defect free goods available for the customers and thereby enhancing goodwill of the business.

10.1 TQM vs. TPM

There are some tools and techniques which are common to both TPM and TQM. In fact, TPM is often considered as a technique of TQM. Employee empowerment, benchmarking, documentation etc, are common to both TPM and TQM.

Further similarities between the two include:

a. Total commitment to the program by the upper level management is required in both TQM and TPM.

b. Employees must be given the power to take corrective actions when required.

c. A long range outlook must be adopted as TPM may take a year or more to implement & is an on-going process. Changes in the employee mind set towards their job responsibilities must take place as well.

TQM strives for quality output and effects but TPM emphasizes the machines and equipments.

Machines (mechanical, pneumatic, hydraulic) need maintenance to upkeep themselves, to keep them in running condition capable of manufacturing products. Any producer goods needs maintenance. Maintenance is classified in different categories.

Maintenance is classified as Breakdown maintenance, Preventive maintenance (periodic maintenance, preventive maintenance, corrective maintenance & maintenance prevention). Periodic maintenance is also known as Time based maintenance (TBM).

10.2 PQCDSM Targets

TPM targets Productivity (P), Quality (Q), Cost (C), Delivery (D), Safety (S) & Maintenance (M).

Productivity (P):

1. Obtain minimum 80 percent OPE (Overall Performance Efficiency)

2. Obtain minimum 90 percent OEE (Overall Equipment Effectiveness)

3. Run the machines even during lunch (Lunch is for operators and not for machines)

Quality (Q):

To operate in such a manner so that there are no customer complaints

Cost (C):

Reduce the manufacturing cost by at least 30%

Delivery (D):

Achieve 100% success in delivering the goods as required by the customers

Safety (S):

Maintain an accident free environment

Maintenance (M):

To work for increasing the suggestions by 3 times. Develop multi skilled and flexible work force in the organization.

10.3 Objectives of TPM:

TPM deals with the achievement of the following objectives:

1. Achieve 'Zero defects', 'Zero breakdown' and 'Zero accidents' in all functional areas of the organization.

2. Involving people at all levels of the organization.

3. Forming different teams to reduce defects and self maintenance.

10.4 Benefits of TPM:

TPM leads to achievement of several direct and indirect benefits:

1. Direct Benefits:

a. Increase productivity and OPE (Overall Plant Efficiency) by 1.5 or 2 times.

b. Rectify customer complaints.

c. Reduce the manufacturing cost by 30%.

d. Satisfy the customer needs by 100% (Delivering the right quantity, at the right time and as per the desired quality).

e. Reduce accidents.

f. Follow measures of reducing pollution.

2. Indirect Benefits:

a. Higher level of confidence amongst the employees.

b. Keep the work place clean, neat and attractive.

c. Favorable change in the attitude of the operators.

d. Achieve goals by working as a team.

e. Horizontal deployment of a new concept in all areas of the organization.

f. Share knowledge and experience.

g. The workers get a feeling of owning the machines.

10.5 OEE (Overall Equipment Efficiency):

The overall equipment efficiency (OEE) is the product of availability of the machine (A), performance efficiency (PE) and yield (Y).

Thus, OEE= A x PE x Y

Rate Efficiency (RE): In case of any machine or equipment, actual average cycle time is slower than the design cycle time because of mechanical reasons, say, friction or jams, etc. Output is reduced because of jams. RE is a ratio between 'actual average cycle time' and the 'design cycle time'.

Speed Efficiency (SE): Actual cycle time (the speed), with the lapse of time, gradually becomes slower than the design cycle time. Machine output gets reduced because it is running at a reduced speed.

Performance Efficiency (PE): PE is the product of rate efficiency and the speed efficiency therefore, **PE= RE x SE**

Mean Time to Repair (MTTR): Machine breakdowns and maintenance needs detection of the fault and repairing that. Often the spare parts are required to be purchased and replaced. If the parts are not easily available they are procured from elsewhere. The time required for maintenance is thus varied. MTTR is the average of the time required to restore the machine in the working condition.

Availability of the machine (A): Availability is the proportion of time machine is actually available out of the time it should be available.

Yield (Y): Yield is the alternative called 'Quality rate' (Q). This is a relative figure, the percentage of good parts out of the total produced, sometimes referred to as 'yield'.

Availability of the machine (A) is the proportion of time machine is actually available out of the time it should be available. A= (MTBF-MTTR)/MTBF

Mean Time between Failures (MTBF) = Total running time/ number of failures

Mean time to repair is abbreviated by MTTR.

10.6 Stages in introduction of TPM

TPM is introduced in the organization in the following four stages:

a. Preparatory stage

b. Introduction stage

c. Implementation stage

d. Institutionalizing stage

However in each stage there are various steps involved, like in preparatory stage the six steps involved are; 1. Announcement by management, 2. Initial evaluation and

promoting TPM, 3. Setting up departmental committees for TPM, 4. Establishing the TPM working system and target & 5. Developing a master plan for institutionalizing.

10.7 Pillars of TPM:

There are 8 pillars of TPM which are as follows:

1. JISHU HOZEN (Autonomous maintenance)

2. 5S

3. KAIZEN

4. Planned Maintenance

5. Quality Maintenance

6. Training

7. Office TPM

8. Safety Health & Environment

1. **JISHU HOZEN:** It means autonomous maintenance. All maintenance tasks need not be entrusted to the maintenance department. Machine shop operators may be trained and developed to undertake some maintenance task themselves. Thus, the skilled maintenance mechanics will free to plan and undertake preventive maintenance tasks. They will be able to spend time on more value added activity and technical repairs. The operators are responsible for upkeep of their equipment to prevent it from deteriorating.

2. **5S:** TPM starts with 5S and ends with 5S. Problems cannot be clearly seen when the work place is unorganized. Cleaning and organizing the workplace helps the team to uncover problems. Making the problem visible is the first step for improvement.

   The 5S are Sort, Systematize, Sweep, Standardize, Self-discipline.

3. **KAIZEN:** Kai means change and Zen means good therefore KAIZEN denotes changing for good. Basically KAIZEN is for small improvements, but carried out on a continual basis and involving all people in the organization. KAIZEN is just the opposite of big spectacular innovations in the organization.

4. **Planned Maintenance:** It aims at having trouble free machines and equipments producing defect free products for total customer satisfaction. This breaks maintenance into 4 groups which are:

   a. Preventive Maintenance

   b. Breakdown Maintenance

   c. Corrective Maintenance

   d. Maintenance Prevention

Planned maintenance thus aimed at taking the effort of the organization from a reactive to a proactive level.

5. **Quality Maintenance:** Customer orientation is the first principle of quality improvement. Quality maintenance is thus aimed at achieving customer delight through highest quality through defect free manufacturing. Defects can occur in any organization but in a quality focused organization defects do not reoccur. Focus is on eliminating non-conformances in a systematic manner.

6. **Training:** Training is not only imparted to the employees with the objective of enhancing their skills but also with the objective of achieving rejuvenation and keeping the morale of the employees high. Devoted employees are eager to come to work and perform all the desired function effectively and independently. Trainings must be organized on a regular basis because it is not only about 'know-how' employees must also 'know-why'.

7. **Office TPM:** Office TPM should be started after activating four other pillars of TPM (Jishu HOZEN, Autonomous maintenance, KAIZEN, Quality maintenance & planned maintenance). Office TPM maintains its importance to improve productivity, efficiency in the administrative functions and identify and eliminate losses. Analyzing processes and procedures are included increased office automation. Office TPM addresses some major losses.

   a. Accuracy loss

   b. Communication channel breakdown, telephone and fax lines.

   c. Communication loss

   d. Cost loss

   e. Customer complaints due to logistics

   f. Expenses on emergency dispatches/purchases

   g. Idle loss

   h. Non-availability of correct online stock status

   i. Office equipment breakdown

   j. Set-up loss and Processing loss

   k. Time spent on retrieval of information

8. **Safety, Health & Environment:** Targets of this pillar of TPM is Zero accident, Zero occupational hazard, Zero health damage and Zero fires. Thus, the area of operation of this pillar is to create a safe workplace, working environment and surrounding area that is not damaged or affected negatively by the processes carried out in the organization. For this purpose a committee is constituted which includes managers, workers and subject experts for achieving health and hygiene not only for the workers but for the entire environment.

10.8 Business Process Re-engineering (BPR):

Business process reengineering is the act of recreating a core business process with the goal of improving product output, quality, or reducing costs. Typically, it involves the analysis of company workflows, finding processes that are sub-par or inefficient, and figuring out ways to get rid of them or change them. Business process reengineering became popular in the business world in the 1990s, inspired by an article called Reengineering Work: Don't Automate, Obliterate which was published in the Harvard Business review by Michael Hammer. His position was that too many businesses were using new technologies to automate fundamentally ineffective processes, as opposed to creating something different, something that is built on new technologies. Think, using technology to *"upgrade"* a horse with lighter horseshoes which make them faster, as opposed to just building a car.

In the decades since, BPR has continued to be used by businesses as an alternative to business process management (automating or reusing existing processes), which has largely superseded it in popularity.And with the pace of technological change faster than ever before, BPR is a lot more relevant than ever before.

10.9 Steps in BPR:

There are various steps involved in the BPR they are as follows:

1. Identifying & communicating the need for change

2. Putting together a team of experts

3. Finding out Key Performance Indicators (KPIs)

4. Reengineering the processes and comparing KPIs

Ford Motor Company is one of the real life examples of an organization implementing BPR in the vendor and account receivables management and achieving benefit from it.

10.10 Tero Technology:

Terotechnology is a practice that leverages management, engineering and financial expertise to optimize installation, operations and upkeep of equipment. Terotechnology is derived from the Greek root word "tero" or "I care," which is used with the term "technology" to refer to the study of the costs associated with an asset throughout its life cycle from acquisition to disposal. The goals of this multidisciplinary approach are to reduce the different costs incurred at the various stages of an asset's life and to develop methods that will help extend its life span. The discipline of terotechnology may also be known as "life-cycle costing."

Take this example: An oil company is attempting to map out the costs of an offshore oil platform. They would use terotechnology to forecast the exact costs associated with assembly, transportation, maintenance and dismantling of the platform, and finally a calculation of salvage value.

The study and application of terotechnology is not an exact science: there are many different variables that need to be estimated and approximated. However, a company that does not use this kind of study may be worse off than one that approaches an asset's life cycle in a more ad hoc manner.

Tero technology uses such <u>financial analysis</u> tools as <u>net present value (NPV)</u>,<u>internal rate of return (IRR)</u> and <u>discounted cash flow (DCF)</u> in an attempt to minimize the costs associated with the asset in the future. These costs can include engineering, maintenance, wages payable to operate the equipment, operating costs and even disposal costs.

10.11 Important Questions:

1. **What is Tero Technology? Give examples of tero technology in actual practice.**

2. **What is Business Process Reengineering? What is the utility of the concept of BPR?**

3. **Discuss TPM. What are the 7 pillars of TPM?**

4. **Compare & contrast TPM & TQM.**

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Unit 11: Quality Function Deployment

Structure

11.1 Introduction

11.2 Quality Function Deployment (QFD)

11.3 Benefits of QFD

11.4 Important Questions

11.5 References

11.1 Introduction

In important function of the operations management is to understand the needs and requirements of their customers and design the products or services accordingly. This makes the customer satisfied to the maximum extent and makes them loyal for longer association. The most important characteristic of any product or service is quality. *Quality* is perceived as the inherent characteristics or features of the product and service which makes a customer happy and delighted. It fulfils the expectations of the customer as desired. However, to make customers happy and delighted, we need to understand their requirements through listening their voices and translating these into our products and services through improved and adjusted calibration and recalibration in designing and processing the production. A change in the product or service design often ranges from modification of existing product to designing a new one and basically includes:

- Modification of an existing product or service.
- Expansion of an existing product line or service offering.
- Clone of a competitor's product or service.
- New product or service.

The degree of change brought in the product through redesigned production process results into newness in the organization as well as in the market. This newness designed and brought in due to growing customer expectations and improved technology is perceived to bring in higher market share and thus improved revenue through customer satisfaction. However, the redesigning of the production process is

not an easy task. Often it is accompanied with large scale changes in the organization as well as equipment. Thus, any changes in the product design and production process must consider the available capital and its capital budgeting decisions.

11.2 Quality Function Deployment (QFD)

To ensure that what customers are offered from the manufacturer is matching with the needs and requirements of the customers is an essential parameter. This requirement is fulfilled through appropriate mechanism and system to listen the customers. Theoretically it is difficult to incorporate every customer in the product and process selection decisions. However, interaction with customers, surveys and feedback mechanisms are useful to get insight about the customer preferences. Now a days, when internet and communication technology has reached to a new height and social media platforms are extensively being used, voice of the customer is being listened and incorporated into the corporate decision-making process.

Although, getting inputs form customers through personal interaction is a very informal way, there is a formal system to obtain insight and integrate it into product or service development process. *Quality function deployment* (QFD) is a structuredapproach for integrating the "voice of the customer" into both the product and servicedevelopment process. The purpose of incorporating CFD is to ensure that all the requirements as expected from the customers are factored into every step of product or service development process. Carefully listening and understanding customers is the central feature of QFD. The customer requirement may be general like lower height or reduced weight, without precisely mentioning the requirements. It is up to the manufacturer to translate this requirement in the form suitable to describe the technical specification of the product or service and device appropriate mechanisms to fulfil this requirement through recalibrations in the process. The translation of customer requirements into its technical terms requires feasibility analysis both in the terms of technology and capital.

The main structure of QFD is based on a set of matrices which relates what is the requirement of customer (what feature) and what would be its technical requirement (how statement). The matrix is also known as house of quality and it provides a structure for collection of data required in QFD process. This matrix allows customer requirement and technical requirements to be placed at one place and judge their feasibility through the interactions. Additional features may be incorporated into the matrix in order to broaden its area and scope of product development analysis. These additional features to be included in the matrix might be assigning weights to different

components depending on their relative importance and competitive evaluations (Figure 11.1).
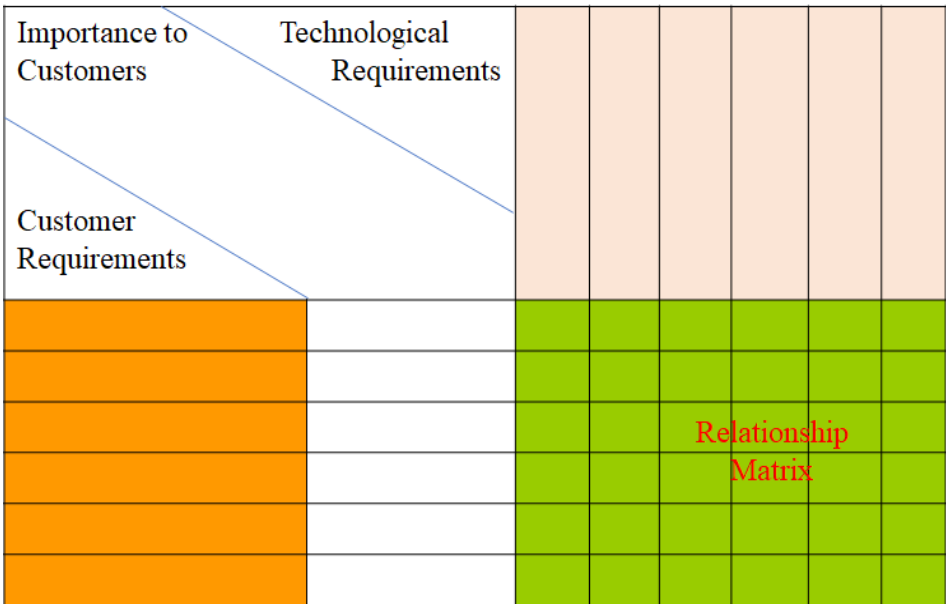

Figure 11.1: The QFD Matrix

For assessing technical requirements necessary for the implementation of QFD, usually a correlation matrix is constructed. This matrix often reveals conflicting information. With additional features, the form of the matrix changes in the form of a house and hence, it is also known as *house of quality* (Figure 11.2).

Figure 11.2: House of Quality
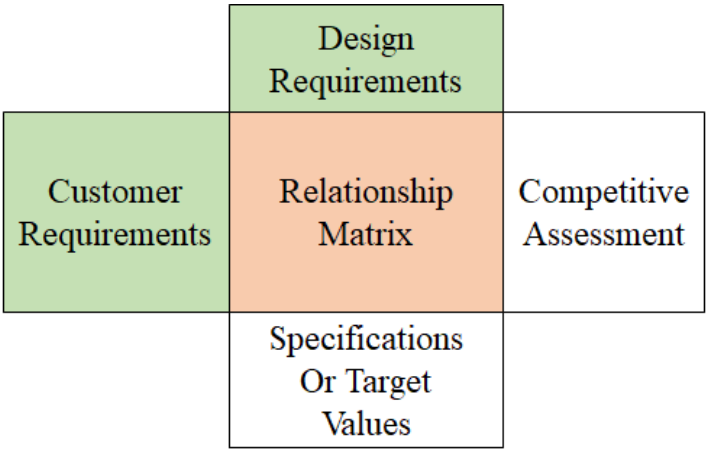
The matrix shows that, how different components of the quality and various requirements interact to decide feasibility of the modification in product and its

production process. This matrix depicts that customer requirements are together clubbed with other requirements like design, specifications and competition.

11.3 Benefits of QFD

The very basic concept of QFD is based on fulfilling customer requirements through listening the voice of the customers and implementing them into the product and production process. Developing a new product or redesigning a product is a tedious task and usually employs following steps:

- Feasibility analysis
- Product specifications
- Process specifications
- Prototype development
- Design review
- Market test
- marketing.
- Product introduction
- Follow-up evaluation

Passing through the rigorous phases and extensive exercise, it becomes necessary to investigate whether the procedure has been useful or not. Below mentioned are few benefits perceived to be achieved due to implementation of QFD:

1. It enables the manufacture to listen voice of the customers and their requirements.
2. It enables to incorporate the features and specifications as expected by the customers.
3. It dictates recalibrations in the production process.
4. Product specifications are adjusted to a precise level.
5. High end technologies are employed.
6. Competitive advantages are attained
7. An appropriate interface is designed to interact with the customers/end users.
8. Customers receive product or service as expected and thus loyalty is increased.
9. It results into more and continuous revenue.

11.4 Important Questions

1. What is meant by quality function development?

2. Explain the concept of information organisation.

3. Write down the benefits of QFD.

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UNIT 12 QUALITY MANAGEMENT

Structure

12.0 Quality Management

12.1 Origin of Quality Management

12.2 House of Quality

12.3 Building of House of Quality

12.4 House of Quality Steps

12.5 Quality Function Deployment (QFD)

 12.5.1 Methodology

 12.5.2 Quality Function Deployment (QFD) Process

 12.5.3 Major Benefits of Quality Function Deployment

  (QFD)

12.6 Important Questions

12.0 Quality Management

Management activities and functions involved in determination of quality policy and its implementation through means such as quality planning and quality assurance (including quality control).

12.1 Origin of Quality Management

While TQM seems like an intuitive process, it came about as a revolutionary idea. The 1920s saw the rise in a reliance on statistics and statistical theory in business, and the first-ever known control chart was made in 1924. People began to build on theories of statistics and ended up collectively creating the method of statistical process control (SPC). However, it wasn't successfully implemented in a business setting until the 1950s.

It was during this time that Japan was faced with a harsh industrial economic environment. Its citizens were thought to be largely illiterate, and its products were known to be of low quality. Key businesses in Japan saw these deficiencies and looked to make a change. Relying on pioneers in statistical thinking, companies such as Toyota integrated the idea of quality management and quality control into their production processes.

Quality management is the act of overseeing all activities and tasks needed to maintain a desired level of excellence. This includes the determination of a quality policy, creating and implementing quality planning and assurance, and quality control and quality improvement. It is also referred to as total quality management (TQM). In general, quality management focuses on long-term goals through the implementation of short-term initiatives.

12.2 House of Quality -

The house of quality is a voice of customer analysis tool and a key component of the quality functional deployment technique. It starts with the voice of the customer. It is a tool to translate what the customer wants into products or services that meet the customer wants in terms of engineering design values by way of creating a relationship matrix.

- Typically the first chart used in Quality Function Deployment
- Data intensive and is capable of capturing large amounts of information.
- Left side has the customer's needs.
- Ceiling has the design features and technical requirements.

- The roofa matrix describing the relationship between the design features. Used to show how the design requirements interact with each other.
- This can be an ordinal measurement scale.
- Competitive section based primarily on the customer's perspective.
- Lower level/foundationbenchmarking & target values used to rank the 'how is'. These are the actions your organization will take to satisfy your customers.

The house of quality, a part of QFD, is the basic design tool of quality function deployment. It identifies and classifies customer desires, identifies the importance of those desires, identifies engineering characteristics which may be relevant to those desires, correlates the two, allows for verification of those correlations, and then assigns objectives and priorities for the system requirements. This process can be applied at any system composition level (e.g. system, subsystem, or component) in the design of a product, and can allow for assessment of different abstractions of a system.

The output of the house of quality is generally a matrix with customer desires on one dimension and correlated non-functional requirements on the other dimension. The cells of matrix table are filled with the weights assigned to the stakeholder characteristics where those characteristics are affected by the system parameters across the top of the matrix. At the bottom of the matrix, the column is summed, which allows for the system characteristics to be weighted according to the stakeholder characteristics. System parameters not correlated to stakeholder characteristics may be unnecessary to the system design and are identified by empty matrix columns, while stakeholder characteristics (identified by empty rows) not correlated to system parameters indicate "characteristics not addressed by the design parameters".[5] System parameters and stakeholder characteristics with weak correlations potentially indicate missing information, while matrices with "too many correlations" indicate that the stakeholder needs may need to be refined.

12.3 Building of House of Quality -

The House of Quality, or Quality Function Deployment (QFD), is a useful tool that Six Sigma Black Belt practitioners use during the Define phase of the DMAIC cycle of Six Sigma projects. The topic can be briefly discussed in green belt training or sometimes on online free six sigma courses. However, the house of quality is one of the more advanced LEAN techniques. Let's look at a practical example of how the house of quality technique can be implemented.

12.4 House of Quality Steps

 To build the house of quality, basic six steps are performed. House of Quality Steps are as follows:

1. Identify what customer wants.
2. Identify how the product will satisfy the customer. It refers to identifying specific product characteristics, features or attributes and showing how they will satisfy customer wants
3. Identify relationships between how's. A couple of questions, those are to be answered here: How do our how's tie together? What is the relationship between our two or more how's?
4. Develop importance ratings. It refers to using the customer's importance ratings and weights from the relationships in the matrix to compute our importance ratings.
5. Evaluate competing products or services. The question to be answered here is: How well do competing products meet customer wants? This activity is completely based on research.
6. Determine the desirable technical attributes. In this step, our performance and the competitor's performance are determined and compared.

12.5 Quality function deployment (QFD)

Is a method developed in Japan beginning in 1966 to help transform the voice of the customer in to engineering characteristics for a product.Yoji Akao, the original developer, described QFD as a "method to transform qualitative user demands into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process."The author combined his work in quality assurance and quality control points with function deployment used in value engineering.

Quality professionals refer to QFD by many names, including matrix product planning, decision matrices, and customer driven engineering. Whatever you call it, QFD is a focused methodology for carefully listening to the voice of the customer and then effectively responding to those needs and expectations.

First developed in Japan in the late 1960s as a form of cause-and-effect analysis, QFD was brought to the United States in the early 1980s. It gained its early popularity as a result of numerous successes in the automotive industry.

12.5.1 Methodology

In QFD, quality is a measure of customer satisfaction with a product or a service. QFD is a structured method that uses the seven management and planning tools to identify and prioritize customers' expectations quickly and effectively.

Beginning with the initial matrix, commonly termed the house of quality, depicted in Figure 1, the QFD methodology focuses on the most important product or service attributes or qualities. These are composed of customer wows, wants, *and* musts.

Once you have prioritized the attributes and qualities, QFD deploys them to the appropriate organizational function for action, as shown in Figure 2. Thus, QFD is the deployment of customer-driven qualities to the responsible functions of an organization.

12.5.2 Quality Function Deployment (QFD) Process

A side benefit of the four phase process is in the resolution of warranty complaints using the words in the 'customer wants' section of the planning HOQ (a warranty complaint is a customer needs not being met or working improperly). Since the four phase process cascades the relationships between customer wants and process control settings, it is easy to see which process control settings have the most impact on delivering the customer need that is expressed in the warranty complaint. Without a four phase QFD model, knowing which process control values to adjust to resolve warranty issues is a much more difficult process.

Four Phase QFD Process

Product Tradeoffs

Product Attributes

Customer Wants — Product Planning HoQ

Part Attributes

Part Planning HoQ

NOTE:
Click HoQ blocks to see examples of House of Quality matrices.

Process Attributes

Process Planning HoQ

Production Controls

Production Control HoQ
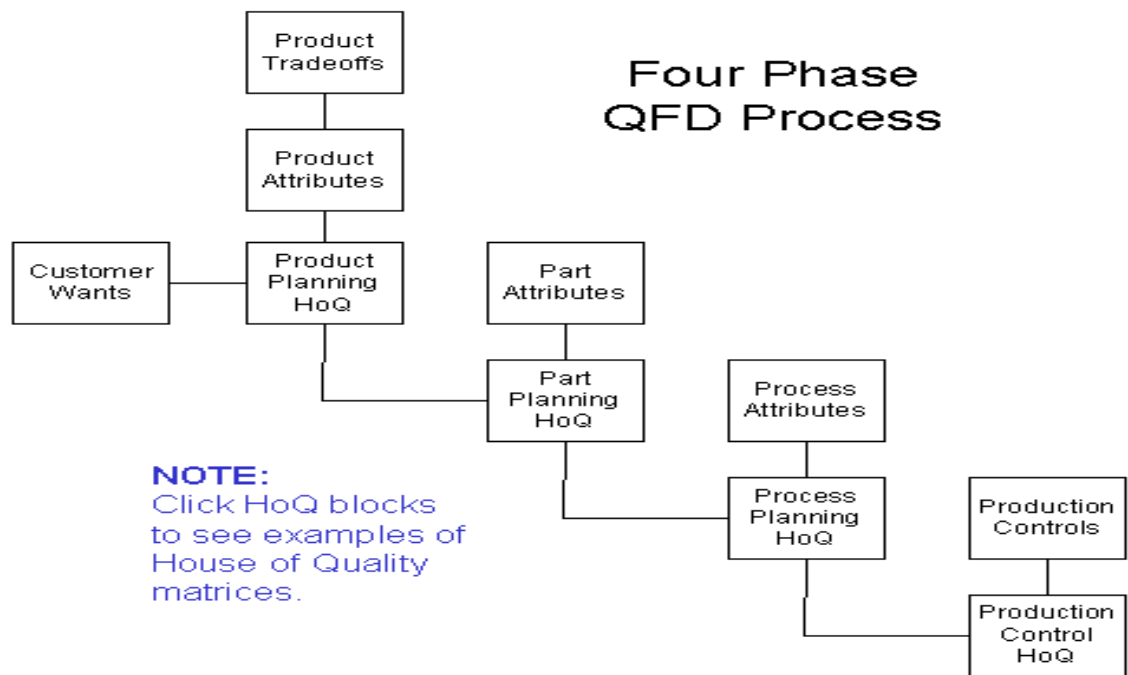
Figure 1 — House of quality template and benefits

Interaction matrix

Product characteristics

Voice of the customer	Priorities	Relationship matrix	Competitive value

Importance rating

Technical difficulty

Technical competitive benchmark

Target values (requirements)

The house of quality provides:
- A requirements *planning* capability
- A tool for graphic and integrated thinking
- A means to capture and preserve the engineering thought process
- A means to communicate the thought process to new members of the QFD team
- A means to inform management regarding inconsistencies between requirements, risks, and needs of the customer

Figure 2 — Waterfall relationship of QFD matrices
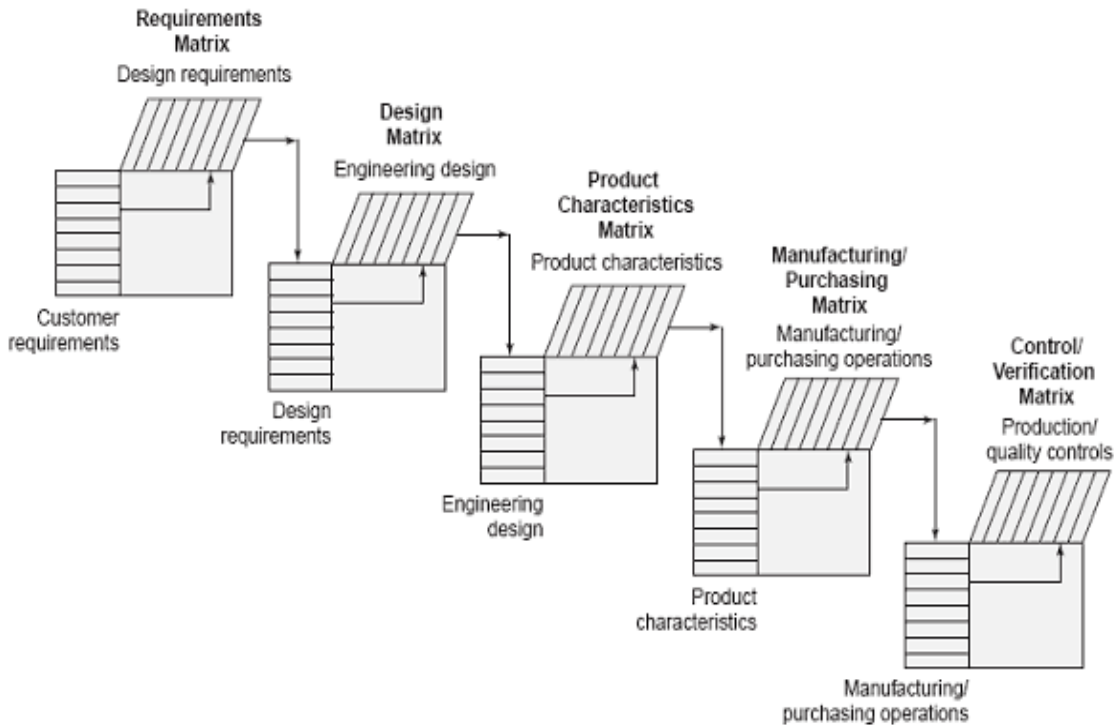
12.5.3 Major benefits of quality function deployment (QFD)

Quality Function Deployment (QFD)-House of Quality –is an effective Management tool to drive the design process and production process with the main aim of satisfying the customer needs. The benefits of QFD are

1. A systematic way of obtaining information and presenting it.
2. Shorter product development cycle.
3. Considerably reduced start-up costs.
4. Fewer engineering changes.
5. Reduced chance of overnights during design process.
6. An environment of team work.
7. Consensus decision.
8. Everything is preserved in writing.
9. It facilitates identification of the causes of customer complaints and makes it easier to takes prompt remedical action.
10. It is a useful tool for improving product Quality.
11. It is a useful tool for competitive analysis of product quality.
12. It is stabilizes quality.
13. It cuts down on rejects and rework at the production site.
14. It decreases claims substantially.
15. Marketing benefits are obtained by identifying sales point.

