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UNIT I

HISTORY AND EVOLUTION :

Connotations of Quality, Quality Dimensions – Product and Service. The concept of TQM, Evolution of TQM – Inspection, SQC, QA and TQM. Conventional quality management versus TQM. Customer supplier focus in TQM. Benefits and Costs of TQM. Historical perspectives of TQM. Quality System Awards and Guidelines – ISO, Malcolm Baldrige National Quality Award (MBNQA), European Foundation for Quality Management (EFQM).

1.1 CONNOTATIONS OF QUALITY

Q1. Define Quality. What are the Quality Connotations according to the different section of society?

Ans :

Meaning

Quality is a complex phenomenon based on perceptions by individuals with different perspectives on products and services. These perceptions have been built up through the past experience of individuals and consumption in various contexts. Consequently, quality encapsulates time and other contextual dimensions that add to the complexity of what is essentially a subjective evaluation of the quality of good and/or service by the consumer.

Definitions

There are varied definitions of quality. Few of these are:

(i) **According to British Defense Industries Quality Assurance Panel** "Quality is conformance to specifications."

(ii) **According to Philip Crosby** "Quality is conformance to requirements."

(iii) **According to Dr. Juran** "Quality is fitness for purpose."

(iv) **According to R.J. Mortiboys** "Quality is synonymous with customer needs and expectations."

(v) **According to Dr. Edward Deming** "Quality is a predictable degree of uniformity and dependability, at low cost and suited to the market."

(vi) **According to Mike Robinson** "Quality is meeting the (stated) requirements of the customer – now and in the future."

(vii) **According to Armand Feigenbaum** "Quality is the total composite product and service characteristics of marketing, engineering, manufacturing and maintenance through which the product and service in use will meet the expectations by the customer.

1.2 QUALITY DIMENSIONS PRODUCT AND SERVICE

Q2. Discuss the Quality Dimensions for Product.

Ans :

In order to develop a more complete definition of quality, there are some of the key dimensions of a quality product or service.

1. Performance

Performance is often a source of contention between customers and suppliers, particularly when deliverables are not adequately defined within specifications. The performance of a product often influences profitability or reputation of the end-user. As such, many , contracts or specifications include damages related to inadequate performance.

2. Features

This dimension may seem obvious, performance specifications rarely define the features required in a product. Thus, it is important that suppliers designing product or services from performance specifications are familiar with its intended uses, and maintain close relationships with the end-users.

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3. Reliability

Reliability may be closely related to performance. For example, 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.

4. Conformance

Conformance answers several questions like if a product development is based on a performance specification, does it perform as specified? If its development is based on design specification, does it possess all of the features defined?

5. Durability

Durability is closely related to warranty. Requirements for product durability are often included within procurement contracts and specifications. For example, fighter aircraft procured to operate from aircraft carriers include design criteria intended to improve their durability in the demanding naval environment.

6. Serviceability

As end users become more focused on Total Cost of Ownership than simple procurement costs, serviceability (as well as reliability) is becoming an increasingly important dimension of quality and criteria for product selection.

7. Aesthetics

The way a product looks is important to end