The main 'process' benefits of using QFD are: improved communication and sharing of information within a cross-functional team

charged with developing a new product. This team will typically include people from a variety of functional groups, such as marketing, sales, service, distribution, product engineering, process engineering, procurement, and production the identification of 'holes' in the current knowledge of the design team the capture and display of a wide variety of important design information in one place in a compact form support for understanding, consensus, and decision making, especially when complex relationships and trade-offs are involved the creation of an informational base which is valuable for repeated cycles of product improvement

The main 'bottom line' benefits of using QFD are: greater likelihood of product success in the marketplace, due to the precise targeting of key customer requirements reduced overall design cycle time, mainly due to a reduction in time-consuming design changes. This is a powerful benefit: customer requirements are less likely to have changed since the beginning of the design project; and more frequent design cycles mean that products can be improved more rapidly than the competition reduced overall cost due to reducing design changes, which are not only time consuming but very costly, especially those which occur at a late stage. Reduced product cost by eliminating redundant features and over-design. When to use QFD is a powerful tool that leads to significant improvements in product/process performances. However, it is not a short-term answer to product development problems.

The method on which QFD is implemented may have a large impact on benefits derived and companies should take up QFD only after getting the consent and commitment of the team members. QFD provides a systematic approach to build a team perspective on what needs to be done, the best ways to do it, the best order to accomplish the tasks proposed and the staffing and resources required to enhance customer satisfaction. It is also a good format for capturing and recording/documenting decision making. Applied through the Kaizen philosophy under Total Quality Control, QFD is the most highly developed form of integrated product and process development in existence.

12.6 Important Questions

5. **What is quality management? Give any one example of house quality management in actual practice.**

6. **What is quality function deployment? Write its importance.**

7. **Discuss the process of QFD.**

8. **What do you mean by Waterfall relationship of QFD matrices?**

9. **Explain the House of Quality Steps.**

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Unit – 13 Failure Mode Effect Analysis

Structure

13.0 Failure Mode Effect Analysis (FMEA)

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13.0 Failure Mode Effect Analysis (FMEA)

Failure Mode Effect Analysis Also called: potential failure modes and effects analysis; failure modes, effects and criticality analysis (FMECA).Begun in the 1940s by the U.S. military, failure modes and effects analysis (FMEA) is a step-by-step approach for identifying all possible failures in a design, a manufacturing or assembly process, or a product or service. It is a common process analysis tool.

"Failure modes" means the ways, or modes, in which something might fail. Failures are any errors or defects, especially ones that affect the customer, and can be potential or actual.

"Effects analysis" refers to studying the consequences of those failures.

Failures are prioritized according to how serious their consequences are, how frequently they occur and how easily they can be detected. The purpose of the FMEA is to take actions to eliminate or reduce failures, starting with the highest-priority ones.Failure modes and effects analysis also documents current knowledge and actions about the risks of failures, for use in continuous improvement. FMEA is used during design to prevent failures. Later it's used for control, before and during ongoing operation of the process. Ideally, FMEA begins during the earliest conceptual stages of design and continues throughout the life of the product or service.

13.0.1 Assumptions of FMEA –

1. When a process, product or service is being designed or redesigned, after quality function deployment (QFD).
2. When an existing process, product or service is being applied in a new way.
3. Before developing control plans for a new or modified process.
4. When improvement goals are planned for an existing process, product or service.
5. When analyzing failures of an existing process, product or service.
6. Periodically throughout the life of the process, product or service.

13.0.2 FMEA Procedure

1. Assemble a cross-functional team of people with diverse knowledge about the process, product or service and customer needs. Functions often included are: design, manufacturing, quality, testing, reliability, maintenance, purchasing (and suppliers), sales, marketing (and customers) and customer service.
2. Identify the scope of the FMEA. Is it for concept, system, design, process or service? What are the boundaries? How detailed should we be? Use flowcharts to identify the scope and to make sure every team member understands it in detail.
3. Fill in the identifying information at the top of your FMEA form. (Figure 1 shows a typical format.) The remaining steps ask for information that will go into the columns of the form.
4. Identify the functions of your scope. Ask, "What is the purpose of this system, design, process or service? What do our customers expect it to do?" Name it with a verb followed by a noun. Usually one will break the scope into separate subsystems, items, parts, assemblies or process steps and identify the function of each.

5. For each function, identify all the ways failure could happen. These are potential failure modes. If necessary, go back and rewrite the function with more detail to be sure the failure modes show a loss of that function.

6. For each failure mode, identify all the consequences on the system, related systems, process, related processes, product, service, customer or regulations. These are potential effects of failure. Ask, "What does the customer experience because of this failure? What happens when this failure occurs?"

7. Determine how serious each effect is. This is the severity rating, or S. Severity is usually rated on a scale from 1 to 10, where 1 is insignificant and 10 is catastrophic. If a failure mode has more than one effect, write on the FMEA table only the highest severity rating for that failure mode.

8. For each failure mode, determine all the potential root causes. Use tools classified as cause analysis tool, as well as the best knowledge and experience of the team. List all possible causes for each failure mode on the FMEA form.

9. For each cause, determine the occurrence rating, or O. This rating estimates the probability of failure occurring for that reason during the lifetime of your scope. Occurrence is usually rated on a scale from 1 to 10, where 1 is extremely unlikely and 10 is inevitable. On the FMEA table, list the occurrence rating for each cause.

10. For each cause, identify current process controls. These are tests, procedures or mechanisms that you now have in place to keep failures from reaching the customer. These controls might prevent the cause from happening, reduce the likelihood that it will happen or detect failure *after* the cause has already happened but *before* the customer is affected.

11. For each control, determine the detection rating, or D. This rating estimates how well the controls can detect either the cause or its failure mode after they have happened but before the customer is affected. Detection is usually rated on a scale from 1 to 10, where 1 means the control is absolutely certain to detect the problem and 10 means the control is certain not to detect the problem (or no control exists). On the FMEA table, list the detection rating for each cause.

12. Optional for most industries: Ask, "Is this failure mode associated with a critical characteristic?" (Critical characteristics are measurements or indicators that reflect safety or compliance with government regulations and need special controls.) If so, a column labelled "Classification" receives a Y or N to show whether special controls are needed. Usually, critical characteristics have a severity of 9 or 10 and occurrence and detection ratings above 3.

13. Calculate the risk priority number, or RPN, which equals S × O × D. Also calculate Criticality by multiplying severity by occurrence, S × O. These numbers provide guidance for ranking potential failures in the order they should be addressed.

14. Identify recommended actions. These actions may be design or process changes to lower severity or occurrence. They may be additional controls to improve detection. Also note who is responsible for the actions and target completion dates.

15. As actions are completed, note results and the date on the FMEA form. Also, note new S, O or D ratings and new RPNs.

FMEA Examples – A bank performed a process FMEA on their ATM system. Figure 1 shows part of it: the function "dispense cash" and a few of the failure modes for that function. The optional "Classification" column was not used. Only the headings are shown for the rightmost (action) columns.

Notice that RPN and criticality prioritize causes differently. According to the RPN, "machine jams" and "heavy computer network traffic" are the first and second highest risks.

One high value for severity or occurrence times a detection rating of 10 generates a high RPN. Criticality does not include the detection rating, so it rates highest the only cause with medium to high values for both severity and occurrence: "out of cash." The team should use their experience and judgment to determine appropriate priorities for action.

13.0.3 Types of FMEA –

1. **Functional**: before design solutions are provided (or only on high level) functions can be evaluated on potential functional failure effects. General Mitigations ("design to" requirements) can be proposed to limit consequence of functional failures or limit the probability of occurrence in this early development. It is based on a functional breakdown of a system. This type may also be used for Software evaluation.
2. **Concept Design / Hardware**: analysis of systems or subsystems in the early design concept stages to analyse the failure mechanisms and lower level functional failures, especially to different concept solutions in more detail. It may be used in trade-off studies.
3. **Detailed Design / Hardware**: analysis of products prior to production. These are the most detailed (in mil 1629 called Piece-Part or Hardware FMEA) FMEAs and used to identify any possible hardware (or other) failure mode up to the lowest part level. It should be based on hardware breakdown (e.g. the BoM = Bill of Material). Any Failure effect Severity, failure Prevention (Mitigation), Failure Detection and Diagnostics may be fully analyzed in this FMEA.
4. **Process**: analysis of manufacturing and assembly processes. Both quality and reliability may be affected from process faults. The input for this FMEA is amongst others a work process / task Breakdown.

13.0.4 Advantages –

1. Catalyst for teamwork and idea exchange between functions.
2. Collect information to reduce future failures, capture engineering knowledge.
3. Early identification and elimination of potential failure modes.
4. Emphasize problem prevention.
5. Improve company image and competitiveness.
6. Improve production yield.
7. Improve the quality, reliability, and safety of a product/process.
8. Increase user satisfaction.
9. Maximize profit.
10. Minimize late changes and associated cost.
11. Reduce impact on company profit margin.
12. Reduce system development time and cost.
13. Reduce the possibility of same kind of failure in future.
14. Reduce the potential for warranty concerns.

Timing- The FMEA should be updated whenever:

1. A new cycle begins (new product/process).
2. Changes are made to the operating conditions.
3. A change is made in the design.
4. New regulations are instituted.
5. Customer feedback indicates a problem.

13.0.5 Uses of FMEA-

1. Development of system requirements that minimize the likelihood of failures.
2. Development of designs and test systems to ensure that the failures have been eliminated or the risk is reduced to acceptable level.
3. Development and evaluation of diagnostic systems.
4. To help with design choices (trade-off analysis).

13.1 Design Review Based on Failure Mode

Design Review Based on Failure Mode (DRBFM) is a tool originally developed by the Toyota Motor Corporation. This tool was developed based on the philosophy that design problems occur when changes are made to existing engineering designs that have already been proven successful.

13.1.1 Methodology

DRBFM Methodology was developed by Tatsuhiko Yoshimura, a Quality Expert and a professor at Japan's Kyushu University. Yoshimura knew that design problems occur when changes are made without the proper level of supporting documentation. Using the philosophy of Preventative Measures (Mizenboushi), he created his own philosophy of DRBFM. Dr. Tatsuhiko Yoshimura supported the development and usage of DRBFM at many companies. He believes companies that implement the usage of DRBFM will be a better company. He believes the implementation of DRBFM requires discipline and engagement of everyone to the one goal of adding value to the customer by meeting engineering functional requirements and customer expectations. The Philosophy of DRBFM centres on three concepts:

- Good Design
- Good Discussion
- Good Dissection

The DRBFM methodology is now a recognized documented process by SAE (Society of Automotive Engineers)and also by AIAG (Automotive Industry Action Group). SAE J2886 DRBFM Recommended Practice was published in 2013 and the AIAG DRBFM Reference Guide was published in September 2014. Bill Haughty is the chair of both the SAE and AIAG committees to ensure a consistent application of the DRBFM process within both documents.

Good Design - The basis for reliability is not to change a design; therefore, Mr. Yoshimura believes that if a design changes, the change should occur in small increments. Disturbance to a design is caused by the discontinuity of implementing changes affecting the interfaces between parts and interactions between systems. The design should not be changed in two different places simultaneously, because making too many changes too fast has the potential to result in failures faster than our capacity to detect them. One key to successful change is to make changes visible.

Good Discussion - In discussions we should concentrate on the proposed changes to a design. If a proven good design is applied to future products, then the risk of failure is low; however, if changes are made to the existing design, then the probability of failure is increased.Mr. Yoshimura advises individuals to work to understand the changes as opposed to trivializing them. He also advises that validation testing can help to identify design weaknesses; but, he also states that good discussions held at preliminary design reviews can achieve the same result. The good discussion that Mr. Yoshimura refers to here is also known as DRBFM (Design Review Based on Failure Modes).

The analysis for DRBFM is modelled after a linkage between a good design review and FMEA. A comprehensive, well-done FMEA can be considered one of the prerequisites (plus many other preparations sheets defined in the methodology) for a DRBFM but it an FMEA is not required since the focus is based on the changes and interfaces. DRBFM is implemented based on novelty of change at any level of the product (design, process, supplier, etc.). The intent of the DRBFM is to make these changes visible by discussing them at length, as well as every possible concern for failure that may potentially occur - anything that impacts quality, cost, or delivery.

Good Dissection - The third part of the GD^3 concept. One objective of a good design review is to examine the results of validation testing, making all product weaknesses visible. This examination involves applying another GD^3 concept, Design Review Based on Test Results (DRBTR). When applying DRBTR, we must, wherever possible, observe the product test before, during and after completion. DRBTR looks for the validation (test) engineer to lead the review of a DRBTR review to exam the tested part and look for buds of problems that are about to happen (test failures are evident). DRBTR encourages the designer and test engineer to discuss potential problems (observations) or weaknesses from a cross functional multi-perspective approach, and to share this information. DRBTR has the designer observing actual test pieces and discussing test results in open discussions, such as design reviews. Furthermore, when dissecting test results, one must consider manufacturing variation, test profile and expected quality and reliability targets of the product. This process is defined in detail in Bill Hughes's EBook. "Design Review Based on Failure Modes (DRBFM) and Design Review Based on Test Results (DRBTR) Process Guidebook." The book features process step by step details of the methods along with examples.

13.1.2 Failure Rate

Failure rate is the frequency with which an engineered system or component fails, expressed in failures per unit of time. It is often denoted by the Greek letter (lambda) and is highly used in reliability engineering.

The failure rate of a system usually depends on time, with the rate varying over the life cycle of the system. For example, an automobile's failure rate in its fifth year of service may be many times greater than its failure rate during its first year of service. One does not expect to replace an exhaust pipe, overhaul the brakes, or have major transmission problems in a new vehicle.

In practice, the mean time between failures (MTBF, 1/») is often reported instead of the failure rate. This is valid and useful if the failure rate may be assumed constant – often used for complex units / systems, electronics – and is a general agreement in some reliability standards (Military and Aerospace). It does in this case *only* relate to the flat region of the bathtub curve, which is also called the "useful life period". Because of this, it is incorrect to extrapolate MTBF to give an estimate of the service lifetime of a component, which will typically be much less than suggested by the MTBF due to the much higher failure rates in the "end-of-life wearout" part of the "bathtub curve".

The reason for the preferred use for MTBF numbers is that the use of large positive numbers (such as 2000 hours) is more intuitive and easier to remember than very small numbers (such as 0.0005 per hour).

The MTBF is an important system parameter in systems where failure rate needs to be managed, in particular for safety systems. The MTBF appears frequently in the engineering design requirements, and governs frequency of required system maintenance and inspections. In special processes called renewal process, where the time to recover from failure can be neglected and the likelihood of failure remains constant with respect to time, the failure rate is simply the multiplicative inverse of the MTBF (1/»).

A similar ratio used in the transport industries, especially in railways and trucking is "mean distance between failures", a variation which attempts to correlate actual loaded distances to similar reliability needs and practices. Failure rates are important factors in the insurance, finance, commerce and regulatory industries and fundamental to the design of safe systems in a wide variety of applications.

Failure rate in the discrete sense -The failure rate can be defined as the following:

The total number of failures within an item population, divided by the total time expended by that population, during a particular measurement interval under stated conditions.

(According to MacDiarmid)

Although the failure rate, is often thought of as the probability that a failure occurs in a specified interval given no failure before time , it is not actually a probability because it can exceed 1. Erroneous expression of the failure rate in % could result in incorrect perception of the measure, especially if it would be measured from repairable systems and multiple systems with non-constant failure rates or different operation times. It can be defined with the aid of the reliability function, also called the survival function, the probability of no failure before time.

13.1.3 Decreasing failure rate

A decreasing failure rate (DFR) describes a phenomenon where the probability of an event in a fixed time interval in the future decreases over time. A decreasing failure rate can describe a period of "infant mortality" where earlier failures are eliminated or corrected and corresponds to the situation where $»(t)$ is a decreasing function. Mixtures of DFR variables are DFR. Mixtures of exponentially distributed random variables are hyper-exponentially distributed.

Renewal processes - For a renewal process with DFR renewal function, inter-renewal times are concave. Brown conjectured the converse that DFR is also necessary for the inter-renewal times to be concave, however it has been shown that this conjecture holds neither in the discrete case nor in the continuous case.

Applications - Increasing failure rate is an intuitive concept caused by components wearing out. Decreasing failure rate describes a system which improves with age.Decreasing failure rates have been found in the lifetimes of spacecraft, Baker and Baker commenting that "those spacecraft that last, last on and on."The reliability of aircraft air conditioning systems were individually found to have an exponential distribution and thus in the pooled population a DFR.

Coefficient of variation - When the failure rate is decreasing the coefficient of variation is $\geqslant 1$, and when the failure rate is increasing the coefficient of variation is $\leqslant 1$.Note that this result only holds when the failure rate is defined for all $t \geqslant 0$ and that the converse result (coefficient of variation determining nature of failure rate) does not hold.

13.1.4 Failure rate data

Failure rate data can be obtained in several ways. The most common means are:

- **Historical data about the device or system under consideration -** Many organizations maintain internal databases of failure information on the devices or systems that they produce, which can be used to calculate failure rates for those devices or systems. For new devices or systems, the historical data for similar devices or systems can serve as a useful estimate.

- **Government and commercial failure rate data -** Handbooks of failure rate data for various components are available from government and commercial sources. MIL-HDBK-217F, Reliability Prediction of Electronic Equipment, is a military standard that provides failure rate data for many military electronic components. Several failure rate data sources are available commercially that focus on commercial components, including some non-electronic components.

Testing - The most accurate source of data is to test samples of the actual devices or systems in order to generate failure data. This is often prohibitively expensive or impractical, so that the previous data sources are often used instead.

Units - Failure rates can be expressed using any measure of time, but hours is the most common unit in practice. Other units, such as miles, revolutions, etc., can also be used in place of "time" units. Failure rates are often expressed in engineering notation as failures per million, or 10^{-6}, especially for individual components, since their failure rates are often very low.

The Failures In Time (FIT) rate of a device is the number of failures that can be expected in one billion (10^9) device-hours of operation. (E.g. 1000 devices for 1 million hours or 1 million devices for 1000 hours each, or some other combination) This term is used particularly by the semiconductor industry. The relationship of FIT to MTBF may be expressed as:

$$MTBF = 1{,}000{,}000{,}000 \times 1/FIT.$$

Additives - Under certain engineering assumptions (e.g. besides the above assumptions for a constant failure rate, the assumption that the considered system has no relevant redundancies), the failure rate for a complex system is simply the sum of the individual failure rates of its components, as long as the units are consistent, e.g. failures per million hours. This permits testing of individual components or subsystem, whose failure rates are then added to obtain the total system failure rate.

Adding "redundant" components to eliminate a single point of failure improves the mission failure rate, but makes the series failure rate (also called the logistics failure rate) worse—the extra components improve the mean time between critical failures (MTBCF), even though the mean time before something fails is worse.

13.2 Kano Model

It's commonly believed insist that customers don't *really* know what they want; they have to be told. The truth is customers *do* know what they want, but may not be proficient at describing their needs. By understanding the three types of customer needs and how to reveal them, you'll better know your customer's true needs and how to address them. The Kano model is useful in gaining a thorough understanding of a customer's needs. You can translate and transform the resulting *verbatim* using the voice of the customer table that, subsequently, becomes an excellent input as what's in a QFD house of quality. The model involves two dimensions:

- **Achievement** (the horizontal axis) which runs from the supplier didn't do it at all to the supplier did it very well.

- **Satisfaction** (the vertical axis), which goes from total dissatisfaction with the product or service to total satisfaction with the product or service.

Dr. Noriaki Kano isolated and identified three levels of customer expectations: that is, what it takes to positively impact customer satisfaction. The figure below portrays the three levels of need: expected, normal, and exciting.

Expected needs -Fully satisfying the customer at this level simply gets a supplier into the market. The entry level expectations are the *must* level qualities, properties, or attributes.These expectations are also known as the dis-satisfiers because by themselves they cannot fully satisfy a customer. However, failure to provide these basic expectations will cause dissatisfaction.

Examples include attributes relative to safety, latest generation automotive components such as a self-starter, and the use of all new parts if a product is offered for

sale as previously unused or new. The musts include customer assumptions, expected qualities, expected functions, and other unspoken expectations.

Normal Needs -These are the qualities, attributes, and characteristics that keep a supplier in the market. These next higher level expectations are known as the wants or the satisfiers because they are the ones that customers will specify as though from a list. They can either satisfy or dissatisfy the customer depending on their presence or absence.

The "wants" include voice of the customer requirements and other spoken expectations (see table below).

Exciting Needs - These are features and properties that make a supplier a leader in the market. The highest level of customer expectations, as described by Kano, is termed the wow level qualities, properties, or attributes. These expectations are also known as the delighters *or* exciters because they go well beyond anything the customer might imagine and ask for. Their absence does nothing to hurt a possible sale, but their presence improves the likelihood of purchase. Wows not only excite customers to make on-the-spot purchases but make them return for future purchases. These are unspoken ways of delighting the customer. Examples include heads-up display in a front windshield, forward- and rear-facing radars, and a 100,000 mile warranty.

Over time, as demonstrated by the arrow going from top left to bottom right in the Kano model, wows become *wants* become musts. For example, automobile self-starters and automatic transmissions. The organization that gets ahead and stays ahead constantly pulses its customers to identify the next wows. The best wows, plenty of wants, and all the musts are what it takes to become and remain an industry leader.

13.2.1 Kano Model Example: Home Buyers Needs –
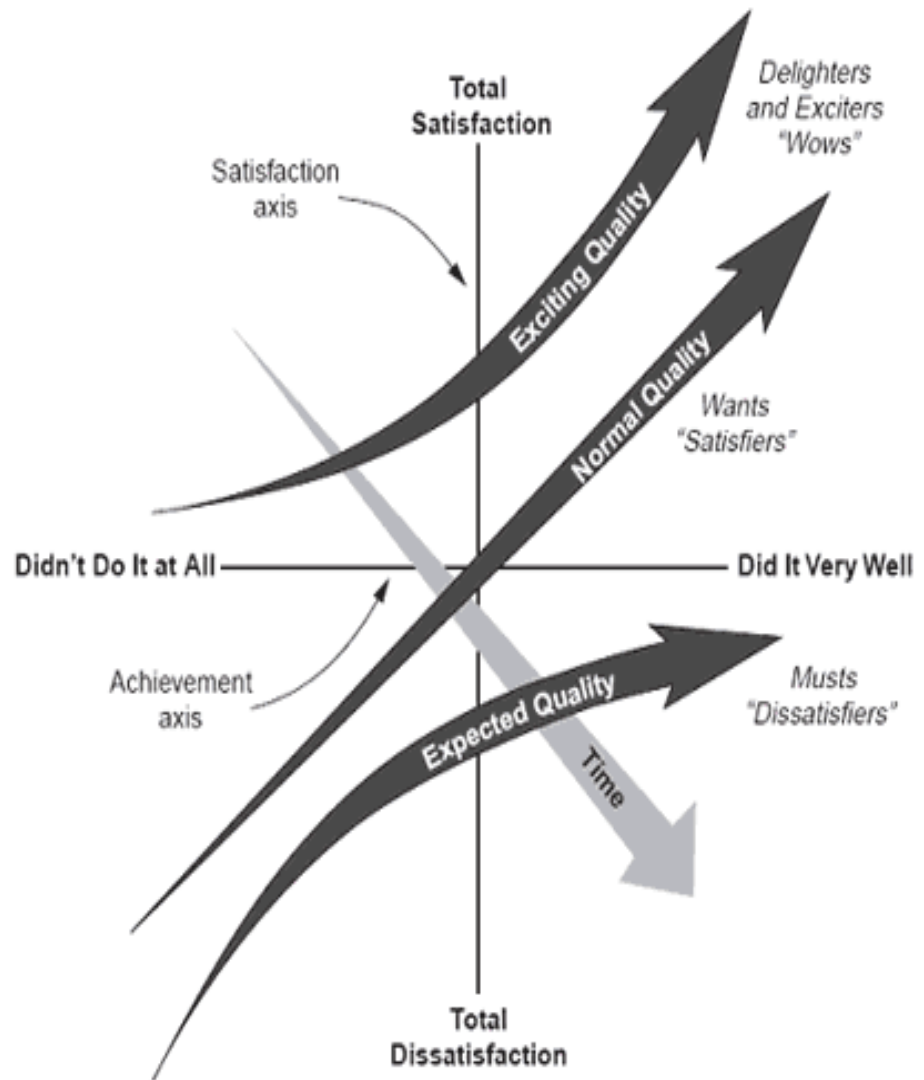
Types of customer requirements

Voice of Customer in Quality Management:-

Voice of the Customer (VOC): The "voice of the customer" is a process used to capture the requirements/feedback from the customer (internal or external) to provide the customers with the best in class service/product quality. VOC Advances: Helping Make Better Design Decisions.

13.2.2 Voice of the Customer (VOC): in Six Sigma –

The "voice of the customer" is a process used to capture the requirements/feedback from the customer (internal or external) to provide the customers with the best in class service/product quality. This process is all about being proactive and constantly innovative to capture the changing requirements of the customers with time.

The "voice of the customer" is the term used to describe the stated and unstated needs or requirements of the customer. The voice of the customer can be captured in a variety of ways: Direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, field reports, complaint logs, etc.

This data is used to identify the quality attributes needed for a supplied component or material to incorporate in the process or product.

Level of customer need	Example related to home buyers
Expected quality	I assume it meets all federal, state, and local building codes.
Normal quality—spoken	Three-car garage, three bedrooms, two baths
Normal quality—unspoken	I'll know it when I see it
Exciting quality	Wow – a lifetime warranty on the roof

13.2.3 Voice of the Customer Table (VOCT)

Quality function deployment (QFD) begins with an exploration and discovery of customer needs. A number of tools and approaches exist to help organizations focus their first and best efforts on what matters most to customers and areas where competitors' offerings may be preferred. The first step is to capture the voice of the customer (VOC). Common sources can include sales and technical trip reports, warranty claims, user support forums or help lines, and social media. Among the well-known market research methods available, surveys and focus groups can be useful for validating what an organization already presumes to know about customer needs. Questionnaires can help capture new information an organization known to exist and specifically seeks. These methods are scripted by the organization and typically address questions about a product or service.

In contrast, customer gamma visits are unique to QFD. A gemba visit involves listening to and observing customers while they are using a product or service to determine what they are doing (or failing to do). During these moments, organizations can uncover information that they did not even know existed and would not know to seek.

13.2.4 How to conduct a GEMBA Visit -

1. Select which customers are most important to visit. List each segment in one row of a customer segments table, as shown in the figure below.

2. Define the conditions of the visit. You want to be present at the most stressful time for the customer. After all, if your product or service does not help solve your customers' most urgent needs, why would they purchase it?
3. Capture what you learn.

Customer segments table – flashlight Example

Who is customer?	What are they doing (or failing to do)?	When are they doing it?	Where are they doing it?	Why are they doing it?	How are they doing it?	What is the current solution?
Scout	Camp out	Night	Campsite	Walk to latrine	Walk on unlit path	Handheld flashlight
Homeowner	See during power failure	Night	Basement	See in dark, check circuit	Hold in hand, set on surface	Handheld flashlight

13.2.5 VOC into Customer Needs

Customers do not always explain their needs completely and accurately. In fact, often they speak about what features they want for a product or service, but not why they want those features. To be innovative, an organization needs to know why customers want certain features. Understanding customer needs at this level enables an organization to develop new solutions before its competitors can. Voice of the customer or VOC information gathered from market research methods, gemba visits, or other means should therefore be restated into customer needs. Use a customer voice table and follow these steps to translate VOC into needs:

1. Document each VOC statement and the situation or context in which it was made.
2. Ask customers to try to restate their input in terms of their needs. Features, especially, should be translated into needs. It is not uncommon to derive as many as five to ten needs from one VOC statement. Unspoken needs will emerge.
3. Have customers prioritize their needs. For accurate ratio scale priorities that can be properly used in later QFD matrices, the analytic hierarchy process (AHP) should be used.

Customer Needs – In QFD, information that meets the following criteria can be considered to express a true customer needs:

1. Defines the benefit customers receive from
   - their problems solved
   - their opportunities enabled
   - their image enhanced
2. Is positively stated
3. Focuses on a single issue
4. Is independent of specific products or services, features and technologies.

Customer Voice Table –

Situation	VOC	Restated as customer need
Scout leaving tent at night	Ouch, I stubbed my toe on a tree root!	I can see where I am now. I can see around my feet.
Scout leaving tent at night	Which path do I take?	I can see where I want to go. I can see in the distance. I can see others approaching me.
Homeowner checking circuits during power failure	Flashlight should not roll after I set it down	I can see even if I'm using both my hands.

Once customers have prioritized their needs, the QFD team can work on identifying product features that will have the greatest impact. In this example, if "I can see around my feet" has the highest priority for the flashlight, then it might make sense to add a second bulb that points downward and has a focal length for a five-foot-tall scout.

13.3 Important Questions

1. Write the procedure failure mode effect analysis?
2. Explain the main advantages and assumption of FMEA?
3. What do you mean by can model? Explain with an example?
4. What is six sigma?
5. How to conduct GEMDA visits?

13.4 References

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UNIT 14 STATISTICAL TOOLS

Structure

14.0 Seven old Statistical Tools

Quality pros have many names for these seven basic tools of quality, first emphasized by Kaoru Ishikawa, a professor of engineering at Tokyo University and the father of "quality circles." Start your quality journey by mastering these tools, and you'll have a name for them too: "indispensable."Many organizations use quality tools to help monitor and manage their quality initiatives.

14.0.1 Cause and Effect Diagram (Ishikawa or Fishbone Chart): Identifies many possible causes for an effect or problem and sorts ideas into useful categories.

14.0.2 Check Sheet: A structured, prepared form for collecting and analyzing data; a generic tool that can be adapted for a wide variety of purposes.

14.0.3 Control Charts: Graphs used to study how a process changes over time. Comparing current data to historical control limits leads to conclusions about whether the process variation is consistent (in control) or is unpredictable (out of control, affected by special causes of variation).

14.0.4 Histogram: The most commonly used graph for showing frequency distributions, or how often each different value in a set of data occurs.

14.0.5 Pareto Chart: Shows on a bar graph which factors are more significant.

14.0.6 Scatter Diagram: Graphs pairs of numerical data, one variable on each axis, to look for a relationship.

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

There are several types of tools that can be used. However, there are seven management tools for quality control that are the most common. Different tools are used for different problem solving opportunities and many of the tools can be used in different ways. The trick is to become familiar and comfortable with all of these quality tools so you can pull the appropriate one out of the **toolbox** when there is a problem solving need.

14.1 Most common quality tools –

14.1.1 Flowchart - Most of us are familiar with flowcharts. You have seen flowcharts of reporting relationships in organizational structures. Flowcharts are also used to document work process flows. This tool is used when trying to determine where the bottlenecks or breakdowns are in work processes. Flowcharting the steps of a process provides a picture of what the process looks like and can shed light on issues within the process. Flowcharts are also used to show changes in a process when improvements are made or to show a new work flow process.

Example Flowchart -


Children's Ministry Drop-off Process
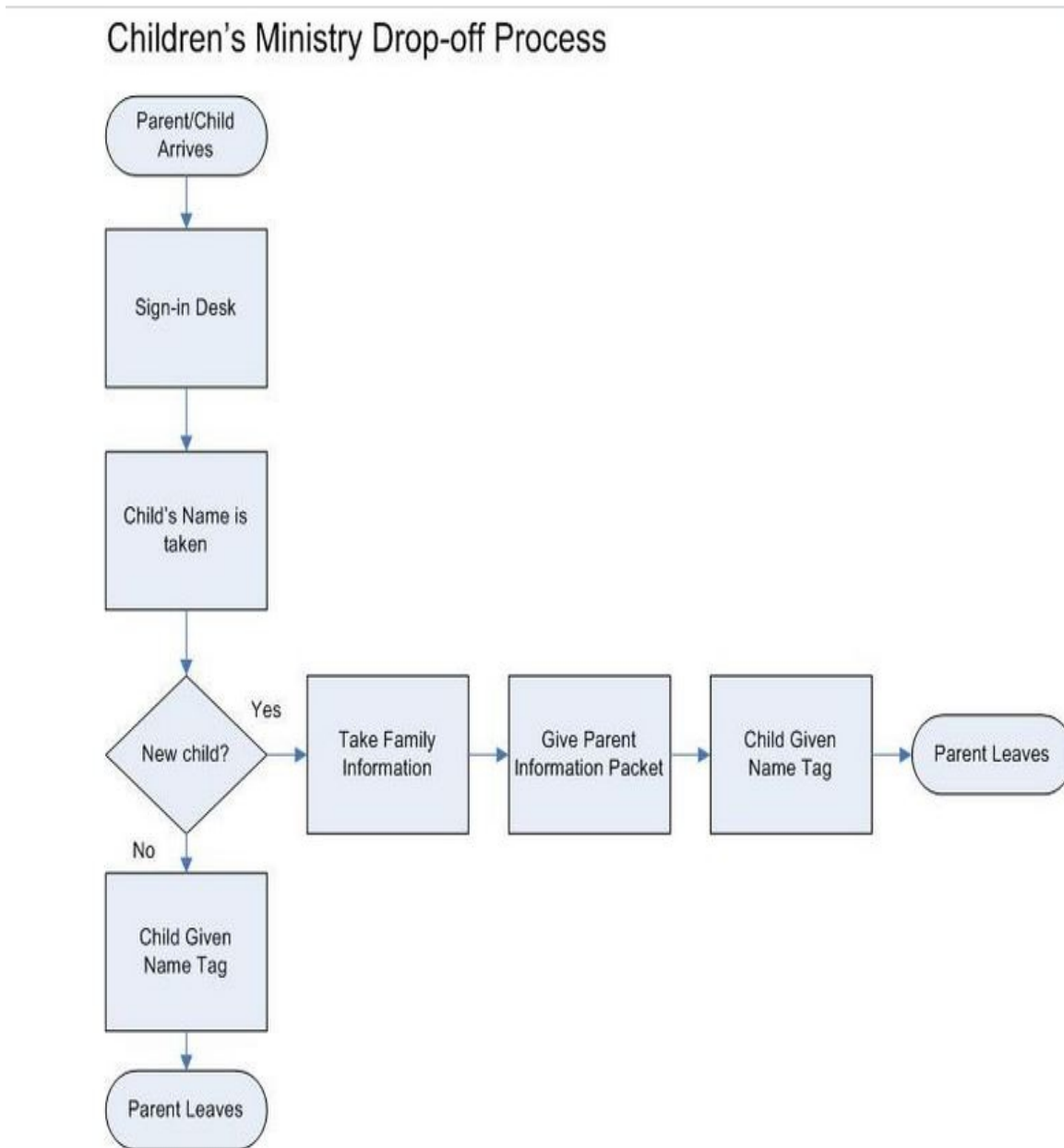
14.1.2 Check Sheet - A check sheet is a basic quality tool that is used to collect data. A check sheet might be used to track the number of times a certain incident happens.As an example, a human resource department may track the number of questions by employees, per category, per day. In this particular check sheet the tools shows the total number of questions received by the human resources department.This information helps that department identify opportunities to proactively share information with employees in an effort to reduce the numbers of questions asked.

Example Check Sheet -

Human Resource Questions						
	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Health Insurance	### //	### ###	////	### /	### ///	35
Disability Insurance	///	////	/	### /	//	16
Sick Time	###	### ///	///	////	###	25
Paid Time Off	### ###	### ###	### ////	### ////	### ///	47
Tuition Reimbursement	///	//	////	///	////	16
Payroll Error	//	/	///	/	//	9
Total	30	35	25	29	29	148

14.1.3 Cause and Effect (fish bone) Diagram - A cause and effect diagram, also know as a fish-bone diagram, shows the many possible causes of a problem. To use this tool, you need to first identify the problem you are trying to solve and simply write it in the box (head of the fish) to the right.Next, you will list the major causes of the problem on the spine of the fish. Causes are typically separated into categories of people, process, materials and equipment. Causes are then identified through brainstorming with a group familiar with the problem.Once all of the possible causes are identified, they can be used to develop an improvement plan to help resolve the identified problem.

Example Cause and Effect (Fish Bone) Diagram -
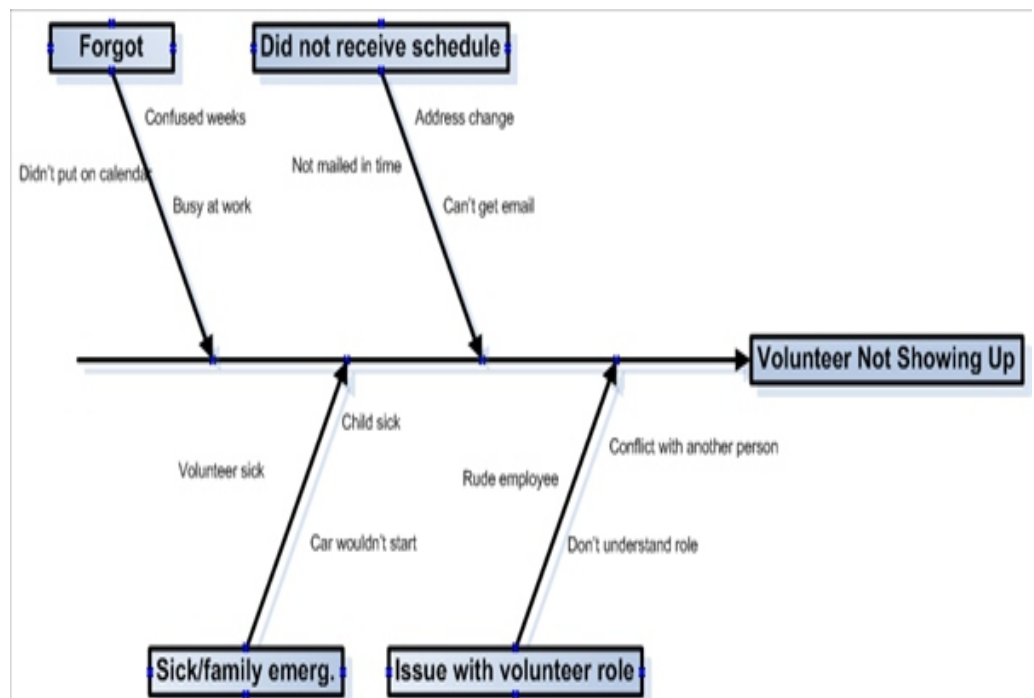
14.1.4 Pareto Chart - A Pareto chart is a bar graph of data showing the largest number of frequencies to the smallest. In this example, we are looking at the number of product defects in each of the listed categories.When you look at the number of defects from the largest to the smallest occurrences, it is easy to see how to prioritize improvements efforts. The most significant problems stand out and can be targeted first.

Example Pareto Chart -
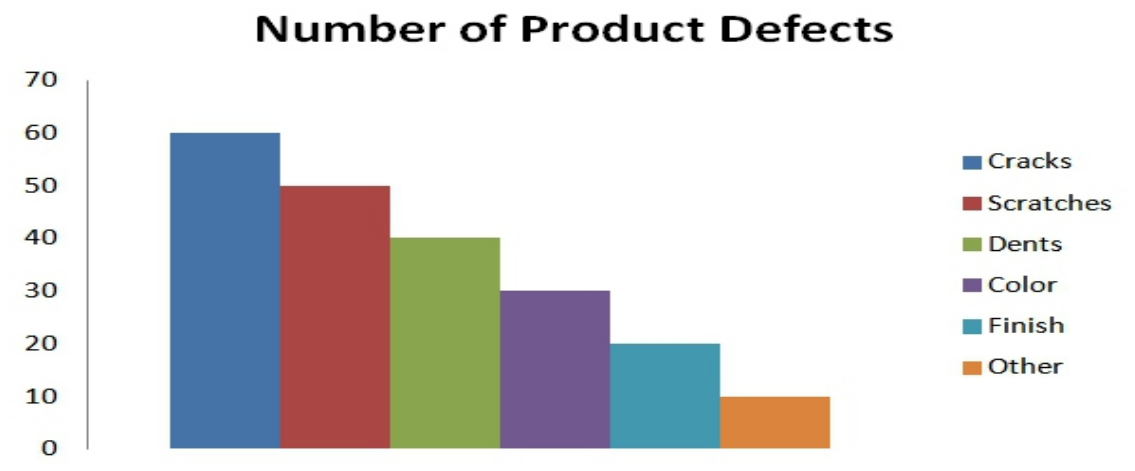
14.1.5 Control Charts - Control charts or run charts are used to plot data points over time and give a picture of the movement of that data. These charts demonstrate when data is consistent or when there are high or low outliers in the occurrences of data. If focuses on monitoring performance over time by looking at the variation in data points and distinguishes between common cause and special cause variation. The Dow Jones Industrial Average is a good example of a control chart.

Example Control (Run) Charts -
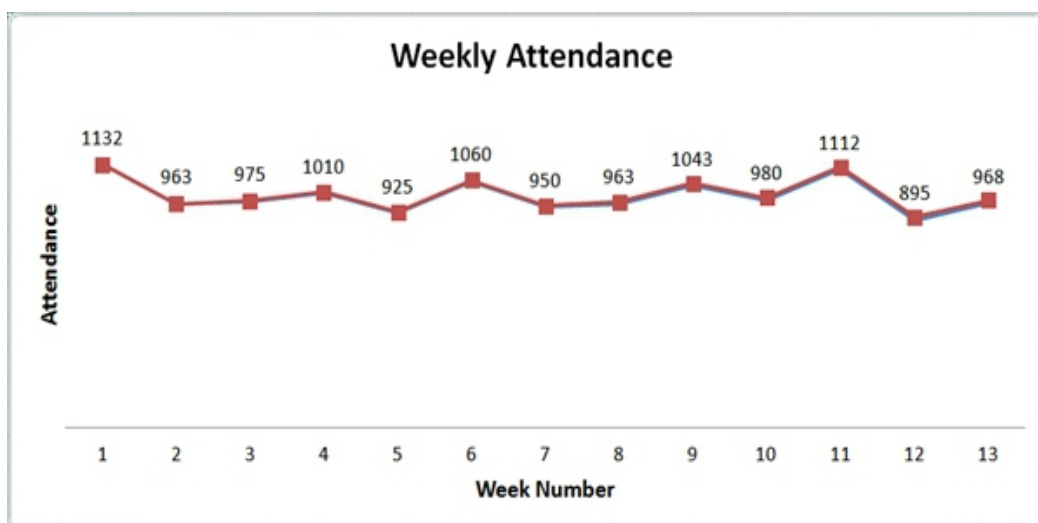
14.1.6 Histograms - A histogram is a display of statistical information that uses rectangles to show the frequency of data items in successive numerical intervals of equal size. In the most common form of histogram, the independent variable is plotted along the horizontal axis and the dependent variable is plotted along the vertical axis. The data appears as colured or shaded rectangles of variable area.

The illustration, below, is a histogram showing the results of a final exam given to a hypothetical class of students. Each score range is denoted by a bar of a certain colour. If this histogram were compared with those of classes from other years that received the same test from the same professor, conclusions might be drawn about intelligence changes among students over the years. Conclusions might also be drawn concerning the improvement or decline of the professor's teaching ability with the passage of time. If this histogram were compared with those of other classes in the same semester who had received the same final exam but who had taken the course from different professors, one might draw conclusions about the relative competence of the professors.
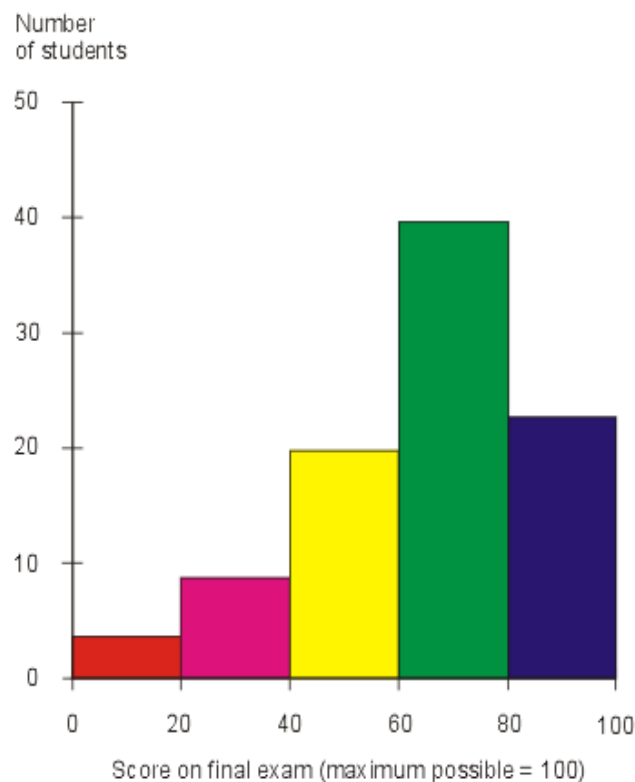
Some histograms are presented with the independent variable along the vertical axis and the dependent variable along the horizontal axis. That format is less common than the one shown here.

14.1.7 Scatter Diagrams - The scatter diagram graphs pairs of numerical data, with one variable on each axis, to look for a relationship between them. If the variables are correlated, the points will fall along a line or curve. The better the correlation, the tighter the points will hug the line. This cause analysis tool is considered one of the seven basic quality tools.

14.2 When to Use a Scatter Diagram -

- When you have paired numerical data.
- When your dependent variable may have multiple values for each value of your independent variable.
- When trying to determine whether the two variables are related, such as:
  - When trying to identify potential root causes of problems.
  - After brainstorming causes and effects using a fishbone diagram, to determine objectively whether a particular cause and effect are related.
  - When determining whether two effects that appear to be related both occur with the same cause.
  - When testing for autocorrelation before constructing a control chart.

14.2.1 Scatter Diagram Procedure -

1. Collect pairs of data where a relationship is suspected.
2. Draw a graph with the independent variable on the horizontal axis and the dependent variable on the vertical axis. For each pair of data, put a dot or a symbol where the x-axis value intersects the y-axis value. (If two dots fall together, put them side by side, touching, so that you can see both.)
3. Look at the pattern of points to see if a relationship is obvious. If the data clearly form a line or a curve, you may stop because variables are correlated. You may wish to use regression or correlation analysis now. Otherwise, complete steps 4 through 7.
4. Divide points on the graph into four quadrants. If there are X points on the graph,

   - Count X/2 points from top to bottom and draw a horizontal line.
   - Count X/2 points from left to right and draw a vertical line.
   - If number of points is odd, draw the line through the middle point.
5. Count the points in each quadrant. Do not count points on a line.
6. Add the diagonally opposite quadrants. Find the smaller sum and the total of points in all quadrants.
   A = points in upper left + points in lower right

   B = points in upper right + points in lower left

   Q = the smaller of A and B

   N = A + B

7. Look up the limit for N on the trend test table.
   - If Q is less than the limit, the two variables are related.
   - If Q is greater than or equal to the limit, the pattern could have occurred from random chance.

Table 5.18 Trend test table.

N	Limit	N	Limit
1—8	0	51—53	18
9—11	1	54—55	19
12—14	2	56—57	20
15—16	3	58—60	21
17—19	4	61—62	22
20—22	5	63—64	23
23—24	6	65—66	24
25—27	7	67—69	25
28—29	8	70—71	26
30—32	9	72—73	27
33—34	10	74—76	28
35—36	11	77—78	29
37—39	12	79—80	30
40—41	13	81—82	31
42—43	14	83—85	32
44—46	15	86—87	33
47—48	16	88—89	34
49—50	17	90	35

14.2.2 Scatter Diagram Example

The ZZ-400 manufacturing team suspects a relationship between product purity (percent purity) and the amount of iron (measured in parts per million or ppm). Purity and iron are plotted against each other as a scatter diagram, as shown in the figure below.

There are 24 data points. Median lines are drawn so that 12 points fall on each side for both percent purity and ppm iron.

To test for a relationship, they calculate:

A = points in upper left + points in lower right = 9 + 9 = 18

B = points in upper right + points in lower left = 3 + 3 = 6

Q = the smaller of A and B = the smaller of 18 and 6 = 6

N = A + B = 18 + 6 = 24

Then they look up the limit for N on the trend test table. For N = 24, the limit is 6.
Q is equal to the limit. Therefore, the pattern could have occurred from random chance, and no relationship is demonstrated.

Purity vs. Iron
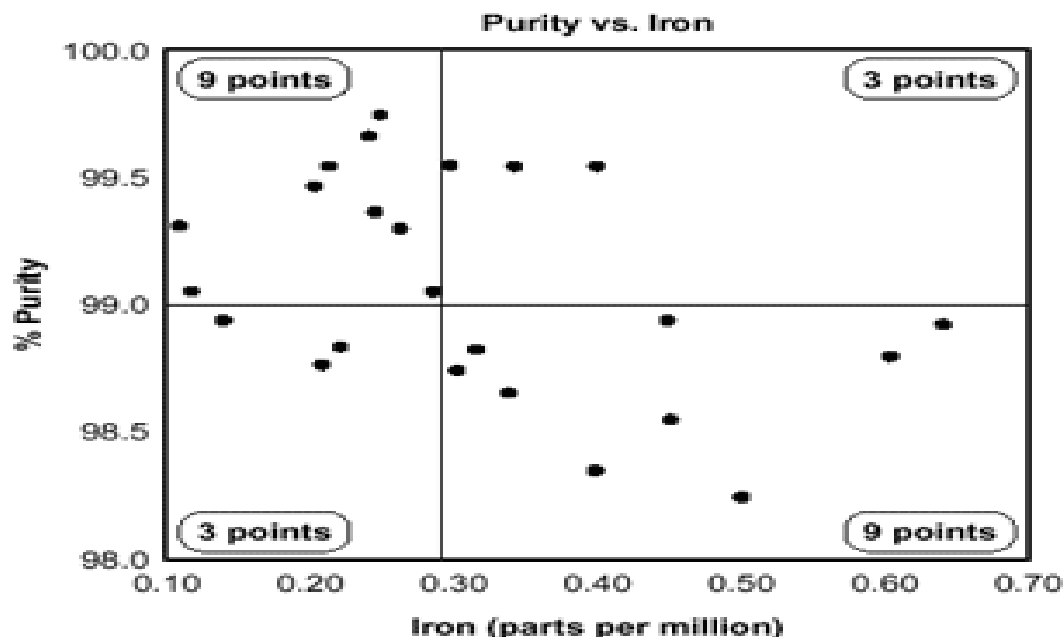
14.2.3 Scatter Diagram Examples

Below are some examples of situations in which might you use a scatter diagram:

- Variable A is the temperature of a reaction after 15 minutes. Variable B measures the color of the product. You suspect higher temperature makes the product darker. Plot temperature and color on a scatter diagram.
- Variable A is the number of employees trained on new software, and variable B is the number of calls to the computer help line. You suspect that more training reduces the number of calls. Plot number of people   trained versus number of calls.
- To test for autocorrelation of a measurement being monitored on a control chart, plot this pair of variables: Variable A is the measurement at a given time. Variable B is the same measurement, but at the previous time. If the scatter diagram shows correlation, do another diagram where variable B is the measurement two times previously. Keep increasing the separation between the two times until the scatter diagram shows no correlation.

14.2.4 Scatter Diagram Considerations -

- Even if the scatter diagram shows a relationship, do not assume that one variable caused the other. Both may be influenced by a third variable.
- When the data are plotted, the more the diagram resembles a straight line, the stronger the relationship.
- If a line is not clear, statistics (N and Q) determine whether there is reasonable certainty that a relationship exists. If the statistics say that no relationship exists, the pattern could have occurred by random chance.
- If the scatter diagram shows no relationship between the variables, consider whether the data might be stratified.
- If the diagram shows no relationship, consider whether the independent (x-axis) variable has been varied widely. Sometimes a relationship is not apparent because the data do not cover a wide enough range.

14.3 Seven New Management Tools

New management planning tools are defined as the seven method(s) for achieving expected outcomes that previously have not been used.In 1976, the Union of Japanese Scientists and Engineering (JUSE) saw the need for tools to promote innovation, communicate information and successfully plan major projects. A team researched and developed the seven new quality control tools, often called the seven management and planning (MP) tools, or simply the seven management tools. They are:

14.3.1 Affinity Diagram - Organizes a large number of ideas into their natural relationships.

14.3.2 Relations Diagram - Shows cause-and-effect relationships and helps you analyze the natural links between different aspects of a complex situation.

14.3.3 Tree Diagram -Breaks down broad categories into finer and finer levels of detail, helping you move your thinking step by step from generalities to specifics.

14.3.4 Matrix Diagram - Shows the relationship between two, three or four groups of information and can give information about the relationship, such as its strength, the roles played by various individuals, or measurements.

14.3.5 Matrix Data Analysis - A complex mathematical technique for analyzing matrices, often replaced by the similar prioritization matrix. A prioritization matrix is an L-shaped matrix that uses pairwise comparisons of a list of options to a set of criteria in order to choose the best option(s).

14.3.6 Arrow Diagram - Shows the required order of tasks in a project or process, the best schedule for the entire project, and potential scheduling and resource problems and their solutions.

14.3.7 Process Decision Program Chart (PDPC)- Systematically identifies what might go wrong in a plan under development.

14.4 Benchmark in Quality Management

A world that is changing faster and faster forces companies to reinvent themselves and their capabilities. In this competitive environment, total quality management (TQM) tools support organizations in managing strategic quality and decision processes.

14.4.1 Benchmarking

"Benchmarking is simply the process of measuring the performance of one's company against the best in the same or another industry. Benchmarking is not a complex concept but it should not be taken too lightly. Benchmarking is basically learning from others. It is using the knowledge and the experience of others to improve the organization. It is analyzing the performance and noting the strengths and weaknesses of the organization and assessing what must be done to improve.

14.4.2 Reasons for Benchmarking

There are several reasons that benchmarking is becoming more commonly used in industry;

- Benchmarking is a more efficient way to make improvements. Managers can eliminatetrial and error process improvements. Practicing benchmarking focuses on tailoring existing processes to fit within the organization.
- Benchmarking speeds up organization's ability to make improvements.
- Compare business practices with those of world class organizations.
- Challenge current practices and processes.
- Create improved goals and practices for the organization.
- Change the perspective of executives and managers.

14.4.3 Objectives of Benchmarking

- Becoming competitive
- Improving industry best practices
- Defining customer requirement
- Establishing effective goals and objectives
- Developing the measures of productivity

14.4.4 Advantages of Benchmarking

- It helps improve process effectiveness
- Helps in cost reduction
- It provides focus in planning operations
- The sharing of information may create opportunities for innovations
- It assesses the firms existing position and provides a basis for establishing standards of performance
- Cross comparison are more likely to expose different ways of doing things
- It provides evidence for additional resources
- Is practitioner led, so gives a sense of ownership
- Facilitates multi-disciplinary team building and networking
- Provides an avenue for change in clinical practices.

14.4.5 Disadvantages of Benchmarking

- Benchmarking is the danger of complacency and arrogance. Many organizations tend to relax after excelling beyond competitors' standards. The realization of having become the industry leader soon leads to arrogance, when considerable scope for further improvements remains.
- It implies there is only one best way of doing business.
- The benchmark may be yesterday's solution to tomorrow's problems. If the operating environment is highly dynamic the solution will be dynamic.
- It depends on the accuracy of the information about the comparator company.

- It may be difficult to decide which activities to benchmark.
- It encourages the mentality of catching up rather than being innovative.
- Lack of strategic relevancy.

14.4.6 Process of Benchmarking

Organizations that benchmark, adapt the process to best fit their own needs and culture. Although number of steps in the process may vary from organization to organization, the following six steps contain the core techniques:

1. Decide what to benchmark.
2. Understand the current performance of your organization.
3. Do proper planning of what, how and when of benchmarking endeavour.
4. Study others well (the practices or system you wish to benchmark)
5. Gather data and learn from it.
6. Use the findings.

14.5 Poka Yoke

Poka Yoke is a quality management concept developed by a Matsushita manufacturing engineer named Shigeo Shingo to prevent human errors from occurring in the production line. Poka yoke (pronounced "poh-kah yoh-kay") comes from two Japanese words – "yokeru" which means "to avoid", and "poka" which means "inadvert errors." Thus, poka yoke more or less translates to "avoiding inadvert errors". Poka yoke is sometimes referred to in English by some people as "fool-proofing". However, this doesn't sound politically correct if applied to employees, so the English equivalent used by Shingo was "error avoidance." Other variants like "mistake proofing" or "fail-safe operation" have likewise become popular.

The main objective of poke yoke is to achieve zero defects. In fact, it is just one of the many components of Shingo's Zero Quality Control (ZQC) system, the goal of which is to eliminate defective products.Poka yoke is more of a concept than a procedure. Thus, its implementation is governed by what people think they can do to prevent errors in their workplace, and not by a set of step-by-step instructions on how they should do their job.Poka yoke is implemented by using simple objects like fixtures, jigs, gadgets, warning devices, paper systems, and the like to prevent people from committing mistakes, even if they try to! These objects, known as poka yoke devices, are usually used to stop the machine and alert the operator if something is about to go wrong.

Anybody can and should practice poka yoke in the workplace. Poke yoke does not entail any rocket science – sometimes it just needs common sense and the appropriate poka yoke device. Poka yoke devices should have the following characteristics: 1) useable by all workers; 2) simple to install; 3) does not require continuous attention from the operator (ideally, it should work even if the operator is not aware of it); 4) low-cost; 5) provides instantaneous feedback, prevention, or correction. A lot of Shingo's poka yoke devices cost less than $50! Of course, error-proofing can be achieved by extensive automation and computerization. However, this approach is expensive and complicated, and may not be practical for small operations. Besides, it defeats the original purpose of poka yoke, which is to reduce defects from mistakes through the simplest and lowest-cost manner possible. Poka yoke is at its best

when it prevents mistakes, not when it merely catches them. Since human errors usually stem from people who get distracted, tired, confused, or de-motivated, a good poka yoke solution is one that requires no attention from the operator. Such a poka yoke device will prevent the occurrence of mistake even if the operator loses focus in what she is doing. Examples of 'attention-free' Poke Yoke solutions:

1. A jig that prevents a part from being disoriented during loading
2. Non-symmetrical screw hole locations that would prevent a plate from being screwed down incorrectly
3. Electrical plugs that can only be inserted into the correct outlets
4. Notches on boards that only allow correct insertion into edge connectors
5. A flip-type cover over a button that will prevent the button from being accidentally pressed

14.5.1 Three levels of Poka-Yoke

- Elimination of spills, leaks, losses at the source or prevention of a mistake from being committed
- Detection of a loss or mistake as it occurs, allowing correction before it becomes a problem
- Detection of a loss or mistake after it has occurred, just in time before it blows up into a major issue (least effective).

14.5.2 Implementation in manufacturing

Poka-yoke can be implemented at any step of a manufacturing process where something can go wrong or an error can be made. For example, a fixture that holds pieces for processing might be modified to only allow pieces to be held in the correct orientation, or a digital counter might track the number of spot welds on each piece to ensure that the worker executes the correct number of welds.Shigeo Shingo recognized three types of poka-yoke for detecting and preventing errors in a mass production system:

1. The contact method identifies product defects by testing the product's shape, size, colour, or other physical attributes.

2. The fixed-value (or constant number) method alerts the operator if a certain number of movements are not made.

3. The motion-step (or sequence) method determines whether the prescribed steps of the process have been followed.

Either the operator is alerted when a mistake is about to be made, or the poka-yoke device actually prevents the mistake from being made. In Shingo's lexicon, the former implementation would be called a warning poka-yoke, while the latter would be referred to as a control poka-yoke. Shingo argued that errors are inevitable in any manufacturing process, but that if appropriate poka-yokes are implemented, then mistakes can be caught quickly and prevented from resulting in defects. By eliminating defects at the source, the cost of mistakes within a company is reduced.

A methodic approach to build up poka-yoke countermeasures has been proposed by the Applied Problem Solving (APS) methodology, which consists of a three-step analysis of the risks to be managed:

1. Identification of the need

2. Identification of possible mistakes

3. Management of mistakes before satisfying the need

This approach can be used to emphasize the technical aspect of finding effective solutions during brainstorming sessions.

14.5.3 Benefits of Poka Yoke implementation

A typical feature of poka-yoke solutions is that they don't let an error in a process happen. But that is just one of their advantages. Others include:

- Less time spent on training workers;
- Elimination of many operations related to quality control;
- Unburdening of operators from repetitive operations;
- Promotion of the work improvement-oriented approach and actions;
- A reduced number of rejects;
- Immediate action when a problem occurs;
- 100% built-in quality control.

14.6 Important Questions:

1. **What is fishbone chart?**
2. **What is Poka Yoke? Also write its benefits.**
3. **What do you mean by benchmarking? Explain with its advantages and disadvantages.**
4. **Write down the process of benchmarking in quality management.**
5. **What is scatter diagram?**
6. **Write a Short note on histogram?**

References:

1. Ishikawa 1985, p. 198: "From my past experience as much as ninety percent of all problems within a company can be solved by means of these tools."
2. Tague 2005, p. 15.
3. Ishikawa 1985, p. 198: "Elementary Statistical Method (the so-called Seven Tools) 1. Pareto chart: The principle of vital few; trivial many 2. Cause and effect diagram (This is not precisely a statistical technique) 3. Stratification 4. Check sheet 5. Histogram. 6. Scatter diagram (analysis of correlation through determination of median; in some instances, use of binomial probability paper) 7. Graph and control chart (Shewhart control chart)".
4. Imai 1986, pp. 239–240: "The seven statistical tools used for such analytical problem-solving are: 1. Pareto diagrams ... 2. Cause-and-effect diagrams ... 3. Histograms ... 4. Control charts ... 5. Scatter diagrams ... 6. Graphs ... 7. Checksheets."

Unit 15 Introduction to IS/ ISO 9004/2000

Structure

15.0 Introduction

15.1 Process approach

15.2 Relationship with ISO9001

15.3 Compatibility with other management systems

**15.4 Quality management systems — Guidelines for performance
improvements**

15.5 Managing systems and processes

15.6 ISO 9001:2000, Quality management systems — Requirements

15.6.1 Quality management system General requirements

15.6.2 Documentation

15.7 ISO 9001:2000, Quality management systems — Requirements

15.8 Documentation requirements

15.8.1 General

15.8.2 Quality manual

15.8.3 Control of documents

15.8.4 Control of records

15.8.5 Use of quality management principles

15.9 Management responsibility

15.9.1 Introduction

15.9.2 Issues to be considered

15.10 ISO 9001:2000, Quality management systems — Requirements

15.10.1 Management commitment

15.10.2 Needs and expectations of interested parties

15.10.3 Needs and expectations

15.11 ISO 9001:2000, Quality management systems — Requirements

15.11.1 Customer focus

15.11.2 Statutory and regulatory requirements

15.11.3 Quality policy

15.12 ISO 9001:2000, Quality management systems — Requirements

15.12.1 Quality policy

15.12.2 Planning Quality objectives

15.13 ISO 9001:2000, Quality management systems — Requirements

15.0 Introduction

The adoption of a quality management system should be a strategic decision by the top management of an organization. The design and implementation of an organization's quality management system is influenced by varying needs, particular objectives, the products provided, the processes employed and the size and structure of the organization. This International Standard is based on eight quality management principles. However, it is not the intent of this International Standard to imply uniformity in the structure of quality management systems or uniformity of documentation.

The purpose of an organization is

- To identify and meet the needs and expectations of its customers and other interested parties (people in the organization, suppliers, owners, society), to achieve competitive advantage, and to do this in an effective and efficient manner, and

- To achieve, maintain, and improve overall organizational performance and capabilities.

The application of quality management principles not only provides direct benefits but also makes an important contribution to managing costs and risks. Benefit, cost and risk management considerations are important for the organization, its customers and other interested parties. These considerations on overall performance of the organization may impact

- Customer loyalty,

- Repeat business and referral,

- Operational results such as revenue and market share,

- Flexible and fast responses to market opportunities,

- Costs and cycle times through effective and efficient use of resources,

- Alignment of processes which will best achieve desired results,

- Competitive advantage through improved organizational capabilities,

- Understanding and motivation of people towards the organization's goals and objectives, as well as participation in continual improvement,

- Confidence of interested parties in the effectiveness and efficiency of the organization, as demonstrated by the financial and social benefits from the organization's performance, product life cycle, and reputation,

- Ability to create value for both the organization and its suppliers by optimization of costs and resources as well as flexibility and speed of joint responses to changing markets.

15.1 Process approach

This International Standard promotes the adoption of a process approach when developing, implementing and improving the effectiveness and efficiency of a quality management system to enhance interested party satisfaction by meeting interested party requirements.

For an organization to function effectively and efficiently, it has to identify and manage numerous linked activities. An activity using resources, and managed in order to enable the transformation of inputs into outputs, is considered as a process. Often the output from one process directly forms the input to the next.

The application of a system of processes within an organization, together with the identification and interactions and managing of these processes can be referred to as the "process approach"

An advantage of the process approach is the ongoing control that it provides over the linkage between the individual processes within the system of processes, as well as their combination and interaction.

When used within a quality management system, such an approach emphasizes the importance of

    a) Understanding and fulfilling the requirements,

    b) The need to consider processes in terms of added value,

    c) Obtaining results of process performance and effectiveness, and

    d) Continual improvement of processes based on objective measurement.

The model of a process-based quality management system shown in Figure 1 illustrates the process linkages presented in clauses 4 to 8. This illustration shows that interested parties play a significant role in defining requirements as inputs. Monitoring the satisfaction of interested parties requires the evaluation of information relating to the perception of interested parties as to whether the organization has met
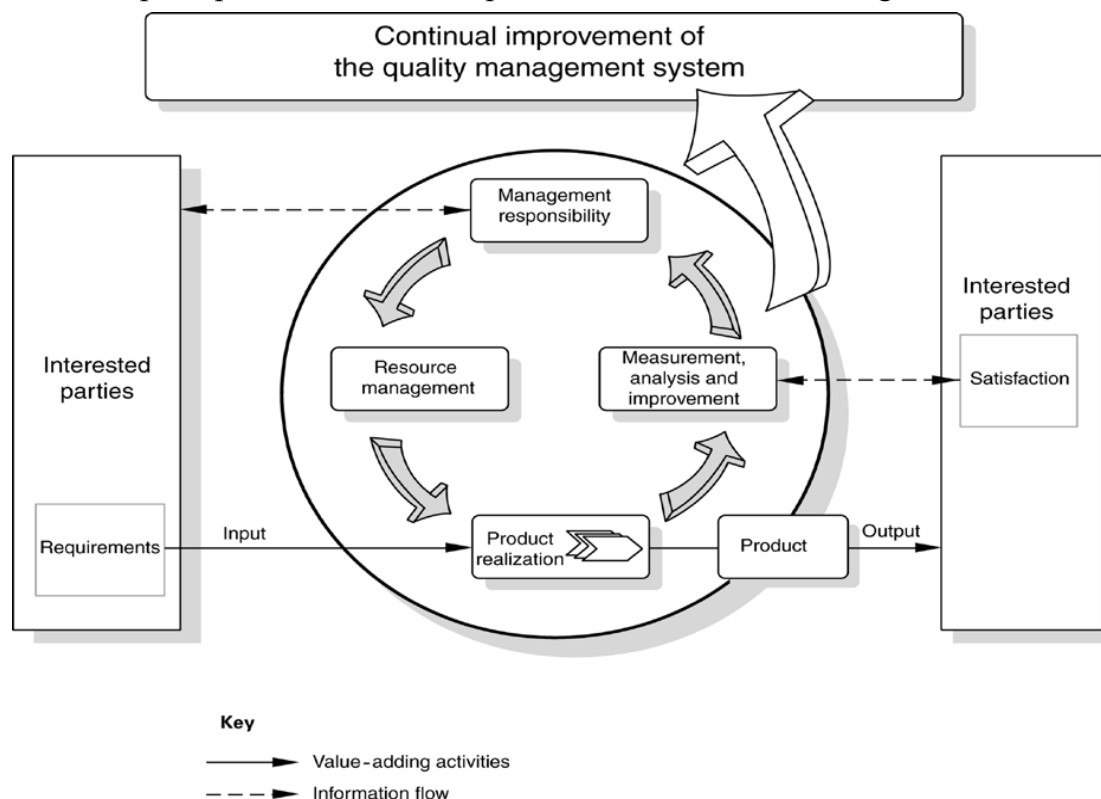
their requirements. The model shown in Figure 1 does not show processes at a detailed level.

Figure 1 — Model of a process-based quality management system

15.2 Relationship with ISO9001

The present editions of ISO 9001 and ISO 9004 have been developed as a consistent pair of quality management system standards which have been designed to complement each other but can also be used independently. Although the two International Standards have different scopes, they have similar structures in order to assist their application as a consistent pair.

ISO 9001 specifies requirements for a quality management system that can be used for internal application by organizations, or for certification, or for contractual purposes. It focuses on the effectiveness of the quality management system in meeting customer requirements.

ISO 9004 gives guidance on a wider range of objectives of a quality

management system than does ISO 9001, particularly for the continual improvement of an organization's overall performance and efficiency, as well as its effectiveness. ISO 9004 is recommended as a guide for organizations whose top management wishes to move beyond the requirements of ISO 9001, in pursuit of continual improvement of performance. However, it is not intended for certification or for contractual purposes.

For further benefit to the user, the basic content of the ISO9001 requirements are included in boxed text following the comparable clause in this International Standard. Information marked "NOTE" is for guidance in understanding or clarification.

15.3 Compatibility with other management systems

This International Standard does not include guidance specific to other management systems, such as those particular to environmental management, occupational health and safety management, financial management, or risk management. However, this International Standard enables an organization to align or integrate its own quality management system with related management systems. It is possible for an organization to adapt its existing management system(s) in order to establish a quality management system that follows the guidelines of this International Standard.

15.4 Quality management systems — Guidelines for performance improvements

1 Scope

This International Standard provides guidelines beyond the requirements given in ISO9001in order to consider both the effectiveness and efficiency of a quality management system, and consequently the potential for improvement of the performance of an organization. When compared to ISO 9001, the objectives of customer satisfaction and product quality are extended to include the satisfaction of interested parties and the performance of the organization. This International Standard is applicable to the processes of the organization and consequently the quality management principles on which it is based can be deployed throughout the organization. The focus of this International Standard is the achievement of ongoing improvement, measured though the satisfaction customers and other interested parties.

This International Standard consists of guidance and recommendations and is not intended for certification, regulatory or contractual use, or as a guide

to the implementation of ISO 9001.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 9000: 2000, Quality *management systems — Fundamentals and vocabulary*.

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 9000 apply.

The following terms, used in this edition of ISO 9004 to describe the supply-chain, have been changed to reflect the vocabulary currently used:

Supplier ⟶ organization ⟶ customer (interested parties)

Throughout the text of this International Standard, wherever the term "product" occurs, it can also mean "service".

4 Quality management system

15.5 Managing systems and processes

Leading and operating an organization successfully requires managing it in a systematic and visible manner. Success should result from implementing and maintaining a management system that is designed to continually improve the effectiveness and efficiency of the organization's performance by considering the needs of interested parties. Managing an organization includes quality management, among other management disciplines.

Top management should establish a customer-oriented organization

a) By defining systems and processes that can be clearly understood, managed and improved in effectiveness as well as efficiency, and

b) By ensuring effective and efficient operation and control of processes and the measures and data used to determine satisfactory performance of the organization.

Examples of activities to establish a customer-oriented organization include

— Defining and promoting processes that lead to improved organizational performance,

— Acquiring and using process data and information on a continuing basis,

— Directing progress towards continual improvement, and

— Using suitable methods to evaluate process improvement, such as self-assessments and management review.

Examples of self-assessment and continual improvement processes are given in annexes A and B respectively.

15.6 ISO 9001:2000, Quality management systems — Requirements

15.6.1 Quality management system General requirements

The organization shall establish, document, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of this International Standard.

The organization shall

a) Identify the processes needed for the quality management system and their application throughout the organization,

b) Determine the sequence and interaction of these processes,

c) Determine criteria and methods needed to ensure that both the operation and control of these processes are effective,

d) Ensure the availability of resources and information necessary to support the operation and monitoring of these processes,

e) Monitor, measure and analyses these processes, and

f) Implement actions necessary to achieve planned results and continual improvement of these processes.

These processes shall be managed by the organization in accordance with the requirements of this International Standard.

Where an organization chooses to outsource any process that affects product conformity with requirements, the organization shall ensure control over such processes. Control of such outsourced processes shall be identified within the quality management system.

NOTE Processes needed for the quality management system referred to above should include processes for management activities, provision of resources, product realization and measurement.

15.6.2 Documentation

Management should define the documentation, including the relevant records, needed to establish, implement and maintain the quality management system and to support an effective and efficient operation of the organization's processes.

The nature and extent of the documentation should satisfy the contractual, statutory and regulatory requirements, and the needs and expectations of customers and other interested parties and should be appropriate to the organization. Documentation may be in any form or medium suitable for the needs of the organization.

In order to provide documentation to satisfy the needs and expectations of interested parties' management should consider

> Contractual requirements from the customer and other interested parties,

> Acceptance of international, national, regional and industry sector standards,

> Relevant statutory and regulatory requirements,

> Decisions by the organization,

> Sources of external information relevant for the development of the organization's competencies, and

> Information about the needs and expectations of interested parties.

> The generation, use and control of documentation should be evaluated with respect to the effectiveness and efficiency of the organization against criteria such as

> Functionality (such as speed of processing),

> User friendliness,

> Resources needed,

> Policies and objectives,

- ➢ Current and future requirements related to managing knowledge,

- ➢ Benchmarking of documentation systems, and

- ➢ Interfaces used by organization's customers, suppliers and other interested parties.

Access to documentation should be ensured for people in the organization and to other interested parties, based on the organization's communication policy.

15.7 ISO 9001:2000, Quality management systems — Requirements

15.8 Documentation requirements

15.8.1 General

The quality management system documentation shall include

a) Documented statements of a quality policy and quality objectives,

b) A quality manual,

c) Documented procedures required by this International Standard,

d) Documents needed by the organization to ensure the effective planning, operation and control of its processes, and

e) Records required by this International Standard.

NOTE 1 where the term "documented procedure" appears within this International Standard, this means that the procedure is established, documented, implemented and maintained.

NOTE 2 the extent of the quality management system documentation can differ from one organization to another due to
a) The size of organization and type of activities,
b) The complexity of processes and their interactions, and
c) The competence of personnel.

NOTE 3 the documentation can be in any form or type of medium.

15.8.2 Quality manual

The organization shall establish and maintain a quality manual that includes

a) The scope of the quality management system, including details of and

justification for any exclusions,

b) The documented procedures established for the quality management system, or reference to them, and

c) A description of the interaction between the processes of the quality management system.

15.8.3 Control of documents

Documentsrequiredbythequalitymanagementsystemshallbecontrolled.Recordsareaspecialtypeofdocument and shall be controlled according to the requirements given in4.2.4.

A documented procedure shall be established to define the controls needed

a) To approve documents for adequacy prior to issue,

b) To review and update as necessary and re-approve documents,

c) To ensure that changes and the current revision status of documents are identified,

d) To ensure that relevant versions of applicable documents are available at points of use,

e) To ensure that documents remain legible and readily identifiable,

f) To ensure that documents of external origin are identified and their distribution controlled, and

g) To prevent the unintended use of obsolete documents, and to apply suitable identification to them if they are retained for any purpose.

15.8.4 Control of records

Records shall be established and maintained to provide evidence of conformity to requirements and of the effective operation of the quality management system. Records shall remain legible, readily identifiable and retrievable. A documented procedure shall be established to define the controls needed for the identification, storage, protection, retrieval, retention time and disposition of records.

15.8.5 Use of quality management principles

To lead and operate an organization successfully, it is necessary to manage it in a systematic and visible manner. The guidance to management offered in this International Standard is based on eight quality management principles.

These principles have been developed for use by top management in order to lead the organization toward improved performance. These quality management principles are integrated in the contents of this International Standard and are listed below

a) Customer focus

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

b) Leadership

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

c) Involvement of people

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

d) Process approach

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

e) System approach to management

Identifying, understanding and managing inter related processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.

f) Continual improvement

Continual improvement of the organization's overall performance should be a permanent objective of the organization.

g) Factual approach to decision making

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

h) Mutually beneficial supplier relationships

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

Successful use of the eight management principles by an organization will result in benefits to interested parties, such as improved monetary returns, the creation of value and increased stability.

15.9 Management responsibility

15.9.1 Introduction

Leadership, commitment and the active involvement of the top management are essential for developing and maintaining an effective and efficient quality management system to achieve benefits for interested parties. To achieve these benefits, it is necessary to establish, sustain and increase customer satisfaction. Top management should consider actions such as

- ➢ Establishing a vision, policies and strategic objectives consistent with the purpose of the organization,

- ➢ Leading the organization by example, in order to develop trust within itspeople,

- ➢ Communicating organizational direction and values regarding quality and the quality management system,

- ➢ Participating in improvement projects, searching for new methods, solutions and products,

- ➢ Obtaining feedback directly on the effectiveness and efficiency of the quality management system,

- ➢ Identifying the product realization processes that provide added value to the organization,

- ➢ Identifying the support processes that influence the effectiveness and efficiency of the realization processes,

- ➢ Creating an environment that encourages the involvement and development of people, and

- ➢ Provision of the structure and resources that are necessary to support the organization's strategic plans.

Top management should also define methods for measurement of the organization's performance in order to determine whether planned objectives have been achieved.

Methods include

- ➢ Financial measurement,

- ➢ Measurement of process performance throughout the organization,

- ➢ External measurement, such as benchmarking and third-party

evaluation,

> Assessment of the satisfaction of customers, people in the organization and other interested parties,

> Assessment of the perceptions of customers and other interested parties of performance of products provided, and

> Measurement of other success factors identified by management.

Information derived from such measurements and assessments should also be considered as input to management review in order to ensure that continual improvement of the quality management system is the driver for performance improvement of the organization.

15.9.2 Issues to be considered

When developing, implementing and managing the organization's quality management system, management should consider the quality management principles outlined in 4.3.

On the basis of these principles, top management should demonstrate leadership in, and commitment to, the following activities:

> Understanding current and future customer needs and expectations, in addition to requirements;

> Promoting policies and objectives to increase awareness, motivation and involvement of people in the organization;

> Establishing continual improvement as an objective for processes of the organization;

> Planning for the future of the organization and managing change;

> Setting and communicating a framework for achieving the satisfaction of interested parties.

In addition to small-step or ongoing continual improvement, top management should also consider breakthrough changes to processes as a way to improve the organization's performance. During such changes, management should take steps to ensure that the resources and communication needed to maintain the functions of the quality management system are provided.

Top management should identify the organization's product realization processes, as these are directly related to the success of the organization. Top management should also identify those support processes that affect both the effectiveness and efficiency of the realization processes or the needs and expectations of interested parties.

Management should ensure that processes operate as an effective and efficient network. Management should analyses and optimizes the interaction of processes, including both realization processes and support processes.

> Consideration should be given to ensuring that the sequence and interaction of processes are designed to achieve the desired results effectively and efficiently,

> ➤ Ensuring process inputs, activities and outputs are clearly defined and controlled,

> ➤ Monitoringinputsandoutputstoverifythatindividualprocessesarelinke dandoperateeffectivelyandefficiently,

> ➤ Identifying and managing risks, and exploiting performance improvement opportunities,

> ➤ Conducting data analysis to facilitate continual improvement of processes,

> ➤ Identifying process owners and giving them full responsibility and authority,

> ➤ Managing each process to achieve the process objectives, and

> ➤ The needs and expectations of interested parties.

15.10 ISO 9001:2000, Quality management systems — Requirements

15.10.1 Management commitment

Top management shall provide evidence of its commitment to the development and implementation of the quality management system and continually improving its effectiveness by

a) Communicating to the organization the importance of meeting customer as well as statutory and regulatory requirements,

b) Establishing the quality policy,

c) Ensuring that quality objectives are established,

d) Conducting management reviews, and

e) Ensuring the availability of resources.

15.10.2 Needs and expectations of interested parties

Every organization has interested parties, each party having needs and expectations. Interested parties of organizations include

➢ Customers and end-users,

➢ People in the organization,

➢ Owners/investors (such as shareholders, individuals or groups, including the public sector, that have a specific interest in the organization),

➢ Suppliers and partners, and

➢ Society in terms of the community and the public affected by the organization or its products.

15.10.3 Needs and expectations

The success of the organization depends on understanding and satisfying the current and future needs and expectations of present and potential customers and end-users, as well as understanding and considering those of other interested parties.

In order to understand and meet the needs and expectations of interested parties, an organization should

➢ Identify its interested parties and maintain a balanced response to their needs and expectations,

➢ Translate identified needs and expectations in to requirements,

➢ Communicate the requirements throughout the organization, and

➢ Focus on process improvement to ensure value for the identified interested parties.

To satisfy customer and end-user needs and expectations, the management of an organization should

➢ Understand the needs and expectations of its customers, including those of potential customers,

➢ Determine key product characteristics for its customers and end-users,

➢ Identify and assess competition in its market, and
➢ Identify market opportunities, weaknesses and future competitive advantage.

Examples of customer and end-user needs and expectations, as related to the organization's products, include

✓ Conformity,

✓ Dependability,

- ✓ Availability,

- ✓ Delivery,

- ✓ Post-realization activities,

- ✓ Price and life-cycle costs,

- ✓ Product safety,

- ✓ Product liability, and

- ✓ Environmental impact.

The organization should identify its people's needs and expectations for recognition, work satisfaction, and personal development. Such attention helps to ensure that the involvement and motivation of people are as strong as possible.

The organization should define financial and other results that satisfy the identified needs and expectations of owners and investors.

Management should consider the potential benefits of establishing partnerships with suppliers to the organization, in order to create value for both parties. A partnership should be based on a joint strategy, sharing knowledge as well as gains and losses. When establishing partnerships, an organization should

- ➢ Identify key suppliers, and other organizations, as potential partners,

- ➢ Jointly establish a clear understanding of customers' needs and expectations,

- ➢ Jointly establish a clear understanding of the partners' needs and expectations ,and

- ➢ Set goals to secure opportunities for continuing partnerships.

- ➢ In considering its relationships with society, the organization should

- ➢ Demonstrate responsibility for health and safety,

- ➢ Consider environmental impact, including conservation of energy and natural resources,

- ➢ Identify applicable statutory and regulatory requirements, and

- ➢ Identify the current and potential impacts on society in general, and the local community in particular, of its products, processes and activities.

15.11 ISO 9001:2000, Quality management systems — Requirements

15.11.1 Customer focus

Top management shall ensure that customer requirements are determined and are met with the aim of enhancing customer satisfaction

15.11.2 Statutory and regulatory requirements

Management should ensure that the organization has knowledge of the statutory and regulatory requirements that apply to its products, processes and activities and should include such requirements as part of the quality management system. Consideration should also be given to

— The promotion of ethical, effective and efficient compliance with current and prospective requirements,

— The benefits to interested parties from exceeding compliance, and

— The role of the organization in the protection of community interests.

15.11.3 Quality policy

Top management should use the quality policy as a means of leading the organization toward improvement of its performance.

An organization's quality policy should be an equal and consistent part of the organization's overall policies and strategy.

In establishing the quality policy, top management should consider

— The level and type of future improvement needed for the organization to be successful,

— The expected or desired degree of customer satisfaction,

— The development of people in the organization,

— The needs and expectations of other interested parties,

— The resources needed to go beyond ISO 9001 requirements, and

— The potential contributions of suppliers and partners.

The quality policy can be used for improvement provided that

— It is consistent with top management's vision and strategy for the organization'sfuture,

— It permits quality objectives to be understood and pursued throughout theorganization,

— It demonstrates top management's commitment to quality and the provision of adequate resources for achievement of objectives,

— It aids in promoting a commitment to quality throughout the organization, with clear leadership by top management,

— It includes continual improvement as related to satisfaction of the needs and expectations of customers and other interested parties ,and

— It is effectively formulated and efficiently communicated.

As with other business policies, the quality policy should be periodically reviewed.

15.12 ISO 9001:2000, Quality management systems — Requirements

15.12.1 Quality policy

Top management shall ensure that the quality policy

a) Is appropriate to the purpose of the organization,

b) Includes a commitment to comply with requirements and continually improve the effectiveness of the quality management system,

c) Provides a framework for establishing and reviewing quality objectives,

d) Is communicated and understood within the organization ,and

e) Is reviewed for continuing suitability.

15.12.2 Planning Quality objectives

The organization's strategic planning and the quality policy provide a framework for the setting of quality objectives. Top management should establish these objectives, leading to improvement of the organization's performance. The objectives should be capable of being measured in order to facilitate an effective and efficient review by management. When establishing these objectives, management should also consider

— Current and future needs of the organization and the markets served,

— Relevant findings from management reviews,

— Current product and process performance,

— Levels of satisfaction of interested parties,

— Self-assessment results,

— Benchmarking, competitor analysis, opportunities for improvement, and

— Resources needed to meet the objectives.

The quality objectives should be communicated in such a way that people in the organization can contribute to their achievement. Responsibility for deployment of quality objectives should be defined.

15.13 ISO 9001:2000, Quality management systems — Requirements

15.13.1 Quality objectives

Top management shall ensure that quality objectives, including those needed to meet requirements for product, are established at relevant functions and levels within the organization. The quality objectives shall be measurable and consistent with the quality policy.

Objectives should be systematically reviewed and revised as necessary.

15.13.2 Quality planning

Management should take responsibility for the quality planning of the organization. This planning should focus on defining the processes needed to meet effectively and efficiently the organization's quality objectives and requirements consistent with the strategy of the organization.

Inputs for effective and efficient planning include

— Strategies of the organization,

— Defined organizational objectives,

— Defined needs and expectations of the customers and other interested parties,

— Evaluation of statutory and regulatory requirements,

— Evaluation of performance data of the products,

— Evaluation of performance data of processes,

— Lessons learned from previous experience,

— Indicated opportunities for improvement ,and

— Related risk assessment and mitigation data.

Outputs of quality planning for the organization should define the product realization and support processes needed in terms such as

— Skills and knowledge needed by the organization,

— Responsibility and authority for implementation of process improvement plans,

— Resources needed, such as financial and infrastructure,

— Metrics for evaluating the achievement of the organization's performance improvement

— Needs for improvement including methods and tools, and

— Needs for documentation, including records.

Management should systematically review the outputs to ensure the effectiveness and efficiency of the processes of the organization.

ISO 9001:2000, Quality management systems — Requirements

5.4.2 Quality management system planning

Top management shall ensure that

a) The planning of the quality management system is carried out in order to meet the requirements given in 4.1,as well as the quality objectives, and

b) The integrity of the quality management system is maintained when changes to the quality management system are planned and implemented.

15.13.3 Responsibility, authority and communication

Top management should define and then communicate the responsibility and authority in order to implement and maintain an effective and efficient quality management system.

People throughout the organization should be given responsibilities and

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ISO 9001:2000, Quality management systems — Requirements

5.5 Responsibility, authority and communication

5.5.1 Responsibility and authority

Top management shall ensure that responsibilities and authorities are defined and communicated within the organization.

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authority to enable them to contribute to the achievement of the quality objectives and to establish their involvement, motivation and commitment.

15.14 Management representative

A management representative should be appointed and given authority by top management to manage, monitor, evaluate and coordinate the quality management system. This appointment is to enhance effective and efficient operation and improvement of the quality management system. There present active should report to top management and communicate with customers and other interested parties on matters pertaining to the quality management system.

ISO 9001:2000, Quality management systems — Requirements

5.5.2 Management representative

Top management shall appoint a member of management who, irrespective of other responsibilities, shall have responsibility and authority that includes

a) ensuring that processes needed for the quality management system are established, implemented and maintained,

b) reporting to top management on the performance of the quality management system and any need for improvement, and

c) ensuring the promotion of awareness of customer requirements throughout the organization.

Note . The responsibility of a management represenrive can include liaison with external parties on matters relating to the quality management system.

15.14.1 Internal communication

The management of the organization should define and implement an effective and efficient process for communicating the quality policy, requirements, objectives and accomplishments. Providing such information can aid in the organization's performance improvement and directly involves its people in the achievement of quality objectives.

Management should active lien courage feedback and communication from people in the organization as a means of involving them.

Activities for communicating include, for example

— Management-led communication in work areas,

— Team briefings and other meetings, such as for recognition of achievement,

— Notice-boards, in-house journals/magazines,

— Audio-visual and electronic media, such as email and websites, and

— Employee surveys and suggestion schemes.

ISO 9001:2000, Quality management systems — Requirements

5.5.3 Internal communication

Top management shall ensure that appropriate communication channels are established with in the organization and that communication takes place regarding the effectiveness of the quality management system.

15.14.2 Management review

Top management should develop the management review activity beyond verification of the effectiveness and efficiency of the quality management system into a process that extends to the whole organization, and which also evaluates the efficiency of the system .Management reviews should be platforms for the exchange of new ideas, with open discussion and evaluation of the inputs being stimulated by the leadership of top management.

To add value to the organization from management review, top management should control the performance of realization and support processes by system review based on the quality management principles. The frequency of review should be determined by the needs of the organization. Inputs to the review process should result in outputs that extend beyond the effectiveness and efficiency of the quality management system. Outputs from reviews should provide data for use in planning for performance improvement of the organization.

15.14.3 Review input

Inputs to evaluate efficiency as well as effectiveness of the quality management system should consider the customer and other interested parties and should include

— Status and results of quality objectives and improvement activities,

— Status of management review action items,

— Results of audits and self-assessment of the organization,

— Feedback on the satisfaction of interested parties, perhaps even to the point of their participation,

— Market-related factors such as technology, research and development, and competitor performance,

— Results from bench marking activities,

— Performance of suppliers,

— New opportunities for improvement,

— Control of process and product nonconformities,

— Marketplace evaluation and strategies,

— Status of strategic partnership activities,

— Financial effects of quality related activities ,and

— Other factors which may impact the organization, such as financial, social or environmental conditions, and relevant statutory and regulatory changes

15.14.4 Review output

By extending management review beyond verification of the quality management system, the outputs of management review can be used by top management as inputs to improvement processes. Top management can use this review process as a powerful tool in the identification of opportunities for performance improvement of the organization.Thescheduleofreviewsshouldfacilitatethetimelyprovisionofda tainthecontextofstrategicplanning for the organization. Selected output should be communicated to demonstrate to the people in the organization how the management review process leads to new objectives that will benefit the organization.

Additional outputs to enhance efficiency include, for example

— Performance objectives for products and processes,

— Performance improvement objectives for the organization,

— Appraisal of the suitability of the organization's structure and resources,

— Strategies and initiatives for marketing, products, and satisfaction of customers and other interested parties,

— Loss prevention and mitigation plans for identified risks ,and

— Information for strategic planning for future needs of the organization.

Records should be sufficient to provide for traceability and to facilitate evaluation of the management review process itself, in order to ensure its continued effectiveness and added value to the organization.

15.15 Introduction

Top management should ensure that there sources essential to the implementation of strategy and the achievement of the organization's objectives are identified and made available. This should include resources for operation and improvement of the quality management system, and the satisfaction of customers and other interested parties. Resources may be people, infrastructure, work environment, information, suppliers and partners, natural resources and financial resources.

15.15.1 Issues to be considered

Consideration should be given to resources to improve the performance of the organization, such as

— Effective, efficient and timely provision of resources in relation to opportunities and constraints,

— Tangible resources such as improved realization and support facilities,

— Intangible resources such as intellectual property,

— Resources and mechanisms to encourage innovative continual improvement,

— Organization structures, including project and matrix management needs,

  — Information management and technology,

  — Enhancement of competence via focused training, education and learning,

  — Development of leadership skills and profiles for the future managers of the organization,

  — Use of natural resources and the impact of resources on the environment ,and

— Planning for future resource needs.

ISO 9001:2000, Quality management systems — Requirements

6 Resource management

6.1 Provision of resources

The organization shall determine and provide the resources needed

a) to implement and maintain the quality management system and continually improve its effectiveness, and

b) to enhance customer satisfaction by meeting customer requirements.

15.15.2 Involvement of people

Management should improve both the effectiveness and efficiency of the organization, including the quality management system, through the involvement and support of people. As an aid to achieving its performance improvement objectives, the organization should encourage the involvement and development of its people

— By providing ongoing training and career planning,

— By defining their responsibilities and authorities,

— By establishing individual and team objectives, managing process performance and evaluating results,

— By facilitating involvement in objective setting and decision making,

— By recognizing and rewarding,

— By facilitating the open, two-way communication of information,

— By continually reviewing the needs of its people,

— By creating conditions to encourage innovation,

— By ensuring effective teamwork,

— By communicating suggestions and opinions,

— By using measurements of its people's satisfaction, and by investigating the reasons why people

15.15.3 Competence, awareness and training

Management should ensure that the necessary competence is available for the effective and efficient operation of the organization. Management should consider analysis of both the present and expected competence needs as compared to the competence already existing in the organization.

Consideration of the need for competence includes sources such as

— Future demands related to strategic and operational plans and objectives,

— Anticipated management and workforce succession needs,

— Changes to the organization's processes, tools and equipment,

— Evaluation of the competence of individual people to perform defined activities, and

— Statutory and regulatory requirements, and standards, affecting the organization and its interested parties.

15.15.4 Awareness and training

Planning for education and training needs should take account of change caused by the nature of the organization's processes, the stages of development of people and the culture of the organization.

The objective is to provide people with knowledge and skills which, together with experience, improve their competence.

Education and training should emphasize the importance of meeting requirements and the needs and expectations of the customer and other interested parties. It should also include awareness of the consequences to the organization and its people of failing to meet the requirements.

To support the achievement of the organization's objectives and the development of its people, planning for education and training should consider

— Experience of people,

— Tacit and explicit knowledge,

— Leadership and management skills,

— Planning and improvement tools,

— Teambuilding,

— Problem solving,

— Communication skills,

— Culture and social behavior,

— Knowledge of markets and the needs and expectations of customers and other interested parties, and

— Creativity and innovation.

To facilitate the involvement of people, education and training also include

— The vision for the future of the organization,

— The organization's policies and objectives,

— Organizational change and development,

— The initiation and implementation of improvement processes,

— Benefits from creativity and innovation,

— The organization's impact on society,

— Introductory programmers for new people ,and

— Periodic refresher programmers' for people already trained.

Training plans should include

— Objectives,

— Programmers and methods,

— Resources needed,

— Identification of necessary internal support,

— Evaluation in terms of enhanced competence of people ,and

— Measurement of the effectiveness and the impact on the organization.

The education and training provided should be evaluated in terms of

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ISO 9001:2000, Quality management systems — Requirements

6.2.2 Competence, awareness and training

The organization shall

a) determine the necessary competence for personnel performing work affecting product quality,

b) provide training or take other actions to satisfy these needs,

c) evaluate the effectiveness of the actions taken,

d) ensure that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives, and

e) maintain appropriate records of education, training, skills and experience.

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expectations and impact on the effectiveness and efficiency of the organization as a means of improving future training plans.

15.15.5 Infrastructure

Management should define the infrastructure necessary for the realization of products while considering the needs and expectations of interested parties. The infrastructure includes resources such as plant, workspace, tools and equipment, support services, information and communication technology, and transport facilities.

The process to define the infrastructure necessary for achieving effective and efficient product realization should include the following:

a) Provision of an infrastructure ,defined in terms such as objectives, function ,performance ,availability ,cost ,safety, security and renewal;

b) Development and implementation of maintenance methods to ensure that the infrastructure continues to meet the organization's needs; these methods should consider the type and frequency of maintenance and verification of operation of each infrastructure element, based on its criticality and usage;

c) Evaluation of the infrastructure against the needs and expectations of interested parties;

d) Consideration of environmental issues associated with infrastructure, such as conservation, pollution, waste and recycling.

Natural phenomena that cannot be controlled can impact the infrastructure. The plan for the infrastructure should consider the identification and mitigation of associated risks and should include strategies to protect the interests of interested parties.

15.15.6 Work environment

Management should ensure that the work environment has a positive influence on motivation, satisfaction and performance of people in order to enhance the performance of the organization. Creation of a suitable work environment, as a combination of human and physical factors, should include consideration of

— Creative work methods and opportunities for greater involvement to realize the potential of people in the organization,

— Safety rules and guidance, including the use of protective equipment,

— Ergonomics,

— Work place location,

— Social interaction,

— Facilities for people in the organization,

— Heat, humidity, light, airflow, and

— Hygiene, cleanliness, noise, vibration and pollution.

15.16 Information

Management should treat data as a fundamental resource for conversion to information and the continual development of an organization's knowledge, which is essential for making factual decisions and can stimulate innovation. In order to manage information, the organization should

— Identify its information needs,

— Identify and access internal and external sources of information,

— Convert information to knowledge of use to the organization,

— Use the data, information and knowledge to set and meet its strategies and objectives,

— Ensure appropriate security and confidentiality ,and

— Evaluate the benefits derived from use of the information in order to improve managing information and knowledge.

15.16.1 Suppliers and partnerships

Managementshouldestablishrelationshipswithsuppliersandpartnerstopromoteandfacilitatecommunicationwith the aim of mutually improving the effectiveness and efficiency of processes that creates value. There are various opportunities for organizations to increase value through working with their suppliers and partners, such as

— Optimizing the number of suppliers and partners,

— Establishing two-way communication at appropriate levels in both organizations to facilitate the rapid solution of problems, and to avoid costly delays or disputes,

— Cooperating with suppliers in validation of the capability of their processes,

— Monitoring the ability of suppliers to deliver conforming products with the aim of eliminating redundant verifications,

— Encouraging suppliers to implement programmers' for continual improvement of performance and to participate in other joint improvement initiatives,

— Involving suppliers in the organization's design and development activities to share knowledge and effectively and efficiently improve the realization and delivery processes for conforming products,

— Involving partners in identification of purchasing needs and joint strategy development, and

— Evaluating, recognizing and rewarding efforts and achievements by suppliers and partners.

15.16.2 Natural resources

Consideration should be given to the availability of natural resources that can influence the performance of the organization. While such resources are often out of the direct control of the organization, they can have significant positive or negative effects on its results. The organization should have plans, or contingency plans, to ensure the availability or replacement of these resources in order to prevent or minimize negative effects on the performance of the organization.

15.16.3 Financial resources

Resource management should include activities for determining the needs for, and sources of, financial resources. The control of financial resources should include activities for comparing actual usage against plans, and taking necessary action.

Management should plan, make available and control the financial resources necessary to implement and maintain an effective and efficient quality management system and to achieve the organization's objectives. Management should also consider the development to innovative financial methods to support and encourage improvement of the organization's performance.

Improving the effectiveness and efficiency of the quality management system can influence positively the financial results of the organization, for example

a) Internally, by reducing process and product failures, or waste in material and time, or

b) Externally, by reducing product failures, costs of compensation under guarantees and warranties, and costs of lost customers and markets.

c) Reporting of such matters can also provide a means of determining ineffective or inefficient activities, and initiating suitable improvement actions.

d) The financial reporting of activities related to the performance of the quality management system and product conformity should be used in management reviews.

15.17 Introduction

Top management should ensure the effective and efficient operation of realization and support processes and the associated process network so that the organization has the capability of satisfying its interested parties. While realization processes result in products that add value to the organization, support processes are also necessary to the organization and add value indirectly.

Any process is a sequence of related activities or an activity that has both input and output. Management should define the required outputs of processes, and should identify the necessary inputs and activities required for their effective and efficient achievement.

The interrelation of processes can be complex, resulting in process networks. To ensure the effective and efficient operation of the organization, management should recognize that the output of one process may become the input to one or more other processes.

15.17.1 Issues to be considered

Understanding that a process can be represented as sequence of activities aids management in defining the process inputs. Once the inputs have been defined, the necessary activities, actions and resources required for the process can be determined, in order to achieve the desired outputs.

Results from verification and validation of processes and outputs should also be considered as inputs to a process, to achieve continual improvement of performance and the promotion of excellence throughout the organization. Continual improvement of the organization's processes will improve the effectiveness and efficiency of the quality managementsystemandtheorganization'sperformance.AnnexBdescribesa" Processforcontinualimprovement" that can be used to assist in the identification of actions needed for continual improvement of the effectiveness and efficiency of processes.

Processes should be documented to the extent necessary to support effective and efficient operation. Documentation related to processes should support

— Identifying and communicating the significant features of the processes,

— Training in the operation of processes,

— Sharing knowledge and experience in teams and workgroups,

— Measurement and audit of processes, and

— Analysis, review and improvement of processes.

The role of people within the processes should be evaluated in order

— To ensure the health and safety of people,

— To ensure that the necessary skills exist,

— To support coordination of processes,

— To provide for input from people in process analysis, and

— To promote innovation from people.

— The drive for continual improvement of the organization's performance should focus on the improvement of the effectiveness and efficiency of processes as the means by which beneficial results are achieved. Increased benefits, improved customer satisfaction, improved use of resources and reduction of waste is examples of measurable results achieved by greater effectiveness and efficiency of processes.

15.17.2 Managing processes

Management should identify processes needed to realize products to satisfy the requirements of customers and other interested parties. To ensure product realization, consideration should be given to associated support processes as well as desired outputs, process steps, activities, flows, control measures, training needs, equipment, methods, information, materials and other resources.

An operating plan should be defined to manage the processes, including

— input and output requirements (for example specifications and resources),

— activities within the processes,

— verification and validation of processes and products,

— analysis of the process including depend ability,

— identification, assessment and mitigation of risk,

— corrective and preventive actions,

— opportunities and actions for process improvement, and

— Control of changes to processes and products.

Examples of support processes include

— managing information,

— training of people,

— finance-related activities,

— infrastructure and service maintenance,

— application of industrial safety/protective equipment ,and

— Marketing.

15.17.3 Process inputs, outputs and review

The process approach ensures that process inputs are defined and recorded in order to provide a basis for formulation of requirements to be used for verification and validation of outputs. Inputs can be internal or external to the organization.

Resolution of ambiguous or conflicting input requirements can involve consultation with the affected internal and external parties. Input derived from activities not yet fully evaluated should be subject to evaluation through subsequent review, verification and validation. The organization should identify significant or critical features of products and processes in order to develop an effective and efficient plan for controlling and monitoring the activities within its processes.

Examples of input issues to consider include

— Competence of people,

— Documentation,

— Equipment capability and monitoring ,and

— Health, safety and work environment.

Process outputs that have been verified against process input requirements, including acceptance criteria, should consider the needs and expectations of customers and other interested parties. For verification purposes, the outputs should be recorded and evaluated against input requirements and acceptance criteria. This evaluation should identify necessary corrective actions, preventive actions or potential improvements in the effectiveness and efficiency of the process. Verification of the product can be carried out in the process in order to identify variation.

The management of the organization should undertake periodic review of process performance to ensure the process is consistent with the operating plan. Examples of topics for this review include

— reliability and repeatability of the process,

— identification and prevention of potential non conformities,

— adequacy of design and development inputs and outputs,

— consistency of inputs and outputs with planned objectives,

— potential for improvements, and

— Resolved issues.

ISO 9001:2000, Quality management systems — Requirements

7 Product realizations

7.1 Planning of product realization

The organization shall plan and develop the processes needed for product realization. Planning of product realization shall be consistent with the requirements of the other processes of the quality management system.

In planning product realization, the organization shall determine the following, as appropriate:

a) quality objectives and requirements for the product;

b) the need to establish processes, documents, and provide resources specific to the product;

c) required verification, validation, monitoring, inspection and test activities specific to the product and the criteria for product acceptance;

d) records needed to provide evidence that the realization processes and resulting product meet requirements.

The output of this planning shall be in a form suitable for the organization's method of operations.

NOTE 1 A document specifying the processes of the quality management system (including the product realization processes) and the resources to be applied to a specific product, project or contract, can be referred to as a quality plan.

NOTE 2 The organization may also apply the requirements given in 7.3 to the development of product realization processes.

15.17.4 Product and process validation and changes

Management should ensure that the validation of products demonstrates that they meet the needs and expectations of customers and other interested parties. Validation activities include modeling, simulation and trials, as well as reviews involving customers or other interested parties.

Issues to consider should include

— Quality policy and objectives,

— Capability or qualification of equipment,

— Operating conditions for the product,

— Use or application of the product,

— Disposal of the product,

— Product lifecycle,

— Environmental impact of the product, and

— Impact of the use of natural resources including materials and energy.

Process validation should be carried out at appropriate intervals to ensure timely reaction to changes impacting the process. Particular attention should be given to validation of processes

— For high value and safety critical products,

— Where deficiency in product will only be apparent in use,

— Which cannot be repeated, and

— Where verification of product is not possible.

The organization should implement a process for effective and efficient control of changes to ensure that product or process changes benefit the organization and satisfy the needs and expectations of interested parties. Changes should be identified, recorded, evaluated, reviewed, and controlled in order to understand the effect on other processes and the needs and expectations of customers and other interested parties.

Any changes in the process affecting product characteristics should be recorded and communicated in order to maintain the conformity of the product and provide information for corrective action or performance improvement of the organization. Authority for initiating change should be defined in order to maintain control.

Outputs in the form of products should be validated after any related change, to ensure that the change has had the desired effect.

Use of simulation techniques can also be considered in order to plan for prevention of failures or faults in processes.

Risk assessment should be undertaken to assess the potential for, and the effect of, possible failures or faults in processes. The results should be used to define and implement preventive actions to mitigate identified risks. Examples of tools for risk assessment include

— fault modes and effects analysis,

— fault tree analysis,

— relationship diagrams,

— simulation techniques, and

— Reliability prediction.

15.17.5 Processes related to interested parties

Management should ensure that the organization has defined mutually acceptable processes for communicating effectively and efficiently with

its customers and other interested parties. The organization should implement and maintain such processes to ensure adequate understanding of the needs and expectations of its interested parties, and for translation into requirements for the organization. These processes should include identification and review of relevant information and should actively involve customers and other interested parties. Examples of relevant process information include

— requirements of the customer or other interested parties,

— market research, including sector and end-user data,

— contract requirements,

— competitor analysis,

— benchmarking, and

— Processes due to statutory or regulatory requirements.

The organization should have a full understanding of the process requirements of the customer, or other interested party, before initiating its action to comply. This understanding and its impact should be mutually acceptable to the participants.

15.18 ISO 9001:2000, Quality management systems — Requirements

Customer-related processes

15.18.1 Determination of requirements related to the product

The organization shall determine

a) requirements specified by the customer, including the requirements for delivery and post-delivery activities,

b) requirements not stated by the customer but necessary for specified or intended use, where known,

c) statutory and regulatory requirements related to the product ,and

d) Any additional requirements determined by the organization.

15.18.2 Review of requirements related to the product

The organization shall review the requirements related to the product. This review shall be conducted prior to the organization's commitment to supply a product to the customer (e.g. submission of tenders, acceptance of contracts or orders, acceptance of changes to contracts or orders) and shall ensure that

a) product requirements are defined,

b) contract or order requirements differing from those previously expressed are resolved ,and

c) The organization has the ability to meet the defined requirements.

Records of the results of the review and actions arising from the review shall be maintained.

Where the customer provides no documented statement of requirement, the customer requirements shall be confirmed by the organization before acceptance.

Where product requirements are changed, the organization shall ensure that relevant documents are amended and that relevant personnel are made aware of the changed requirements.

NOTE In some situations, such as internet sales, a formal review is impractical for each order. Instead the review can cover relevant product information such as catalogues, or advertising material.

15.18.3 Customer communication

The organization shall determine and implement effective arrangements for communicating with customers in relation to

a) Product information,

b) enquiries, contracts or order handling, including amendments, and

c) Customer feedback, including customer complaints.

15.18.4 Design and development

Top management should ensure that the organization has defined, implemented and maintained the necessary design and development processes to respond effectively and efficiently to the needs and expectations of its customers and other interested parties.

When designing and developing products or processes, management should ensure that the organization is not only capable of considering their basic performance and function, but all factors that contribute to meeting the product and process performance expected by customers and other interested parties. For example, the organization should consider life cycle, safety and health, testability, usability, user-friend lines, dependability, durability, ergonomics, the environment, product disposal and identified risks.

Management also has the responsibility to ensure that steps are taken to identify and mitigate potential risk to the users of the products and processes of the organization. Risk assessment should be undertaken to assess the potential for, and the effect of, possible failures or faults in products or processes. The results of the assessment should be used to define and implement preventive actions to mitigate the identified risks. Examples of tools for risk assessment of design and development include

— design fault modes and effects analysis,

— fault tree analysis,

— reliability prediction,

— relationship diagrams,

— ranking techniques ,and

— Simulation techniques.

ISO 9001:2000, Quality management systems — Requirements

7.3 Design and development

7.3.1 Design and development planning

The organization shall plan and control the design and development of product.

During the design and development planning the organization shall determine
a) the design and development stages,
b) the review, verification and validation that are appropriate to each design and development stage, and
c) the responsibilities and authorities for design and development.

The organization shall manage the interfaces between different groups involved in design and development to ensure effective communication and clear assignment of responsibility.

Planning output shall be updated, as appropriate, as the design and development progresses.

15.18.5 Design and development input and output

The organization should identify process inputs that affect the design and development of products and facilitate effective and efficient process performance in order to satisfy the needs and expectations of customers, and those of other interested parties. These external needs and expectations, coupled with those internal to the organization, should

be suitable for translation into input requirements for the design and development processes.

Examples are as follows:

a) external inputs such as

— customer or marketplace needs and expectations,

— needs and expectation of other interested parties,

— supplier 's contributions,

— user input to achieve robust design and development,

— changes in relevant statutory and regulatory requirements,

— international or national standards, and

— industry codes of practice;

b) internal inputs such as

— policies and objectives,

— needs and expectations of people in the organization, including those receiving the output of the process,

— technological developments,

— competence requirements for people performing design and development,

— feedback information from past experience,

— records and data on existing processes and products, and

— outputs from other processes;

c) inputs that identify those characteristics of processes or products that are crucial to safe and proper functioning and maintenance, such as

— operation, installation and application,

— storage, handling and delivery,

— physical parameters and the environment ,and

— Requirements for disposal of the products.

Product-related inputs based on an appreciation of the needs and expectations of end users, as well as those of the direct customer, can be important. Such inputs should be formulated in a way that permits the product to be verified and validated effectively and efficiently.

The output should include information to enable verification and validation to planned requirements. Examples of the output of design and development include

— data demonstrating the comparison of process inputs to process outputs,

— product specifications, including acceptance criteria,

— processes pacifications,

— materials specifications,

— testing specifications,

— training requirements,

— user and consumer information,

— purchase requirements, and

— Reports of qualification tests.

— Design and development outputs should be reviewed against inputs to

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ISO 9001:2000, Quality management systems — Requirements

7.3.2 Design and development inputs

Inputs relating to product requirements shall be determined and records maintained. These shall include

a) functional and performance requirements,

b) applicable statutory and regulatory requirements,

c) where applicable, information derived from previous similar designs, and

d) other requirements essential for design and development.

These inputs shall be reviewed for adequacy. Requirements shall be complete, unambiguous and not in conflict with each other.

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provide objective evidence that outputs have effectively and efficiently met the requirements for the process and product.

7.3.3 Design and development outputs

The outputs of design and development shall be provided in a form that enables verification against the design and development input and shall be approved prior to release.

Design and development outputs shall

a) meet the input requirements for design and development,

b) provide appropriate information for purchasing, production and for service provision,

c) contain or reference product acceptance criteria, and

d) specify the characteristics of the product that are essential for its safe and proper use.

Top management should ensure that appropriate people areas signed to manage and conduct systematic reviews to determine that design and development objectives are achieved. These reviews may be conducted

at selected points in the design and development process as well as at completion.

Examples of topics for such reviews include

— adequacy of input to perform the design and development tasks,

— progress of the planned design and development process,

— meeting verification and validation goals,

— evaluation of potential hazards or fault modes in product use,

— life-cycle data on performance of the product,

— control of changes and their effect during the design and development process,

— identification and correction of problems,

— opportunities for design and development process improvement, and

— Potential impact of the product on the environment.

At suitable stages, the organization should also undertake reviews of design and development outputs, as well as the processes, in order to satisfy the needs and expectations of customers and people within the organization who receive the process output. Consideration should also be given to the needs and expectations of other interested parties.

Examples of verification activities for output of the design and development process include

— comparisons of input requirements with the output of the process,

— comparative methods, such as alternative design and development calculations,

— evaluation against similar products,

— testing, simulations or trials to check compliance with specific input requirements, and

— Evaluation against lessons learned from past process experience, such as nonconformities and deficiencies.

Validation of the output of the design and development processes is important for the successful reception and use by customers, suppliers, people in the organization and other interested parties.

Participation by the affected parties permits the actual users to evaluate the output by such means as

— validation of engineering designs prior to construction, installation or application,

— validation of software outputs prior to installation or use, and

— Validation of services prior to wide spread introduction.

Partial validation of the design and development outputs may be necessary to provide confidence in their future application.

Sufficient data should be generated through verification and validation activities to enable design and development methods and decisions to be reviewed. The review of methods should include

— process and product improvement,

— usability of output,

— adequacy of process and review records,

— failure investigation activities, and

— Future design and development process needs.

15.19 ISO 9001:2000, Quality management systems — Requirements

15.19.1 Design and development review

At suitable stages, systematic reviews of design and development shall be performed in accordance with planned arrangements

a) to evaluate the ability of the results of design and development to meet requirements ,and

b) To identify any problems and propose necessary actions.

Participants in such reviews shall include representatives of functions concerned with the design and development stage(s) being reviewed. Records of the results of the reviews and any necessary actions shall be maintained.

15.19.2 Design and development verification

Verification shall be performed in accordance with planned arrangements to ensure that the design and development outputs have met the design and development input requirements. Records of the results of the verification and any necessary actions shall be maintained.

15.19.3 Design and development validation

Design and development validation shall be performed in accordance with planned arrangements to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use, when known. Wherever practicable, validation shall be completed prior to the delivery or implementation of the product. Records of the results of validation and any necessary actions shall be maintained.

15.19.4 Control of design and development changes

Design and development changes shall be identified and records maintained. The changes shall be reviewed, verified and validated, as appropriate, and approved before implementation. There view of design and development changes shall include evaluation of the effect of the changes on constituent parts and product already delivered.

Records of the results of the review of changes and any necessary actions shall be maintained.

15.19.5 Purchasing process

Topmanagementoftheorganizationshouldensurethateffectiveandefficient purchasingprocessesaredefinedand implemented for the evaluation and control of purchased products, in order that purchased products satisfy the organization's needs and requirements, as well as those of interested parties.

Use of electronic linkage with suppliers should be considered in order to optimize communication of requirements.

To ensure the effective and efficient performance of the organization, management should ensure that purchasing processes consider the following activities:

— timely, effective and accurate identification of needs and purchased product specifications;

— evaluation of the cost of purchased product, taking account of product performance, price and delivery;

— the organization's need and criteria for verifying purchased products;

— unique supplier processes;

— consideration of contract administration, for both supplier and partner arrangements;

— warranty replacement for nonconforming purchased products;

— logistic requirements;

— product identification and traceability;

— preservation of product;

— documentation, including records;

— control of purchased product which deviates from requirements;

— access to suppliers' premises;

— product delivery, installation or application history;

— supplier development;

— Identification and mitigation of risks associated with the purchased product.

Requirements for suppliers' processes and product specifications should be developed with suppliers in order to benefit from available supplier knowledge. The organization could also involve suppliers in the purchasing process in relation to their products in order to improve the effectiveness and efficiency of the organization's purchasing process. This could also assist the organization in its control and availability of inventory.

The organization should define the need for records of purchased product verification, communication and response to nonconformities in order to demonstrate its own conformity to specification.

15.19.6 Supplier control process

The organization should establish effective and efficient processes to identify potential sources for purchased materials, to develop existing suppliers or partners, and to evaluate their ability to supply the required products in order to ensure the effectiveness and efficiency of overall purchasing processes.

Examples of inputs to the supplier control process include

— evaluation of relevant experience,

— performance of suppliers against competitors,

— review of purchased product quality, price, delivery performance and response to problems,

— audits of supplier management systems and evaluation of their potential capability to provide the required products effectively and efficiently and within schedule,

— checking supplier references and available data on customer

satisfaction,

— financial assessment to assure the viability of the supplier throughout the intended period of supply and cooperation,

— supplier response to inquiries, quotations and tendering,

— supplier service, installation and support capability and history of performance to requirements,

— supplier awareness of and compliance with relevant statutory and regulatory requirements,

— the supplier's logistic capability including locations and resources ,and

— The supplier's standing and role in the community, as well as perception in society.

Management should consider actions needed to maintain the organization's performance and to satisfy interested parties in the event of supplier failure.

15.20 ISO 9001:2000, Quality management systems — Requirements

15.20.1 Purchasing process

The organization shall ensure that purchased product conforms to specified purchase requirements. The type and extent of control applied to the supplier and the purchased product shall be dependent upon the effect of the purchased product on subsequent product realization or the final product.

The organization shall evaluate and select suppliers based on their ability to supply product in accordance with the organization's requirements. Criteria for selection, evaluation and re-evaluation shall be established. Record soft he results of evaluations and any necessary actions arising from the evaluation shall be maintained.

15.20.2 Purchasing information

Purchasing information shall describe the product to be purchased, including where appropriate

a) requirements for approval of product, procedures, processes and equipment,

b) requirements for qualification of personnel, and

c) Quality management system requirements.

The organization shall ensure the adequacy of specified purchase requirements prior to their communication to the supplier.

15.20.3 Verification of purchased product

The organization shall establish and implement the inspection or other activities necessary for ensuring that purchased product meets specified purchase requirements.

Where the organization or its customer intends to perform verification at the supplier's premises, the organization shall state the intended verification arrangements and method of product release in the purchasing information.

15.20.4 Operation and realization

Top management should go beyond control of the realization processes in order to achieve both compliance with requirements and provide benefits to interested parties. This may be achieved through improving the effectiveness and efficiency of the realization processes and associated support processes, such as

— reducing waste,

— training of people,

— communicating and recording information,

— developing supplier capability,

— improving infrastructure,

— preventing problems,

— processing methods and process yield, and

— Methods of monitoring.

15.21 ISO 9001:2000, Quality management systems — Requirements

15.21.1 Production and service provision

The organization shall plan and carry out production and service provision under controlled conditions. Controlled conditions shall include, as applicable

a) the availability of information that describes the characteristics of

the product,

b) the availability of work instructions, as necessary,

c) the use of suitable equipment,

d) the availability and use of monitoring and measuring devices,

e) the implementation of monitoring and measurement ,and

f) The implementation of release, delivery and post-delivery activities.

15.21.2 Validation of processes for production and service provision

The organization shall validate any processes for production and service provision where the resulting output cannot be verified by subsequent monitoring or measurement. This includes any processes where deficiencies become apparent only after the product is in use or the service has been delivered.

Validation shall demonstrate the ability of these processes to achieve planned results.

The organization shall establish arrangements for these processes including, as applicable

a) defined criteria for review and approval of the processes,

b) approval of equipment and qualification of personnel,

c) use of specific methods and procedures,

d) requirements for records, and

e) Revalidation.

15.21.3 Identification and traceability

The organization can establish a process for identification and traceability that goes beyond the requirements in order to collect data which can be used for improvement.

The need for identification and traceability may arise from

— status of products, including component parts,

— status and capability of processes,

— benchmarking performance data, such as marketing,

— contract requirements, such as product recall capability,

— relevant statutory and regulatory requirements,

— intended use or application,

— hazardous materials, and

— Mitigation of identified risks.

ISO 9001:2000, Quality management systems — Requirements

7.5.3 Identification and traceability

Where appropriate, the organization shall identify the product by suitable means throughout product realization.

The organization shall identify the product status with respect to monitoring and measurement requirements.

Where traceability is a requirement, the organization shall control and record the unique identification of the product.

NOTE In some industry sectors, configuration management is a means by which identification and traceability are maintained.

15.21.4 Customer property

The organization should identify responsibilities in relation to property and other assets owned by customers and other interested parties and under the control of the organization, in order to protect the value of the property. Examples of such property are

— ingredients or components supplied for inclusion in a product,

— product supplied for repair, maintenance or upgrading,

— packaging materials supplied directly by the customer,

— customer materials handled by service operations such as storage,

— services supplied on behalf of the customer, such as transport of customer property to a third party, and

— Customer intellectual property, including specifications, drawings and property information.

ISO 9001:2000, Quality management systems — Requirements

7.5.4 Customer property

The organization shall exercise care with customer property while it is under the organization's control or being used by the organization. The organization shall identify, verify, protect and safe guard customer property provided for use or incorporation into the product. If any customer property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the customer and records maintained.
NOTE Customer property can include intellectual property.

15.21.5 Preservation of product

Management should define and implement processes for handling, packaging, storage, preservation and delivery of product that prevent damage, deterioration or misuse during internal processing and final delivery of the product. Management should involve supplier sand partners in defining and implementing effective and efficient processes to protect purchased material.

Management should consider the need for any special requirements arising from the nature of the product. Special requirements can be associated with software, electronic media, and hazardous materials, products requiring special people for service, installation or application, and products or materials that are unique or irreplaceable.

Management should identify resources needed to maintain the product throughout its life cycle to prevent damage, deterioration or misuse. The

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ISO 9001:2000, Quality management systems — Requirements

7.5.5 Preservation of product

The organization shall preserve the conformity of product during internal processing and delivery to the intended destination. This preservation shall include identification, handling, packaging, storage and protection. Preservation shall also apply to the constituent parts of a product.

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organization should communicate information to the interested parties involved about the resources and methods needed to preserve the intended use of the product throughout its lifecycle.

15.21.6 Control of measuring and monitoring devices

Management should define and implement effective and efficient measuring and monitoring processes, including methods and devices for verification and validation of products and processes to ensure the satisfaction of customers and other interested parties. These processes include surveys, simulations, and other measurement and monitoring activities.

In order to provide confidence in data, the measuring and monitoring processes should include confirmation that the devices are fit for use and are maintained to suitable accuracy and accepted standards, as well as a means of identifying the status of the devices.

The organization should consider means to eliminate potential errors from processes, such as "fool-proofing", for verification of process

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ISO 9001:2000, Quality management systems — Requirements

7.6 Control of monitoring and measuring devices

The organization shall determine the monitoring and measurement to be undertaken and the monitoring and measuring devices needed to provide evidence of conformity of product to determined requirements.

The organization shall establish processes to ensure that monitoring and measurement can be carried out and are carried out in a manner that is consistent with the monitoring and measurement requirements.

Where necessary to ensure valid results, measuring equipment shall

a) be calibrated or verified at specified intervals or prior to use, against measurement standards traceable to international or national measurement standards; where no such standards exist, the basis used for calibration or verification shall be recorded;

b) be adjusted or re-adjusted as necessary;

c) be identified to enable calibration status to be determined;

d) be safeguarded from adjustments that would invalidate the measurement result;

e) be protected from damage and deterioration during handling, maintenance and storage.

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outputs in order to minimize the need for control of measuring and monitoring devices, and to add value for interested parties.

15.22 Introduction

Measurement data are important for making fact-based decisions. Top management should ensure effective and efficient measurement, collection and validation of data to ensure the organization's performance and the satisfaction of interested parties. This should include review of the validity and purpose of measurements and the intended use of data to ensure added value to the organization.

Examples of measurement of performance of the organization's processes include

— measurement and evaluation of its products,

— capability of processes,

— achievement of project objectives, and

— Satisfaction of customer and other interested parties.

The organization should continually monitor its performance improvement actions and record their implementation, as this can provide data for future improvements.

The results of the analysis of data from improvement activities should be one of the inputs to management review in order to provide information for improving the performance of the organization.

15.22.1 Issues to be considered

Measurement, analysis and improvement include the following considerations:

a) measurement data should be converted to information and knowledge to be of benefit to the organization;

b) measurement, analysis and improvement of products and processes should be used to establish appropriate priorities for the organization;

c) measurement methods employed by the organization should be reviewed periodically, and data should be verified on a continual basis for accuracy and completeness;

d) benchmarking of individual processes should be used as a tool for improving the effectiveness and efficiency of processes;

e) measurements of customer satisfaction should be considered as vital for evaluation of the organization's performance;

f) use of measurements, and the generating and communicating of the information obtained, are essential to the organization and should be the basis for performance improvement and the involvement of interested parties; such information should be current, and its purpose should be clearly defined;

g) appropriate tools for the communication of information resulting from the analyses of the measurements should be implemented;

h) the effectiveness and efficiency of communicating with interested parties should be measured to determine whether the information is timely and clearly understood;

i) where process and product performance criteria are met, it may still be beneficial to monitor and analyses performance data in order to understand better the nature of the characteristic understudy;

j) the use of appropriate statistical or other techniques can help in the understanding of both process and measurementvariation,andcantherebyimproveprocessandproductperf ormancebycontrollingvariation;

k) Self-assessment should be considered on a periodic basis to assess the maturity of the quality management system and the level of the

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ISO 9001:2000, Quality management systems — Requirements

8 Measurement, analysis and improvement

8.1 General

The organization shall plan and implement the monitoring, measurement, analysis and improvement processes needed

a) to demonstrate conformity of the product,

b) to ensure conformity of the quality management system, and

c) to continually improve the effectiveness of the quality management system.

This shall include determination of applicable methods, including statistical techniques, and the extent of their use.

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organization's performance, as well as to define opportunities for performance improvement (see annex).

15.22.2 Measurement and monitoring of system performance

Top management should ensure that effective and efficient methods are used to identify areas for improvement of the quality management system performance. Examples of methods include

— satisfaction surveys for customers and other interested parties,

— internal audits,

— financial measurements, and

— Self-assessment.

15.22.3 Measurement and monitoring of customer satisfaction

Measurement and monitoring of customer satisfaction is based on review of customer-related information. The collection of such information may be active or passive. Management should recognize that there are many sources of customer-related information, and should establish effective and efficient processes to collect analyses and use this information for improving the performance of the organization. The organization should identify sources of customer and end-user information, available in written and verbal forms, from internal and external sources. Examples of customer-related information include

— customer and user surveys,

— feedback on aspects of product,

— customer requirements and contract information,

— market needs,

— service delivery data, and

— Information relating to competition.

Management should use measurement of customer satisfaction as a vital tool. The organization's process for requesting, measuring and monitoring feedback of customer satisfaction should provide information on a continual basis. This process should consider conformity to requirements, meeting needs and expectations of customers, as well as the price and delivery of product.

The organization should establish and use sources of customer satisfaction information and should cooperate with its customers in order to anticipate future needs. The organization should plan and establish processes to listen effectively and efficiently to the "voice of the customer". Planning for these processes should define and implement data-collection methods, including information sources, frequency of collection, and data-analysis review. Examples of sources of information on customer satisfaction include

— Customer complaints,

— communicating directly with customers,

— questionnaires and surveys,

— subcontracted collection and analysis of data,

— focus groups,

— reports from consumer organizations,

— reports in various media, and

— Sector and industry studies.

ISO 9001:2000, Quality management systems — Requirements

8.2 Monitoring and measurement

8.2.1 Customer satisfaction

As one of the measurements of the performance of the quality management system the organization shall monitor information relating to customer perception as to whether the organization has met customer requirements. The methods for obtaining and using this information shall be determined.

15.22.4 Internal audit

Top management should ensure the establishment of an effective and efficient internal audit process to assess the strengths and weakness of the quality management system. The internal audit process acts as a management tool for independent assessment of any designated process or activity. The internal audit process provides an independent tool for use in obtaining objective evidence that the existing requirements have been met, since the internal audit evaluates the effectiveness and efficiency of the organization.

It is important that management ensure improvement actions are taken in response to internal audit results. Planning for internal audits should be flexible in order to permit changes in emphasis based on findings and objective evidence obtained during the audit. Relevant input from the area to be audited, as well as from the interested parties, should be considered in the development of internal audit plans.

Examples of subjects for consideration by internal auditing include

— effective and efficient implementation of processes,
  — analysis of quality cost data,
  — effective and efficient use of resources,
  — process and product performance results and expectations,
  — adequacy and accuracy of performance measurement,
  — improvement activities, and
  — Relationships with interested parties.

Internal audit reporting sometimes includes evidence of excellent performance in order to provide opportunities for recognition by management and motivation of people.

ISO 9001:2000, Quality management systems — Requirements

8.2.2 Internal audit

The organization shall conduct internal audits at planned intervals to determine whether the quality management system

a) conforms to the planned arrangements, to the requirements of this International Standard and to the quality management system requirements established by the organization, and

b) is effectively implemented and maintained.

An audit programme shall be planned, taking into consideration the status and importance of the processes and are as to be audited, as well as the results of previous audits. The audit criteria, scope, frequency and methods shall be defined.Selection of auditors and conduct of audits shall ensure objectivity and impartiality of the audit process. Auditors shall not audit their own work.

The responsibilities and requirements for planning and conducting audits, and for reporting results and maintaining records shall be defined in a documented procedure.

The management responsible for the are a being audited shall ensure that actions are taken without unduedelay to eliminatedetected non conformities and their causes. Follow-up activities shall include the verification of the actions taken and the reporting of verification results.

NOTE See ISO 10011-1, ISO 10011-2 and ISO 10011-3 for guidance.

15.22.5 Financial measures

Management should consider the conversion of data from processes to financial information in order to provide comparable measures across processes and to facilitate improvement of the effectiveness and efficiency of the organization. Examples of financial measures include

— prevention and appraisal costs analysis,

— nonconformity cost analysis,

— internal and external failure cost analysis, and

— Life-cycle cost analysis.

15.22.6 Self-assessment

Top management should consider establishing and implementing self-assessment. This is a careful evaluation, usually performed by the organization's own management that results in an opinion or judgment of the effectiveness and efficiency of the organization and the maturity of the quality management system. It can be used by the organization to benchmark its performance against that of external organizations and world-class performance. Self-assessment also aids in evaluating the performance improvement of the organization, whereas the internal audit process of an organization is an independent audit used to obtain objective evidence that existing

Policies, procedures or requirements have been met, as it evaluates the effectiveness and efficiency of the quality management system.

The range and depth self-assessment should be planned in relation to the organization's objectives and priorities. The self-assessment approach described in annex A focuses on determining the degree of the effectiveness and efficiency of the implementation of the organization's quality management system. Some of the advantages of using the self-assessment approach given in annex A are that

— it is simple to understand,

— it is easy to use,

— it has minimal impact on the use of management resources, and

— It provides input for enhancing the performance of the organization's quality management system.

Annex A is only one example of self-assessment. Self-assessment should not be considered as an alternative to internal or external quality auditing. Use of the approach described in annex A can provide management with an overall view of the performance of the organization and the degree of maturity of the quality management system. It can also provide input for identifying areas in the organization requiring performance improvement and in helping to determine priorities.

15.22.7 Measurement and monitoring of processes

The organization should identify measurement methods and should perform measurements to evaluate process performance. The organization should incorporate these measurements into processes and use the measurements in process management.

Measurements should be used for managing daily operations, for evaluation of the processes that may be suitable for small-step or ongoing continual improvements, as well as for breakthrough projects, according to the vision and strategic objectives of the organization.

Measurements of process performance should cover the needs and expectations of interested parties in a balanced manner. Examples include

— capability,

— reaction time,

— cycle time or throughput,

— measurable aspects of dependability,

— yield,

— the effectiveness and efficiency of the organization's people,

— utilization of technologies,

— waste reduction, and

— cost allocation and reduction.

> **ISO 9001:2000, Quality management systems — Requirements**
>
> **8.2.3 Monitoring and measurement of processes**
>
> The organization shall apply suitable methods for monitoring and, where applicable, measurement of the quality management system processes. These methods shall demonstrate the ability of the processes to achieve planned results. When planned results are not achieved, correction and corrective action shall be taken, as appropriate, to ensure conformity of the product.

15.22.8 Measurement and monitoring of product

The organization should establish and specify the measurement requirements (including acceptance criteria) for its products. The measurement of product should be planned and performed in order to verify that the requirements of interested parties have been achieved and used to improve the realization processes.

When selecting measurement methods for ensuring that products conform to requirements and when considering customer needs and expectations, the organization should consider the following:

a) the types of product characteristics, which then determine the types of measurement, suitable measurement means, the accuracy required and skills needed;

b) equipment, software and tools required;

c) the location of suitable measurement points in the realization process sequence;

d) characteristics to be measured at each point, and the documentation and acceptance criteria to be used;

e) customer established points for witness or verification of selected characteristics of a product;

f) inspections or testing required to be witnessed or performed by statutory and regulatory authorities;

g) where, when and how the organization intends, or is required by the customer or statutory and regulatory authorities, to engage qualified third parties to perform

— type testing,

— in-process inspections or testing,

— product verification,

— product validation, and

— product qualification;

h) qualification of people, materials, products, processes, and the quality management system;

i) final inspection to confirm that verification and validation activities have been completed and accepted;

j) Recording the results of product measurements.

The organization should review the methods used for measuring products and the planned records of verification, to consider opportunities for performance improvement. Typical examples of product measurement records that could be considered for performance improvement include

— inspection and test reports,

— material release notices,

— product acceptance forms ,and

— Certificates of conformity as required.

ISO 9001:2000, Quality management systems — Requirements

8.2.4 Monitoring and measurement of product

The organization shall monitor and measure the characteristics of the product to verify that product requirements have been meet. This shall be carried out at appropriate stages of the product realization process in accordance with the planned arrangements.

Evidence of conformity with the acceptance criteria shall be maintained. Records shall indicate the person(s) authorizing release of product.

Product release and service delivery shall not proceed until the planned arrangements have been satisfactorily completed, unless otherwise approved by a relevant authority and, where applicable, by the customer.

15.22.9 Measurement and monitoring the satisfaction of interested parties

The organization should identify the measurement information required to meet the needs of interested parties (other than customers) ,in relation to the processes of the organization in order to balance the al location resources. Such information should include measurements relating to the people in the organization, owners and investors, suppliers and partners, as well as society. Measurement examples are as follows.

a) For people in the organization, the organization should

  — survey the opinions of its people regarding how well the organization satisfies their needs and expectations, and

  — Assess individual and collective performances and their contribution to organizational results.

b) For owners and investors, the organization should

  — assess its capacity to attain defined objectives,

  — assess its financial performance,

  — evaluate the impact of external factors on its results, and

  — Identify the value contributed by the actions taken.

c) For suppliers and partners, the organization should

  — survey the opinions of suppliers and partners on their satisfaction with the purchasing processes of the organization,

  — monitor and supply feedback on the performance of suppliers and partners and their compliance with the organization's purchasing policy, and

  — Assess the quality of product purchased, contributions from suppliers and partners, and mutual benefits derived from the relationship.

d) For society, the organization should

  — Define and track suitable data relative to its objectives, in order to achieve satisfactory interaction with society, and

  — Periodically assess the effectiveness and efficiency of its actions and the perceptions of its performance by relevant parts of society.

15.23 Control of nonconformity

Top management should empower people in the organization with the authority and responsibility to report nonconformities at any stage of a process in order to ensure timely detection and disposition of nonconformities. Authority for response to nonconformities should be defined to maintain achievement of process and product requirements. The organization should effectively and efficiently control nonconforming product identification, segregation and disposition in order to prevent misuse.

Where practical, non conformities should be recorded, together with their disposition, to assist learning and to provide data for analysis and

improvement activities .The organization may also decide that non conformities to both product realization and support processes should be recorded and controlled.

The organization can also consider recording information on those nonconformities that are corrected in the normal course of work. Such data can provide valuable information for improving the effectiveness and efficiency of processes.

15.23.1 Nonconformity review and disposition

The management of the organization should ensure the establishment of an effective and efficient process to provide for review and disposition of identified nonconformities. Review of nonconformities should be conducted by authorized people to determine if any trends or patterns of occurrence require attention. Negative trends should be considered for improvement and as input to management review where reduction goals and resource needs are considered.

People carrying out the review should have the competence to evaluate the total effects of the non conformity and should have the authority and resources to disposition then on conformity and to define appropriate

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ISO 9001:2000, Quality management systems — Requirements

8.3 Control of nonconforming product

The organization shall ensure that product which does not conform to product requirements is identified and controlled to prevent its unintended use or delivery. The controls and related responsibilities and authorities for dealing with nonconforming product shall be defined in a documented procedure.

The organization shall deal with nonconforming product by one or more of the following ways:

a) by taking action to eliminate the detected non conformity;

b) byauthorizingitsuse,releaseoracceptanceunderconcessionbyarelevantauthorityand,whereapplicable,by the customer;

c) by taking action to preclude its original intended use or application.

Records of the nature of nonconformities and any subsequent actions taken, including concessions obtained, shall be maintained.

When nonconforming product is corrected it shall be subject to re-verification to demonstrate conformity to the requirements.

When nonconforming product is detected after delivery or use has started, the organization shall take action appropriate to the effects, or potential effects, of the nonconformity.

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corrective action. Acceptance of nonconformity disposition may be a contractual requirement of the customer, or a requirement of other interested parties.

15.23.2 Analysis of data

Decisions should be based on analysis of data obtained from measurements and information collected as described in this International Standard. In this context, the organization should analyses data from its various sources to assess performance against plans, objectives and other defined goals, and to identify areas for improvement including possible benefits for interested parties.

Decisions based on facts require effective and efficient actions such as

— valid analysis methods,

— appropriate statistical techniques, and

— Making decisions and taking actions based on results of logical analyses, as balanced with experience and intuition.

Analysis of data can help to determine the root cause of existing or potential problems,and there of regicide decisions about the corrective and preventive actions needed for improvement.

For an effective evaluation by management of the total performance of the organization, data and information from all parts of the organization should be integrated and analyses .The organization's overall performance should be
Presented in a format that is suitable for different levels of the organization. The results of this analysis can be used by the organization to determine

— trends,

— customer satisfaction,

— satisfaction of other interested parties,

— effectiveness and efficiency of its processes,

— supplier contribution,

— success of its performance improvement objectives,

— economics of quality, financial and market-related performance,

— Bench marking of its performance, and Competitiveness.

ISO 9001:2000, Quality management systems — Requirements

8.4 Analysis of data

The organization shall determine, collect and analyse appropriate data to demonstrate the suitability and effectiveness of the quality management system and to evaluate where continual improvement of the effectiveness of the quality management system can be made. This shall include data generated as a result of monitoring and measurement and from other relevant sources.

The analysis of data shall provide information relating to

a)   Customer satisfaction,

b)   conformity to product requirements,

c)   characteristics and trends of processes and products including opportunities for preventive action,and

d)   suppliers.

15.23.3 Improvement

Management should continually seek to improve the effectiveness and efficiency of the processes of the organization, rather than wait for a problem to reveal opportunities for improvement. Improvements can

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ISO 9001:2000, Quality management systems — Requirements

8.5 Improvement

8.5.1 Continual improvement

The organization shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.

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range from small-step ongoing continual improvement to strategic break through improvement projects .The organization should have a process in place to identify and manage improvement activities .These improvements may result in change to the product or processes and even to the quality management system or to the organization.

15.23.4 Corrective action

Top management should ensure that corrective action is used as a tool for improvement. Corrective action planning should include evaluation of the significance of problems, and should be in terms of the potential impact on such

aspects   as   operating   costs,   costs   of   nonconformity,   product

performance, dependability and the safety and satisfaction of customers and other interested parties. People from appropriate disciplines should participate in the corrective action process. Also, the effectiveness and efficiency of processes should be emphasized when actions are taken and the actions should be monitored to ensure that desired goals are met. Corrective actions should be considered for inclusion in management review.

In pursuing corrective action, the organization should identify sources of information, and collect information to define the necessary corrective actions. The defined corrective action should be focused on eliminating causes of nonconformities in order to avoid recurrence. Examples of sources of information for corrective action consideration include

— Customer complaints,

— Non conformity reports,

— internal audit reports,

— outputs from management review,

— outputs from data analysis,

— outputs from satisfaction measurements,

— relevant quality management system records,

— the organization's people,

— process measurements, and

— Results of self-assessment.

There are many ways to determine the causes of nonconformity, including analysis by an individual or the assignment of a corrective-action project team. The organization should balance the investment in the corrective action against the impact of the problem being considered.

In evaluating the need for actions to ensure that nonconformities do not recur, the organization should consider providing appropriate training for people assigned to corrective-action projects.

The organization should incorporate root-cause analysis, as appropriate,

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ISO 9001:2000, Quality management systems — Requirements

8.5.2 Corrective action

The organization shall take action to eliminate the cause of nonconformities in order to prevent recurrence. Corrective actions shall be appropriate to the effects of the nonconformities encountered.

A documented procedure shall be established to define requirements for

a) reviewing nonconformities (including customer complaints),

b) determining the causes ,

c) evaluating the need for action to ensure that nonconformities do not recur,

d) determining and implementing action needed,

e) records of the results of action taken, and

f) reviewing corrective action taken.

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into the corrective-action process. Root- cause analysis results should be verified by testing prior to defining and initiating corrective action.

15.23.5 Loss prevention

Management should plan to mitigate the effects of loss to the organization in order to maintain the performance of processes and products. Loss prevention in the form of planning should be applied to realization and support processes, activities and products to ensure the satisfaction of interested parties.

To be effective and efficient, planning for loss prevention should be systematic. This should be based on data from appropriate methods, including evaluation of historical data for trends, and criticality relative to the performance of the organization and its products, in order to generate data in quantitative terms. Data can be generated from

— use of risk analysis tools such as fault mode and effects analysis,

— review of customer needs and expectations,

— market analysis,

— management review output,

— outputs from data analysis,

— satisfaction measurements,

— process measurements,

— systems that consolidate sources of information from interested parties,

— relevant quality management system records,

— lessons learned from past experience,

— results of self-assessment, and

— Processes that provide early warning of approaching out-of-control operating conditions.

Such data will provide information to develop an effective and efficient plan for loss prevention and prioritization appropriate to each process and product, in order to satisfy the needs and expectations of interested parties.

Results of the evaluation of the effectiveness and efficiency of loss prevention plans should be an output from management review, and

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ISO 9001:2000, Quality management systems — Requirements

8.5.3 Preventive action

The organization shall determine action to eliminate the causes of potential non conformities in order to prevent their occurrence. Preventive actions shall be appropriate to the effects of the potential problems.

A documented procedure shall be established to define requirements for

a) determining potential nonconformities and their causes,

b) evaluating the need for action to prevent occurrence of non conformities,

c) determining and implementing action needed,

d) records of results of action taken, and

e) reviewing preventive action taken.

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should be used as an input for the modification of plans and as input to the improvement processes.

15.23.6 Continual improvement of the organization

To aid in ensuring the future of the organization and the satisfaction of interested parties, management should create a culture which involves people actively seeking opportunities for improvement of performance in processes, activities and products.

To involve people, top management should create an environment where authority is delegated so that people are empowered and accept responsibility to identify opportunities where the organization can improve its performance. This can be achieved by activities such as

— setting of objectives for people, projects and the organization,

— benchmarking competitor performance and best practice,

— recognition and reward for achievement of improvement, and

— Suggestion schemes including timely reaction by management.

To provide a structure for improvement activities, top management should define and implement a process for continual improvement that can be applied to realization and support processes and activities. To ensure the effectiveness and efficiency of the improvement process,

consideration should be given to realization and support processes in terms of

— effectiveness (such as outputs meeting requirements),

— efficiency (such as resources per unit in terms of time and money),

— external effects (such as statutory and regulatory change),

— potential weakness (such as lack of capability and consistency),

— the opportunity to employ better methods,

— control of planned and unplanned change, and

— Measurement of planned benefits.

Such a process for continual improvement should be used as a tool for improving the organization's internal effectiveness and efficiency, as well as to improve the satisfaction of customers and other interested parties.

Management should support improvements in the form of small-step ongoing activities integral to existing processes as well as breakthrough opportunities, in order to gain maximum benefit for the organization and interested parties.

Examples of inputs to support the improvement process include information derived from

— Validation data,

— process yield data

— test data,

— data from self-assessment,

— stated requirements and feedback from interested parties,

— experience of people in the organization,

— financial data,

— product performance data ,and

— Service delivery data.

Management should ensure that product or process changes are approved, prioritized, planned, provisioned and controlled to satisfy interested party requirements and avoid exceeding the capability of the organization.

A process presenting continual process improvement for implementation by an organization is described in annex B.

Annex A

(Informative)

15.24 Guidelines for self-assessment

15.24.1 Introduction

Self-assessment is a carefully considered evaluation resulting in an opinion or judgment of the effectiveness and efficiency of the organization and the maturity of the quality management system. Self-assessment is usually performed by the organization's own management. The intent of self-assessment is to provide fact-based guidance to the organization regarding where to invest resources for its improvement.

It also can be useful in measuring progress against objectives, and to reassess the continuing relevance of those objectives.

Many models currently exist for the self-assessment of organizations to quality management system criteria. The most widely recognized and used models are national and regional quality award models, also referred to as organizational excellence models.

The self-assessment approach described in this annex is intended to provide a simple, easy-to-use approach to determine the relative degree of maturity of an organization's quality management system and to identify the main areas for improvement.

Specific features of the ISO 9004 self-assessment approach are that it can
— be applied to the entire quality management system, or to a part of the quality management system, or to any process,
— be applied to the entire organization or part of the organization,
— be completed quickly with internal resources,
— be completed by a multi-discipline team, or by one person in the organization who is supported by top management,
— form an input to a more comprehensive management system self-assessment process,
— identify and facilitate the prioritization of opportunities for improvement ,and
— Facilitate maturing of the quality management system towards world-class performance.

The ISO 9004 self-assessment approach is to evaluate the maturity of the quality management system for each major clause in ISO9004 on as cal ranging from1 (no formal system) to5 (best-in-class performance).This annex provides guidance in the form of typical questions that the organization can ask in order to evaluate its performance for each of the main clauses in ISO9004.

Another advantage to this approach is that results monitored over time can be used to appraise the maturity of an organization.

This approach to self-assessment is neither a substitute for internal audit of the quality management system nor for the use of existing quality award models.

15.24.2 Performance maturity levels

The performance maturity levels used in this self-assessment approach are shown in Table A.1.

Table A.1 — Performance maturity levels

Maturity level	Performance level	Guidance
1	No formal approach	No systematic evident, results, results approach no poor or unpredictable results.
2	Reactive approach	Problem- or corrective-based systematic approach; minimum data on improvement results available.
3	Stable formal system approach	Systematic process-based approach, early stage of systematic improvements; data available on conformance to objectives and existence of improvement trends.
4	Continual improvement emphasized	Improvement use; results a sustai process in good n ned improvement d trends.
5	Best-in-class performance	Strongly process best-in-integrated ; class improvement benchmarked results demonstrated.

15.24.2 Self-assessment questions

The award models as well as other self-assessment models have a wide range of detailed criteria for assessing the performance of management systems. Self-assessment provides an easy approach for evaluating the maturity of an organization based on clauses 4 to 8 of this International Standard. Each organization should develop a set of questionsforthoseclausesofthisInternationalStandardthataresuitabletoitsneeds.Examplesoftypicalquestions for self-assessment is provided below. The sub clause numbers are given in parentheses.

Question 1: Managing systems and processes (4.1)

a) How does management apply the process approach to achieve the effective and efficient control of processes, resulting in performance improvement?

Question 2: Documentation (4.2)

a) How are documents and records used to support effective and efficient operation of the processes of the organization?

Question 3: Management responsibility — General guidance (5.1)

a) How does top management demonstrate its leadership, commitment and involvement?

Question 4: Needs and expectations of interested parties (5.2)

a) How does the organization identify customers' needs and expectations on a continual basis?

b) How does the organization identify people's need for recognition, work satisfaction, competence and personal development?

c) How does the organization consider the potential benefits of establishing partnerships with its suppliers?

d) How does the organization identify other interested parties' needs and expectations that can result in setting objectives?

e) How does the organization ensure that statutory and regulatory requirements have been considered?

Question 5: Quality policy (5.3)

a) How does the quality policy ensure that the needs and expectations of customers and other interested parties are understood?

b) How does the quality policy lead to visible and expected improvements?

c) How does the quality policy consider the organization's vision of the future?

Question 6: Planning (5.4)

a) How do the objectives translate the quality policy into measurable goals?

b) How are the objectives deployed to each management level to assure individual contribution to achievement?

c) How does management ensure the availability of resources needed to meet the objectives?

Question 7: Responsibility, authority and communication (5.5)

a) How does top management ensure that responsibilities are established and communicated to people in the organization?

b) How do communicating quality requirements, objectives and accomplishments contribute to improvement of the organization's performance?

Question 8: Management review (5.6)

a) How does top management ensure valid input information is available for the management review?

b) How does the management review activity evaluate information to improve the effectiveness and efficiency of the processes of the organization?

Question 9: Resource management — General guidance (6.1)

a) How does top management plan for resources to be available in a timely manner?

Question 10: People (6.2)

a) How does management promote involvement and support of people for improvement of the effectiveness and efficiency of the organization?

b) How does management ensure that the competence of people in the organization is adequate for current and future needs?

Question 11: Infrastructure (6.3)

a) How does management ensure that the infrastructure is appropriate for the achievement of the objectives of the organization?

b) How does management consider environmental issues associated with the infrastructure?

Question 12: Work environment (6.4)

a) How does management ensure that the work environment promotes motivation, satisfaction, development and performance of people in the organization?

Question 13: Information (6.5)

a) How does management ensure that appropriate information is easily available for fact-based decision making?

Question 14: Suppliers and partnerships (6.6)

a) How does management involve suppliers in the identification of purchasing needs and joint strategy development?

b) How does management promote partnership arrangements with suppliers?

Question 15: Natural resources (6.7)

a) How does the organization ensure the availability of necessary natural resources for its realization processes?

Question 16: Financial resources (6.8)

a) How does management plan, provide, control and monitor the financial resources necessary to maintain an effective and efficient quality management system and to ensure the achievement of the objectives of the organization?

b) How does management ensure awareness of people in the organization about the link between product quality and costs?

Question 17: Product realization — General guidance (7.1)

a) How does top management apply the process approach to ensure the effective and efficient operation of the realization and support

processes and the associated process network?

Question 18: Processes related to interested parties (7.2)

a) How has management defined customer-related processes to ensure consideration of customers 'needs?

b) How has management defined other interested-party-related processes to ensure consideration of interested parties' needs and expectations?

Question 19: Design and development (7.3)

a) How has top management defined design and development processes to ensure they respond to the needs and expectations of the organization's customers and other interested parties?

b) How are design and development processes managed in practice, including the definition of design and development requirements and the achievement of planned outputs?

c) How are activities such as design review, verification, and validation and configuration management considered in the design and development processes?

Question 20: Purchasing (7.4)

a) How has top management defined purchasing processes that ensure purchased products satisfy the organization's needs?

b) How are purchasing processes managed?

c) How does the organization ensure conformity of purchased products from specification through to acceptance?

Question 21: Production and service operations (7.5)

a) How does top management ensure that the input to the realization processes takes account of customers' and other interested parties' needs?

b) How is realization processes managed from inputs to outputs?

c) How are activities such as verification and validation considered in realization processes?

Question 22: Control of measuring and monitoring devices (7.6)

a) How does management control the measuring and monitoring devices to ensure that correct data are being obtained and used?

Question 23: Measurement, analysis and improvement — General guidance (8.1)

a) How does management promote the importance of measurement, analysis and improvement activities to ensure that the organization's performance results in satisfaction of interested parties?

Question 24: Measurement and monitoring (8.2)

a) How does management ensure collection of customer-related data for analysis,in order to obtain information for improvements?

b) How does management ensure the collection of data from other interested parties for analyses and possible improvements?

c) How does the organization use self-assessment of the quality management system for improving the overall effectiveness and efficiency of the organization?

Question 25: Control of nonconformity (8.3)

a) How does the organization control process and product non conformity?

b) How the organization does analyses nonconformity for lessons learned and process and product improvement?

Question 26: Analysis of data (8.4)

a) How does the organization analyze data to assess its performance and identify areas for improvement?

Question 27: Improvement (8.5)

a) How does management use corrective action for evaluating and eliminating recorded problems affecting its performance?

b) How does management use preventive action for loss prevention?

c) How does the management ensure the use of systematic improvement methods and tools to improve the organization's performance?

15.24.3 Documentation of self-assessment results

There are many ways to format self-assessment questions to evaluate performance, to indicate maturity ratings and to record possible improvement actions. One approach is shown in Table A.2.

Table A.2 — Example of the recording of self-assessment results

Sub clause	Question No.	Actual performance observations	Rating	Improvement action
5.2	4 a)	Our process is better than any other process in the world for this item	5	None required
5.2	4 b)	We have no system for this item	1	Need to structure a process to address this by WHOM and by WHEN?

Self-assessment can be used in a flexible way according to the needs of the organization. One approach would be to perform the self-assessment on an individual basis for all or part of the quality management system and then to pursue improvement. Another approach would be to have a cross-functional group of people perform self- assessment on all or part of the quality management system, followed by group review and analysis, and then consensus building to determine improvement priorities and action plans. How self-assessment can be effectively and efficiently used in an organization is only limited by the imagination and ingenuity of the individuals in the organization who have an interest in achieving excellence.

15.24.4 Linking potential benefits of ISO 9004 to self-assessment

There are many different ways to decide what actions should be taken as a result of self-assessment. One approach is to consider the self-assessment output together with the potential key benefits to be gained from a robust quality management system. This approach would enable an organization to identify and initiate improvement projects that would potentially provide the best benefits based on the priority needs of the organization. To facilitate the use of such an approach, examples of potential benefits are given below relating to the questions in A.3 and to particular sub clauses of this International Standard. These examples may be used as a starting point to construct a list that is appropriate for the organization. Examples of potential benefits are as follows.

Benefit 1: Managing systems and processes (4.1)

Provides a systematic and visible way to lead and operate an organization that continually improves performance.

Benefit 2: Documentation (4.2)

Provides information and supporting evidence of the effectiveness and efficiency ot the quality management system.

Benefit 3: Management responsibility — General guidance (5.1)

Ensures the consistent and visible involvement of top management.

Benefit 4: Needs and expectations of interested parties (5.2)

Ensures that the quality management system considers, in a balanced way, the needs and expectations of all interested parties, to get an effective and efficient system.

Benefit 5: Quality policy (5.3)

Ensures all interested parties' needs are understood and provides direction to the total organization leading to visible and expected results.

Benefit 6: Planning (5.4)

Translates the quality policy into measurable objectives and plans to provide clear focus on important areas throughout the organization.

Enhances learning from previous experiences.

Benefit 7: Responsibility, authority and communication (5.5)

Provides an organization-wide, consistent and comprehensive approach and clarifies roles and responsibilities and linkages to all interested parties.

Benefit 8: Management review (5.6)

Involves top management in the improvement of the quality management system. Assesses whether plans have been achieved and indicates appropriate action for improvement.

Benefit 9: Resource management — General guidance (6.1)

Ensures the availability of adequate resources in terms of people, infrastructure, work environment, information, suppliers and partners, natural resources and financial resources so that the objectives of the organization can be achieved.

Benefit 10: People (6.2)

Provides better understanding of roles, responsibilities and goals and enhances involvement at all levels in the organization in order to achieve performance improvement objectives.

Encourages recognition and reward.

Benefits 11, 12, 13 and 15 to: Infrastructure (6.3), Work environment (6.4), Information (6.5) and Natural

Resources (6.7)

Provide for effective use of resources other than human resources.Enhance understanding of restrictions and opportunities to ensure that objectives and plans are achievable.

Benefit 14: Suppliers and partnerships (6.6)

Promotes partner relationships with suppliers and other organizations for mutual benefit.

Benefit 16: Financial resources (6.8)

Provides better understanding of the relationship between cost and benefits. Encourages improvement towards effective and efficient achievement of the organization's objectives.

Benefit 17: Product realization — General guidance (7.1)

Structures the operations of the organization to achieve a desired result.

Benefit 18: Processes related to interested parties (7.2)

Ensures that resources and activities are managed as processes.Ensures that all interested parties' needs and expectations are understood throughout the organization.

Benefit 19: Design and development (7.3)

Structures the design and development processes to respond effectively and efficiently to the needs and expectations of customers and other interested parties.

Benefit 20: Purchasing (7.4)

Ensures that suppliers are aligned with the organization's quality policy and objectives.

Benefit 21: Production and service operations (7.5)

Ensures sustained customer satisfaction by producing products, delivering services and providing support functions that meet customers' needs and expectations.

Benefit 22: Control of measuring and monitoring devices (7.6)

Ensures the accuracy of data for analysis.

Benefit 23: Measurement, analysis and improvement — General guidance (8.1)

Ensures effective and efficient measurement, collection and validation of data for improvement.

Benefit 24: Measurement and monitoring (8.2)

Provides controlled methods for measurement and monitoring of processes and products.

Benefit 25: Control of nonconformity (8.3)

Provides for effective disposition of nonconformity in products and processes.

Benefit 26: Analysis of data (8.4)

Provides for factual decision making.

Benefit 27: Improvement (8.5)

Increases the effectiveness and efficiency of the organization. Focuses on prevention and improvement based on trends.

15.25 Process for continual improvement

A strategic objective of an organization should be the continual improvement of processes in order to enhance the organization's performance and benefit its interested parties.

There are two fundamental ways to conduct continual process improvement, as follows:

a) Break through projects which either lead to revision and improvement of existing processes or the implementation of new processes; these are usually carried out by cross-functional teams outside routine operations;

b) Small-step ongoing improvement activities conducted within existing processes by people.

Breakthrough projects usually involve significant redesign of existing processes and should include

— definition of the objectives and an outline of the improvement project,

— analysis of the existing process (the "as-is" process) and realizing opportunities for change,

— definition and planning of improvement to the process,

— implementation of the improvement,

— verification and validation of the process improvement, and

— Evaluation of the improvement achieved, including lessons learned.

Breakthrough projects should be conducted in an effective and efficient way using project management methods. After completion of the change, a new project plan should be the basis for continuing process management.

People in the organization are the best source of ideas for small-step or ongoing process improvement and often participate as work groups. Small-step ongoing process improvement activities should be controlled in order to understand their effect. The people in the organization that are involved should be provided with the authority, technical support and necessary resources for the changes associated with the improvement.

Continual improvement by either of the methods identified should involve the following.

a) Reason for improvement: a process problem should be identified and an area for improvement selected, noting the reason for working on it.

b) Current situation: the effectiveness and efficiency of the existing process should be evaluated. Data to discover what types of problems occur most often should be collected and analyzed. A specific problem should be selected and an objective for improvement should be set.

c) Analysis: the root causes of the problem should be identified and verified.

d) Identification of possible solutions: alternative solutions should be explored. The best solution should be selected and implemented; i.e. the one that will eliminate the root causes of the problem and prevent the problem from recurring.

e) Evaluation of effects: it should then be confirmed that the problem and its root causes have been eliminated or their effects decreased, that the solution has worked, and the objective for improvement has been met.

f) Implementation and standardization of the new solution: the old process should be replaced with the improved process, thereby preventing the problem and its root causes from recurring.

g) Evaluation of the effectiveness and efficiency of the process with the improvement action completed: the effectiveness and efficiency of the improvement project should be evaluated and consideration should be given for using its solution elsewhere in the organization.

The process for improvement should be repeated on remaining problems, developing objectives and solutions for further process improvement.

In order to facilitate the involvement and awareness of people in improvement activities, management should consider activities such as

— forming small groups and having leaders elected by the group members,

— allowing people to control and improve their workplace ,and

— Developing people's knowledge, experience and skills as a part of the overall quality management activities of the organization.

— Monitoring devices, and to add value for interested parties.

15.25.1 Questions

1. What is ISO?
2. What is ISO 9000?
3. Why should my Organization implement ISO 9000 ?
4. How do ISO 9000 Standards work?
5. Which are the ISO 9000 Quality Models?
6. What is ISO 9000: 2000?

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Structure

16.0 Introduction
16.1 Quality Audit

16.2 Total Quality Culture (TQC)
16.3 Important Questions

16.0 Introduction

The term 'audit' was defined in the 16th Century as "the official examination of the accounts with verification by reference to witness and vouchers". Gradually, it came to be associated with 'any systematic investigation or appraisal or procedures or operation for the purpose of determining conformity with prescribed procedures'. Today audit can be defined as "Checking – Inspection – Examination - Reporting". According to ISO 8402: "An audit is a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and suitable to achieve objectives" (ISO –8402)

16.1 Quality Audit

A quality audit entails a systematic evaluation of a representative sample of the activities and drawing inference on the quality system as a whole. Quality audit is always performed against a documented system. **The process of the quality system determines whether:**

1. **The documentation meets the defined quality objective of theorganization.**
2. **The activities performed are in conformity with the documentedsystem.**
3. **The quality system is effective with respect to documentation and its implementation, in meeting the defined quality objectives,and**
4. **Statutory and safety requirements are beingfulfilled.**

Now question come what is quality auditing? Quality auditing is the process of examining the effectiveness of management control programs, the purposes of which is to prevent problems. Quality audit, which forms an important part of a quality

management system, is an independent review conducted to compare the given aspects of quality performance with a standard for that performance. It is one of the key management tools for achieving the objectives set out by the organization. It is an activity of gathering information for the improvement or corrective actions forstandard.

Audit should be carried out to:

1. Determine conformity or non-conformity of quality system elements with specified requirements.
2. Determine the effectiveness of the implemented quality system in meeting the specified quality objective.
3. Afford an opportunity to improve the quality system.

16.1.1 Types of Quality Audit

There are three types of quality audits, namely, first party (internal), and second party (external) and third party (extrinsic) audits. Let us understand each of these in details:

1) First party quality audit (Internal audit): when an organization conducts an audit on its own quality system using its own staff / external consultants, the audit is known as first part quality audit or internal quality audit. Important points are: auditing staff must be trained for conducting this exercise and should not bias against the functional department being audited.

2) Second party quality audit (external quality audit): The second party quality audit is performed by the purchasing organization upon the supplier organization. The idea here is to have an assessment of the supplier's processes in order to have confidence that the supplier would be able to supply goods or services of an agreed quality level on a sustained basis. Important point is these audits can be performed by the trained personnel of the purchasing organization or an outside agency hired by them.

3) Third party quality audit (extrinsic audit): this audit is performed by the certification bodies (ISO registered bodies) on the applicant organization seeking such certification. If these, auditors, after conducting the quality audit on the organization with respect to a standard, find the organization to be worthy enough, the certification is granted to the organization. Third party audits normally results in the disruption of day-to-day activities of the organization being audited during the duration of the audit.
Apart from the registered certification bodies, the third part audit may also be conducted by some government departments dealing with environment and pollution, health and safety, atomic energy etc.

16.1.2 Quality Audit Categories:

1. **System Audits** are looking at a particular system which includes multiple processes and can spread across several employees and departments. The audit of your calibration system can be considering a system audit. Your interaction chart lists yours systems.
2. **Conformance Audits** are audits to define system requirements. These are global in nature. For example a 3rd party audit of your ISO 9001 SYSTEM is a conformance audit.
3. **Compliance Audit** is an audit to regulatory requirements. This includes government agency audits.

4. **Process Audit** is a focused audit on a set of processes within your organization. It examines adherence to procedures and specifications during production or service activities.
5. **Product Audit** is a focus audit on the product itself. This may be an inspection activity or an out of the box audit.
6. **Department Audit** is a focus audit on one department that looks at the processes, specifications, and systems in one department only. It will look at the different operations with in that department. It will also examine department organization and training.

16.1.3 Audit Stages

1. Determine the audit focus
2. Prepare for the audit
3. Perform the audit
4. Report the findings in the initial findings report
5. Determine the corrective action
6. Update the findings report with the corrective action
7. Conduct the corrective action
8. Update the findings report when actions are completed
9. Follow Up
10. Closure

16.1.4 Quality Audit Benefits:

1. It drives continuous improvement
2. Lets management know problems or potential problems

3. Provides input into management decisions
4. Accesses training and effectiveness
5. Shows management support of the quality program
6. Verifies compliance

Therefore quality audit is an important tool for continuous improvement and the audit and auditing organization must follow the above stages. During auditing the auditor must follow some important guidelines to fulfill the objectives:

1. Do not be biased
2. Keep an open mind
3. Do not be argument
4. Be patient
5. Remind the participant that the audit is for continuous improvement
6. Always state the facts
7. Do not correct the person on the spot.
8. Report accurately and clearly
9. Be familiar with the procedure

Finally an ISO 9001:2000 certificate proves that the Quality Management System has been certified against a best practice standard and found compliant. Issued by a third party certification body/registrar after auditing, the certificate lets customers know they can trust that the companies have implemented the necessary internal processes to meet obligations.

Date:

Page No.

Clause of the ISO Standard/ Area Covered	Details of person(S) Met, Activity Observed, Location of activity, Records /Documents Audited	Non – conformity Observed

Signature of the Auditor:

Name:

Name of the Company

Modern quality management

The traditional method of quality control made the holding of stocks essential. Pressures to reduce stock holding and their associated costs led to the development of Quality Assurance and Total Quality Management (TQM) as replacements for Classic QC. The emphasis now is to prevent the purchase or production of defective goods in the first place, not to catch them after the event.

It is now appreciated that quality depends on the people and the processes used, not just the materials. Quality and efficiency has been widened, therefore, to cover the entire firm, not just materials and products. The avoidance of faulty production requires that three aspects are efficient:

- Methods - systems and procedures
- People - both line and staff functions
- Materials

All these have to be efficient for a quality outcome. All aspects of a firm's operations have to be examined and improved across the firm.

Businesses do not operate in isolation, but as part of a group of organizations forming the supply chain, which includes suppliers, wholesalers, agents and final customers. So, quality assurance teams must work with all of these groups and organizations to ensure that quality is maintained at all levels. This has led to the movement from traditional quality methods to broader quality approaches and philosophies including:

- ❖ Quality Assurance - procedures as well as products are examined and changed if necessary to ensure/assure customers that products are fit for purpose.
- ❖ Totals Quality Management (TQM) - this is the system where the responsibility for quality lies with ALL employees. It commits the organization to continuous improvement (Kaizen) of all activities relating to the quality of the product and the satisfaction of the customer. TQM is really a culture, as to be effective it requires a change in attitudes.
- ❖ Self-checking - the individual or group responsible for the product or task checks quality all the time, ensuring that the next person in the chain receives a quality product.
- ❖ Team working. Firms work with their suppliers, sometimes even investing money and/or buying shares in them, to ensure that the product purchased is of the desired quality, so needing no checking on delivery; in effect it is pre-checked at the supplier's factory.

Quality has become a team responsibility ensuring a focus on high quality at all times. However, quality is not a static concept. The quality of the competitor products may improve, changing the competitive position so requiring a consistent and on-going process of analysis of the external environment and a commitment to continuous improvement.

16.3 Important Questions

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1. **What is Quality Audit?**
2. **What are the different types of Quality Audit?**
3. **What are the different quality audit categories?**
4. **Briefly explain the various stages involved in Quality Audit.**
5. **What are the various benefits of quality audit?**
6. **What is total quality culture?**

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UNIT No. 17 LEADERSHIP

STRUCTURE

17.0 Definitions

17.0.1 Characteristics of Quality Features

17.0.2 Leadership Concepts

17.1 Role of TQM Leaders

17.2 Implementation

17.3 Quality Council

17.4 Employee Involvement

17.4.1 Introduction

17.4.2 Motivation

17.4.3 Maslow's Hierarchy of Needs

17.5 Herzberg's Two-Factor Theory

17.6 Employee Wants

17.7 Achieving a Motivated Work Force

17.8 Empowerment

17.9 Important Questions

17.0 Definitions

There is no universal definition of leadership and indeed many books have been devoted to the topic of leadership. In his book Leadership, James MacGregor Burns describes a leader as one who instills purposes, not one who control, by brute force. A leader strengthens and inspires the followers to accomplish shared goals. Leaders shape the organization's values, promote the organization's values, protect the organization's values and exemplify the organization's values. Ultimately, Burns says. "Leader, and followers raise one another to higher levels of motivation and morality ... leadership becomes moral in that it raises the level of human conduct and ethical aspiration of both the leader and the led, and thus has a transforming effect on both." Similarly, Daimler Chrysler's CEO Bob Eaton defines a leader as " ... someone who can take a group of people to a place they don't think they can go." "Leadership is we, not me; mission, not my show; vision, not division; and community, not domicile.'? As the above illustrates, leadership is difficult to define in anything other than lofty words. The Malcolm Baldrige National Quality Award has a more grounded definition of lead- ership in its core values. As stated in its core values and concepts, visionary leadership is:

"An organization's senior leaders should set directions and create a customer focus, clear and visible values, and high expectations. The directions, values, and expectations should balance the needs of all your stakeholders. Your leaders should ensure the creation of strategies, systems, and methods for achieving excellence, stimulating innovation, and building knowledge and capabilities. The values and strategies should help guide all activities and decisions of your organization. Senior leaders should inspire and motivate your entireworkforce and should encourage all employees to contribute, to develop and learn, to be innovative, and to be creative.

Senior leaders should serve as role models through their ethical behavior and their personal involvement in planning, communications, coaching, development of future leaders, review of organizational performance, and employee recognition. As role models, they can reinforce values and expectations while building leadership, commitment, and initiative throughout your organization."

Leadership can be difficult to define. However, successful quality leaders tend to certain characteristics.

17.0.1 Characteristics of Quality Leaders

There are 12 behaviors or characteristics that successful quality leaders demonstrate

1. They give priority attention to external and internal customers and their needs. Leaders place themselves in the customers' shoes and service their needs from that perspective. They continually evaluate the customers' changing requirements.

2. They empower, rather than control, subordinates. Leaders have trust and confidence in the performance of their subordinates. They provide the resources, training, and work environment to help subordinates do their jobs. However, the decision to accept responsibility lies with the individual.

3. They emphasize improvement rather than maintenance. Leaders use the phrase "If it isn't perfect, improve it" rather than "If it ain't broke, don't fix it." There is always room for improvement, even if the improvement is small. Major breakthroughs sometimes happen, but it's the little ones that keep the continuous process improvement on a positive track.

4. They emphasize prevention. "An ounce of prevention is worth a pound of cure" is certainly true. It is also true that perfection can be the enemy of creativity. We can't always wait until we have created the perfect process or product. There must be a balance between preventing problems and developing better, but not perfect, processes.

5. They encourage collaboration rather than competition. When functional areas, departments, or work groups are in competition, they may find subtle ways of working against each other or withholding information. Instead, there must be collaboration among and within units.

6. They train and coach, rather than direct and supervise. Leaders know that the development of the human resource is a necessity. As coaches, they help their subordinates learn to do a better job.

7. They learn from problems. When a problem exists, it is treated as an opportunity rather than something to be minimized or covered up. "What caused it?" and "How can we prevent it in the future?" are the questions quality leaders ask.

8. They continually try to improve communications. Leaders continually disseminate information about the TQM effort. They make it evident that TQM is not just a slogan. Communication is two way-ideas will be generated by people when leaders encourage them and act upon them. For example, on the eve of Desert Storm, General Colin Powell solicited enlisted men and women for advice on winning the war. Communication is the glue that holds a TQM organization together.

9. They continually demonstrate their commitment to quality. Leaders walk their talk-their actions, rather than their words, communicate their level of commitment. They let the quality statements be their decision-making guide.

10. They choose suppliers on the basis of quality, not price. Suppliers are encouraged to participate on project teams and become involved. Leaders know that quality begins with quality materials and the true measure is the life-cycle cost.

11. They establish organizational systems to support the quality effort. At the senior management level a quality council is provided, and at the first-line supervisor Level, work groups and project teams are organized to improve the process.

12. They encourage and recognize team effort. They encourage, provide recognition, and reward individuals and teams. Leaders know that people like to know that their contributions are appreciated and important. This action is one of the leader's most powerful tools.

17.0.2 Leadership Concepts

In order to become successful, leadership requires an intuitive understanding of human nature-the basic needs, wants, and abilities of people. To be effective, a leader understands that:

1. People, paradoxically, need security and independence at the same time.
2. People are sensitive to external rewards and punishments and yet are also strongly self-motivated.
3. People like to hear a kind word of praise. Catch people doing something right, so you can pat them on the back.
4. People can process only a few facts at a time; thus, a leader needs to keep things simple.
5. People trust their gut reaction more than statistical data.

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

Leaders need to give their employees independence and yet provide a secure working environment one that encourages and rewards successes. A working environment must be provided that fosters employee creativity and risk-taking by not penalizing mistakes.

A leader will focus on a few key values and objectives. Focusing on a few values or objectives gives the employees the ability to discern on a daily basis what is important and what is not. Employees, upon understanding the objectives, must be given personal control over the task in order to make the task their own and, thereby, something to which they can commit. A leader, by giving the employee a measure of control over an important task, will tap into the employee's inner drive. Employees, led by the manager can become excited participants in the organization.

Having a worthwhile cause such as total quality management is not always enough to get employees to participate. People, (and, in turn, employees) follow a leader, not a cause. Indeed, when people like the leader but not the vision, they will try to change the vision or reconcile their vision to the leader's vision. If the leader is liked, people will not look for another leader. This is especially evident in politics. If the leader is trusted and liked, then the employees will participate in the total quality management cause.

Therefore, it is particularly important that a leader's character and competence, which is developed by good habits and ethics, be above reproach. Effective leadership begins on the inside and moves out.

17.1 Role of TQM Leaders

Everyone is responsible for quality, especially senior management and the CEO; however, only the latter can provide the leadership system to achieve results. For instance, in the 1980's, General Electric's CEO, Jack Welch, instituted leadership training courses at all levels of the organization. The General Electric training courses taught leadership approaches and models and provided the opportunity for teams to develop solutions to real business problems. Many of the solutions the teams developed were implemented. Jack Welch supported the development

of a leadership system whereby quality control leaders were developed at all levels in all functions of the organization, including research, marketing, manufacturing, sales, finance, and human resources. Senior managers need to be provided with the skills to implement quality control techniques and actively participate in the quality council.

Senior management has numerous responsibilities. Senior management must practice the philosophy of Management by Wandering Around (MBWA). Management should get out of the office and visit customers, suppliers, departments within the organization, and plants within the organization. That way, managers learn what is happening with a particular customer, supplier, or project. MBWA can substantially reduce paperwork.

Encourage subordinates to write only important messages that need to be part of the permanent record. For example, Kinko's executives perform normal operating duties for two or three days at one location. This approach is an excellent technique for gaining firsthand information.

The idea is to let employees think for themselves. Senior management's role is no longer to make the final decision, but to make sure the team's decision is aligned with the quality statements of the organization. Push problem solving and decision making to the lowest appropriate level by delegating authority and responsibility.

Senior managers must stay informed on the topic of quality improvement by reading books and articles, attending seminars, and talking to other TQM leaders. The leader sends a strong message to subordinates when that leader asks if they have read a particular book or article.

The needed resources must be provided to train employees in the TQM tools and techniques, the technical requirements of the job, and safety. Resources in the form of the appropriate equipment to do the job must also be provided.

Senior managers must find time to celebrate the success of their organization's quality efforts by personally participating in award and recognition ceremonies. This activity is an excellent opportunity to reinforce the importance of the effort and to promote TQM. A phone call or handshake combined with a sincere "thank you for a job well done" is a powerful form of recognition and reward. One of the duties of the quality council is to establish or revise the recognition and

reward system. In particular, senior management's incentive compensation must include quality improvement performance.

Also, provisions must be made to reward teams as well as creative individuals. Senior managers must be visibly and actively engaged in the quality effort by serving on teams, coaching teams, and teaching seminars. They should lead by demonstrating, communicating, and reinforcing the quality statements. As a rule of thumb, they should spend about one-third of their time on quality.

A very important role of senior managers is listening to internal and external customers and suppliers through visits, focus groups, and surveys. This information is translated into core values and process improvement projects.

Another very important role is communication. The objective is to create awareness of the importance of TQM and provide TQM results in an ongoing manner. The TQM message must be "sold" to personnel, for if they don't buy it, TQM will never happen.

In addition to internal efforts, there must be external activities with customers and suppliers, the media, advertising in trade magazines, and interaction with the quality community.

By following the preceding suggestions, senior managers should be able to drive fear out of the organization, break down barriers, remove system roadblocks, anticipate and minimize resistance to change, and, in general, change the culture. Only with the involvement of senior management can TQM be a success.

17.2 Implementation

The TQM implementation process begins with senior management and, most important, the CEO's commitment. The importance of the senior management role cannot be overstated. Leadership is essential during every phase of the implementation process and particularly at the start. In fact, indifference and lack of involvement by senior management are frequently cited as the principal reasons for the failure of quality improvement efforts. Delegation and rhetoric are insufficient-involvement is required.

Senior management needs to be educated in the TQM concepts. In addition to formal education, managers should visit successful TQM organizations, read selected articles and books, and attend seminars and conferences. The next step is [or senior management to develop an implementation plan.

Timing of the implementation process can be very important. Is the organization ready to embark on the total quality journey? There may be some foreseeable problems, such as a reorganization, change in senior management personnel, interpersonal conflicts, a current crisis, or a time-consuming activity. These problems may postpone implementation to a more favorable time.

The next step is the formation of the quality council. Initiation or these duties is substantial part of the implementation of TQM. The development of core values, a vision statement, a mission statement, and a quality policy statement, with input from all personnel, should be completed first.

The active involvement of middle managers and first-line supervisors is essential to the success of the TQM effort. They are accountable for achieving many or the organization's performance goals and objectives, and they form enduring links in the communication chain from senior management to the front-line workers. Without middle management's early and active support, the TQM effort could fail. Senior management needs to ensure that managers at all levels have an opportunity, as soon as possible, to develop ownership in the TQM effort and a chance to acquire the insight and skills necessary to become leaders. One way to accomplish this concept is to have a retreat. The retreat will focus on TQM training, leadership skills, and active involvement in the development of the organization's statements.

If there is a union, there should he early discussions with the representatives on TQM.

Managers should involve union leaders by sharing with them implementation plans for TQM. As the quality effort progresses, managers and union leaders should work together on quality improvement activities. For example, the United Auto Workers have worked closely with the big three automakers in their TQM activities.

At this stage of the implementation process, it is important to communicate TQM to the entire organization. Communication is important throughout the implementation stage. Communication is necessary to create TQM awareness, interest, desire, and action.

Everyone needs to be trained in quality awareness and problem solving. This training is conducted when the employee is placed on a project team or the work group is ready for the training.

Customer, employee, and supplier surveys must be conducted to benchmark the attitudes of these three stakeholders. Information from these surveys provides ideas for quality improvement projects. The quality council determines the quality improvement projects.

In addition the council establishes the project teams and work groups and monitors their progress. The organization has to be patient and not rush the teams for solutions that don't eliminate the root causes. There is often a tendency to rush the implementation process. TECSTAR, a small business, was able to achieve savings of more than $3 million the first year of its TQM program, On the other hand, Kariee, a Malcolm Baldrige

National Quality Award winner, did not achieve results until the third year, but then was more than a 300% increase in the organization's bottom line.

17.3 Quality Council

In order to build quality into the culture, a quality council is established to provide overall direction. It is the driver for the TQM engine.

In a typical organization the council is composed of the chief executive officer (CEO) the senior managers of the functional areas, such as design, marketing, finance, production, and quality; and a coordinator or consultant. If there is a union, consideration should be given to having a representative on the council. Some organizations, such as Friendly Ice Cream of Wilbaham, MA, include front-line representatives from every area. A coordinator is necessary to assume some of the added duties that a quality improvement activity requires. The individual selected for the coordinator's position should be a brigs young person with executive potential. That person will report to the CEO.

The responsibility of the coordinator is to build two-way trust, propose team needs to the council, share council expectations with the team, and brief the council on team progress. In addition, the coordinator will ensure that the teams are empowered and know their responsibilities. The coordinator's activities are to assist the team leaders, share lessons learned among teams, and have regular leaders' meetings.

In smaller organizations where managers may be responsible for more than one functional area, the number of members will be smaller. Also, a consultant would most likely be employed rather than a coordinator.

In general, the duties of the quality council are to:

1. Develop, with input from all personnel, the core values, vision statement, mission statement, and quality policy statement.
2. Develop the strategic long-term plan with goals and the annual quality improvement program with objectives. Create thetotal education and training plan.
3. Determine and continually monitor the cost of poor quality.
4. Determine the performance measures for the organization, approve those for the functional areas, and monitor them.
5. Continually determine those projects that improve the processes, particularly those that affect external and internal customer satisfaction.
6. Establish multifunctional project and departmental or work group teams and monitor their progress.

## 17.4 Employee Involvement

17.4.1 Introduction

Employee involvement is one approach to improving quality and productivity. Its use is credited for contributing to the success enjoyed by the Japanese in the world marketplace. Employee involvement is not a replacement for management nor is it the final word-in quality improvement. It is a means to better meet the organization's goals for quality and productivity at all levels of an organization.

17.4.2 Motivation

Knowledge of motivation helps us to understand the utilization of employee involvement to achieve process improvement.

One of the first and most popular motivational theories was developed by Abraham Maslow. He stated that motivation could best be explained in terms of a hierarchy of needs and that there were five levels. These levels are survival, security, social, esteem, and self-actualization. They are shown in Figure 4-1. Once a given level is satisfied, it can no longer motivate a person.

Figure 4-1 **Maslow's Hierarchy of Needs**
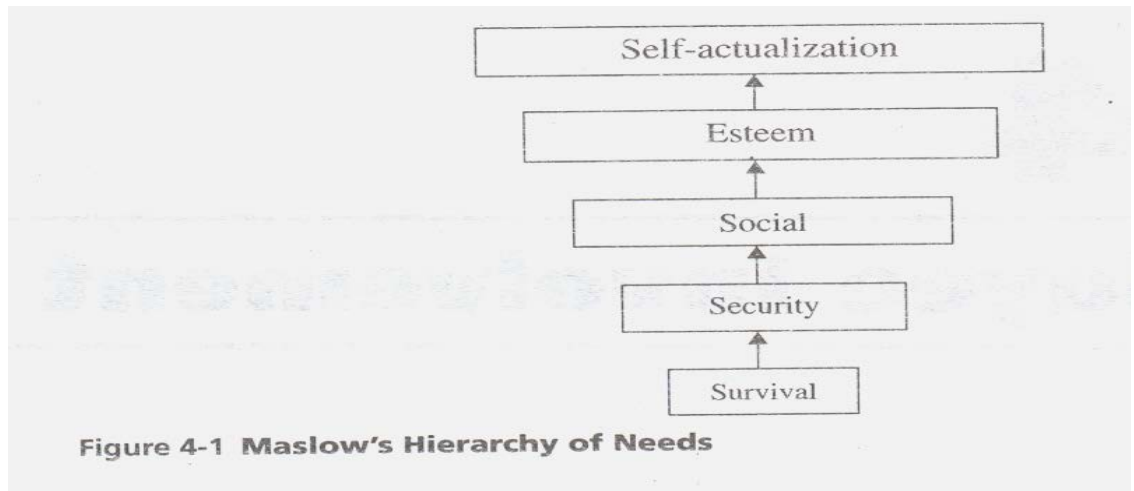
Relating these needs to motivation, we know that Level 1 (survival) means food, clothing, and shelter, which is usually provided by ajob. In the workplace, Level needs include proper lighting, heating/air conditioning, ventilation, phone system, data/voice access, and computer information system.' Level 2 (security) can mean a safe place towork and job security, which are very important to employees. When the organization demonstrates an interest in the personal well-being of employees, it is a motivating factor. A threat oflosing one's job certainly does not enhance motivation. Level 2 is not limited to job security. It also includes having privacy on the job such as being able to lock one's office door or having lockable storage for personal items, as well as having a safe work environment that may include ergonomic adjustable furniture.

Because we are social animals, Level 3 (social) relates to our need to belong. It has been said that cutting someone out of the group is devastating to that individual. Isolation is an effective punishment. Conversely, giving an individual the opportunity to be part of the group by feeling important and needed will motivate that person. If possible, employees should be provided with both formal

social areas such as a cafeteria and conference rooms and informal areas such as water coolers and bulletin boards}

Being a member of a team is a good way to bring employees into the group. Level 4 (esteem) relates to pride and self-worth. Everyone, regardless of position or job assignment, wants to be recognized as a person of value to the organization. Where possible, employees should be given offices or personal spaces with aesthetics. Businesscards, workspace size, and office protocols also provide employees with a certain level of self-esteem within an organization." Seeking advice or input into business or production processes is a good way of telling employees that they are of value. This activity requires giving employees control and freedom of their jobs by providing trust'

Level 5 (self-actualization) says that individuals must be given the opportunity to go as far as their abilities will take them. Many organizations have a policy of promotingfrom within. It is true that some employees do not want to move up the corporate ladder, which is understandable. However, those who do want to move up must know that it is possible.

It is important to note that as employees move up the hierarchy, they will immediately revert back to the previous level if they feel threatened. For example, if an employee is satisfied in Level 3, a rumor of downsizing may cause an immediate return to Level 2.

17.5 Herzberg's Two-Factor Theory

Frederick Herzberg extended the general work of Maslow by using empirical research to develop his theory on employee motivation. He found that people were motivated by recognition, responsibility, achievement, advancement, and the work itself. These factors were labeled motivators. In addition, his research showed that bad feelings were associated with low salary, minimal fringe benefits, poor working conditions, ill-defined organizational policies, and mediocre technical supervision. These job-related factors were labeled dissatisfies or hygiene factors, which implies they are preventable. It is important to realize that dissatisfies are often extrinsic in nature and motivators are intrinsic. The presence of the extrinsic conditions does not necessarily motivate employees; however, their absence results in dissatisfaction among employees. Absence of motivating factors does not make employees dissatisfied, but when

there are motivating factors present, they do provide strong levels of motivation that result in good job performance for the individual and the organization. In general, dissatisfies must be taken care of before motivators can be actuated. Herzberg's dissatisfies are roughly equivalent to Maslow's lower levels, and the motivators are similar to the upper levels."

17.6 Employee Wants

While management thinks that good pay is the number one want of the employee, survey results show that this factor is usually in the middle of the ranking. Table 4-1 shows employee wants and manager perceptions of employee wants. Employee wants tend to follow the theories of Maslow and Herzberg. It is interesting to note that the managers' perceptions are much different. By involving employees through the use of teams in meaningful work and by providing the proper reward and recognition, managers can reap the advantages of greater quality and productivity along with employee satisfaction. This chapter describes how managers can develop employee motivation and how they can involve their employees through empowerment. If managers are to effectively motivate employees, they must align their actions closer to the motivators.

TABLE 4-1
What Employees Want

Factor	Employee Rating	Manager Rating
Interesting work	1	5
Appreciation	2	8
Involvement	3	10
Job security	4	2
Good pay	5	1
Promotion/growth	6	3
Good working conditions	7	4
Loyalty to employees	8	7
Help with personal problems	9	9
Tactful discipline	10	6

Source: Study by K. Kovich, *Advanced Management Journal*, as reported in the article by Theodore B. Kinni, "Motivating the Unmotivated," *Quality Digest*, March 1993.

The building of a motivated work force is for the most part an indirect process. Managers at all levels cannot cause an employee to become motivated; they must create the environment for individuals to motivate themselves. Concepts to achieve a motivated work force are as follows:

1. Know thyself. Managers must understand their own motivations, strengths, and weaknesses. This understanding can best be obtained by having peers and employees anonymously appraise the manager's performance. Motivating managers know that the most valuable resource is people and that their success largely depends on employees achieving their goals.

2. Know your employees. Most people like to talk about themselves; therefore, themotivating manager will ask questions and listen to answers. With knowledge of the employees' interests, the manager can help achieve them within the business context. As the manager learns more about the employee, he/she can assist the employee in directing their efforts toward satisfying their goals and well-being. This knowledge will also enable the manager to utilize their strengths.

3. Establish a positive attitude. A positive action-oriented attitude permeates the work unit. Managers are responsible for generating attitudes that lead to positive actions. Feedback should, for the most part (say, 87%), be positive and constructive. Respect and sensitivity toward others is essential to the development of positive attitudes. Asking employees for their opinions concerning job-related problems is an effective way to build a cooperative atmosphere. Managers should treat ideas and suggestions as priceless treasures and implement them immediately whenever possible.

4. Share the goals. A motivated work force needs well-defined goals that address both individual and organizational needs.

5. Monitor progress. The process of goal-setting should include a road map detailing the journey with periodic milestones and individual assignments. Managers should periodically review performance.

6. Develop interesting work. Managers should consider altering the employees' assignments by means of job rotation, job enlargement, and job enrichment.

Job rotation permits employees to switch jobs within a work unit for a prescribed period of time. This activity reduces boredom and provides knowledge of the

entire process and the affect of the sub-process. Thus, quality consciousness is raised, which may lead to process improvement. Job enlargement combines tasks horizontally so that the employee performs a number of jobs sequentially. Thus, the employee is responsible for a greater portion of the product or service, which may also lead to process improvement.

Job enrichment combines tasks vertically by adding managerial elements such as planning, scheduling, and inspection. This contributes to the employees' sense of autonomy and control over their work, which may lead to process improvement.

7. Communicate effectively. Effective communication provides employees with knowledge about their work unit and the organization rather than "grapevine" information.

8. Celebrate success. Recognizing employee achievements is the most powerful tool in the manager's' toolbox.

These eight concepts can be used at all managerial levels of the organization.

17.8 Empowerment

The Manufacturers' Alliance for Productivity and Innovation stated that organizations that empower employees as part of their total management effort are twice as likely as other firms to report significant product or service improvement."

The dictionary definition of empowerment is to invest people with authority. Its purpose is to tap the enormous reservoir of potential contribution that lies within every worker. An operational definition follows:

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 customer requirements within well-defined boundaries in order to achieve organizational values and goals.

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 employee becomes the process owner-thus, the individual is not only responsible but also accountable. Job enrichment is aimed at expanding

the content of an individual's job, whereas empowerment focuses on expanding on the context of the job such as its interactions and interdependencies to other functions of the organization.

In order to create the empowered environment, three conditions are necessary.

1. Everyone must understand the need for change. People fear change. The effective communication of why the organization needs to change is critical to success. In addition, people need to understand the role they will play in the change process. Senior management must understand that people change for their own reasons, not for reasons of the organization. People who are older, well educated, highly skilled, and experienced are more likely to accept increased demands and expectations associated with empowerment. In addition, one's perceived internal control (locus of control) contributes to whether or not an employee is receptive to. An empowered environment.

2. The system needs to change to the new paradigm. The system needs to change to reinforce and motivate individual and group accomplishments. Individuals and groups must understand that freedom to act and (sometimes to fail) is not only OK but is encouraged. Other contextual factors need to be considered if empowerment is to be successful, such as the role of unions and the type of industry (service or manufacturing).

If the union environment is not willing to engage employees in an empowerment culture, success will be difficult.

3. The organization must enable its employees. Enablement means providing information, education, and skill. To ask people to change work habits without providing them with the tools for change only increases resistance to the change process. Additional factors that should be considered before determining if organization can enable its employees are strategy and technology. 16 Companies that have a business strategy and technology focus of customization are more likely to embrace empowerment compared to companies whose strategy is that of low-cost and high volume.

There is nothing mystical about empowerment. People generally want to be more in charge of their jobs and careers. After all, they do that successfully in their personal lives every day. Most people appreciate and value the trust and responsibility inherent in an environment that supports empowered people and their actions. When people have the information, education, and skills required

to perform in a changed environment, understand their boundaries of empowerment, and realize the necessity for change, their resistances to that change decreases greatly.

A 1993 ASQ/Gallup survey showed that employees feel empowered to:

Stop work in progress   83%

Intervene on customer's behalf 81 %

Make exception to procedures   61 %

Rework product or service   61 %

Replace merchandise   37%

Refund money/authorize credit   26%

17.9 Important Questions

1. Define Leadership.
2. Write a Plan to implement TQM in a community college.
3. List the 5 levels in Maslow's hierarchy of needs and describe each level.
4. Write short notes of Quality Council.
5. Define Employee Involvement.
6. Describe Herzberg's dissatisfies and motivators.

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UNIT18 REWARD SYSTEM AND EMPLOYEES PRODUCTIVITY

STRUCTURE

18.1 INTRODUCTION

World-class achievers follow world-class models. Reward and recognition are essential for appreciating the employee's work and inspiring them for continues improvement in their work. During the ruff time a ward of appreciation and encouragement in often an incentive. We need to keep trying when going on work is easy. Recognition of our efforts inspires us to even higher level of achievement. Some quality organization in India have started using consist of rewards and game sharing on the pattern of Japan.Rewarding and recognizing people more than any other management act profoundly effects employees'motivation and job satisfaction. Sometimes Managers fail to appreciate people and recognize their contribution on a day-to- day basis. Other time Managers lose sight of purpose and provide monitory rewards while forgetting to say ' Thank you.

18.2 REWARDS:-

Rewards on the other hands are a direct delivery of money and something of financial value. Reward should punctual ate appropriate achievement and serve as manifestation of ongoing recognition. The recognition is an intangible expression of worth. Rewards are concrete expression of appreciation that is meaningful to the receiver. Recognition is always powerful but reward without recognition is weak. When rewards displace recognition they are a waste of an opportunity and resources. Unfortunately too often Manager of many organizations in India expresses appreciation with a cash award without demonstrating a sincere appreciation of their employee's contribution. Typical reward given in Indian organization to employees are pay, promotion, increased bonus, benefits, company car, profit sharing and trips etc, to increase the morale of an employee in the organization for better productivity, peace and prosperity.

18.3 RECOGNITION

Recognition is an act of acknowledgment, approving and appreciating an activity or service of the employees in any organization.
The term Re-means again and cognition – means to think. Thus recognition means to think again. An affective recognition strategy causes people to think

Again about the value and unique contribution of each person that brings to the per suite of total quality. Recognition is an ongoing activity that does not focus only at award ceremonies. It is directed at an industrial self-esteem and social needs. It is an intangible acknowledgement of a person and a method of teams' accomplishment. The forms of acknowledgement most commonly used in recognition are praise, personal thank, letter, momentous and social lunch and dinner.

18.4 OBJECTIVE OF REWARD SYSTEM

Reward system needs to embody following four objective which are adopted by many International and Indian award winner:-

- Disciplined use of quality improvement and problems solving approach are recognized and rewarded.

- Teamwork and efforts to eliminate internal competition are encouraged by recognizing and rewarding successful practices.

- Clear and specific quality improvement objective are included in performance appraisal and reward system.

- Promotion criteria include the action and activities that support total quality in any organization.

18.5 PRINCIPLIES FOR EVALUATION OF REWARD SYSTEM

In order to establish the appropriate reward and recognition objective for total quality implementation plan, the following principles may be used to evaluate the existing and proposed reward system:-

- Place emphasis on success rather than failure.
- Deliver recognition in an open and published way.
- Deliver recognition in a personal and honest manner that is appropriate to the employees.
- By attention to the timing, if it is praise, provide it immediately. If it is reward, make the response quickly.
- Strive for clear and well-communicated line of sight between achievement and award.
- Above all recognize recognition. That is recognize the people who recognize other for doing what is the best in totality.

- The umbrella objective of a reward strategy is to ensure that quality tools and process are used. Work systems are changed and team behaviors are adopted in support of better environment.

18.6 STRATEGIC GUIDELINES FOR REWARD AND RECOGNITION

Without supporting recognition and reward system the transition to action and behavior that implement quality concepts will be incrementally more difficult. In our views a successful Indian organization, which have implemented, total quality in the organization have following seven strategic guidelines for its implementation:-

- Recognizing positive action and behaviors of employees. Recognizing manager for implementing total quality.
- Develop promotion criteria that reinforce equality behavior. Recognizing quality in bonus plan objective
- Have separate appraisal for salary revision Create a bonus plan for all benefits
- Introduce a gain sharing plan and share gains with employee for as long as the organization receives are turn.

In nutshell for introducing an effective reward system we need to adopt that forms – NOAH principles – • No more prizes for predicting rains.   Prizes only for building arks.

The employee's productivity is directly proportional to the reward system in any organization. To study the relationship between employee productivity and reward system in an organization we may discuss the following important strategic initiatives.

18.7 MANAGERIAL LEADERSHIP AND COMMITMENT

- The behaviors of management team at all level of the organization provide the necessary leadership; it sets the tune and acts as example for its successful implementation of quality in the organization. Any successful organizational efforts realize on the competence and support of local management.

- In any organization each individual Manager must first accept and interact with the following four supposition for managing a quality organization:- Setting team and individual performance based on customer requirements.

- Methods of reviewing objective and planning for variance have to be consistent. Employees are better able to improve the work system then the management because the problem comes from system not from the workers.

- Performance improvement is not accomplished by slogans, punishment and unrealistic goal.

18.8 SIX KEY GOALS

We have consolidated the following observation in to six key goals for laying the foundation for better productivity in any organization:-

- Manager must act as a role model and promoter.
- Employee's involvement and teamwork must be established on an integral part of productivity.
- Quality improvement must be promoted by Managers personally by using quality process.
- Management must maintain a style of openness, patience and trust worthiness.
- Quality support must be included in the method to identifying supervision and Managers.

It should be treated as a necessary ending task since it is a continues process.

18.9 SUPPORTING ORGANIZATIONAL ROLE AND STRUCTURE

To establish support organizational role and structure for better productivity management should consider following strategic initiative:-

- Developing and communicating a clear image for future state.
- Using multiple and consistent leverage point to manage the transition. Implementing organizational arrangement for the transition.

Each of these initiatives would require same level of incremental or re-directed main power, original re-structuring and re-defining of roles.

18.10 EDUCATION AND TRAINING PROGRAMME

International award winners have selected nine goals for education and training programmers for better productivity:-

- Training on basic of productivity to all employees.
- Education plan as an integral part of quality maintenance strategy.

- Education plan that facilitate the transfer of skills and knowledge to actual environment of the group.

- Tailoring the training plan to the level of function and business area of the workshop.

- Curriculum comprising principles, tools and process action for the behavior change.

- Training should be conducted in National Work Group so that they can learn and apply the appropriate skills together.

- Classroom training must be reinforced with on the job coaching and refresher courses.

18.11 EXTERNAL CONSULTANT

External Consultant can be the vital asset to management in starting up the better productivity with the total quality management and the right use of technique needed for planning and implementing the strategic for change. But a caution must be observed in selecting an appropriate consultant for the purpose of business development program.

18.12 TEN TOPS AXIOMS FOR SUCCESSFUL REWARD SYSTEM AND EMPLOYEES PRODUCTIVITY IN ORGANISATION.

1. Do the normal, sensible things first by producing, marketable products, looking after management, personnel and customers.

2. Change the criteria for selecting managers. In addition to professional know-how, they need to think more about their responsibilities than about their careers or power games.

3. Realize the importance of the lowest levels of management. They represent the organization. For that reason focus on people and products rather than on systems and procedures.

4. Remember that it's better to take the long view than to seize a short-term advantage. Proper timing is more important. Make rapid, though not always perfect, decisions. Keep three phases in mind: recognize what is needed early, then accelerate the decision-making process; and finally, implement the

decision quickly.

5.   Soberly estimate the possibilities of streaming and subsequently implementing the measures. Adapt corporate structures more rapidly to growth, activity and empowerment. Do not subsidies non-viable business. Adapt the workforce to new circumstances both regionally and professionally. Think of a reduction in costs as an opportunity to think about long-term options and to lay the groundwork for future investments.

6.   Do not overlook renovation in addition to innovation. Furthermore, innovation should be applied to management, leadership, and organization, as well as to products.

7.   Communication as a means to an end is the key. Of course, actions and facts are more convincing than mere words.

8.   Establish good labor-management relations even though an ideal peace is unlikely.

9.   Implement a new style of management and new kinds of relations with employees based on management commitment and employees involvement.

10.   And last but certainly not the least, the most important single axiom for executives is: be credible and consistent in word and deed.

Twelve condition for excellence.

These 12 conditions of excellence for total quality are as follows:-

-            Customer satisfaction
-            Stock holders value
-            Employees satisfaction
-            Public approval
-            Value ratio
-            Error free performance
-            Product/Process leadership
-            Management leadership
-            The operating plan
-            Customer orientation

- Human resources excellence

- Value/Cost ratio

18.13 FIVE ROLES OF LEADERS

The five roles of a leaders and managers for the above are as under:- Challenging the Process

Leaders are pioneers – people who seek out new opportunities and are willing to change the status quo. They recognize that failure to change creates mediocrity. They innovate, experiment and explore ways to improve the organizations. Most importantly, they realize that not all good ideas come from themselves. They realize that others •close to a problem' are probably more able to come up with a sensible solution.

Inspiring a Shared Vision

Leaders look towards and beyond the horizon. They look to the future with a dream of what might be. They envisage the future with a positive and hopeful outlook. They believe that if people work together, they can achieve the impossible. Leaders are expressive and attract followers through their genuineness and skillful communication.

Enabling Others to Act

Leaders know that they are rewarded for getting others to achieve results. They can't do it alone. They need to infuse people with enthusiasm and commitment. They have to be persuasive. Leaders develop relationships based on mutual trust and they get people to work together – towards collaborative goals. They stress participation in decision-making and problem solving. They actively involve others in planning, allowing them the discretion to make decisions even if this means making mistakes. Risk taking is encouraged. Leaders ensure that people feel strong and able to do a job.

Modeling the Way

Leaders are clear about their business values and beliefs. They have standards which are understood by all. They stand up for what they believe in and they communicate this to their people. They keep people and projects on course by behaving consistently with these values and modeling –how they expect others to act. Their words and deeds are consistent. Leaders make us believe that the impossible is within reach. They also plan and breakdown projects into achievable steps by creating opportunities for small wins. They make it easier for others to achieve goals by focusing on these steps and identifying key priorities.

Encouraging the Heart

Leaders encourage people to achieve difficult targets. They persist in their efforts by relating recognition to achievements. They visibly recognize contributions to the overall purpose and give frequent feedback. Leaders let others know that their efforts are appreciated. They communicate the success of the team and celebrate small wins.

Leaders nurture a team philosophy and go out of their way to say • thank you for a job well done. They manage to sustain efforts and encourage others to put even more efforts into what they do.

18.14 FEATURES OF GOOD LEADERS

- Search for challenging opportunities to change, grow, innovate and improve.
- Experiment, take risks and learn from the accompany in mistakes.
  Envision an uplifting and ennobling future.
- Enlist others in a common vision by appealing to their values, interests, hopes and dreams.
- Foster collaboration by promoting cooperative goals and building trust.
- Strengthen others by sharing information and power and increasing their discretion and visibility.
- Set an example for others by behaving in ways that are consistent with others stated values.
- Plant small wins that promote consistent progress and build commitment. Recognize individual contributions to the success of every project.
- Celebrate team accomplishments regularly.

18.15 CASE STUDY

The 1992's were a watershed for the Indian Banking Industry, and particularly for Nationalized banks which hitherto had a monopoly in the Industry. Following the deregulation of the financial sector, the Bank has faced increased competition from other financial institutions like Can fin Home Ltd., LIC Housing Corp. and Foreign Private Sector Banks. These specialized financial institutions were giving a tough competition for Corp. Bank resulting in an intense squeeze on profit margins and the need to make considerable efforts to retain its clientele. Under such pressure, Corp. Bank introduced new technology and new financial products and new reward system for bank managers and staff. Information and communication technologies (ICTs) enabled the bank to process much larger volumes of business and just as importantly, the new ICTs themselves facilitated the development of new, technically based products and services (such as home banking, smart cards and debit cards) which Corp. Bank started to market to its customers.

Running parallel with these technical changes was the dismantling of the paternalistic Human Resource Management System. In essence, Corp. Bank bureaucratic culture and its associated belief system for managers and staff of appropriate behavior being

rewarded by steady promotion through the ranks was swept aside.

The new culture in the past changing environment, emphasized customer service and the importance of measuring and rewarding staff according to their performance. The new performance related reward system was introduced at the board meeting held in June, 2002. Mr. N.K. Singh, Chairman and Managing Director of the Bank said that the proposed reward system would be a key strategy to ‘maintain our reputation and market share•. He outlined that in future, the salary of bank managers would be tied to their leadership skills and the quality of customer service. Accordingly, the reward system would link manager's pay to behavior traits that relate to leadership and customer service. The variable pay for both managers and staff would be based on what is accomplished because customer service is central to Corp. Bank's strategic plan, a three category rating system that involves • not meeting'customer expectations, meeting' them or for exceeding' them is the essence of the new rewardsystem.

1. Outline the merits and limitations of Corp. Bank's proposed reward system for the managers and staff.

2. Development an alternative reward system for corp. Bank's employees and explain why it is superior than the proposed reward system.

18.16 Important Questions

1 What is reward?
2 How to get reward of an employee?
3 Explain the term recognition with its merit and demerit?
4 Describe about reward policy foreign organization?
5 Write down principle for evaluation of reward system?
6 What is leadership? Also explain features of a good leader.

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Notes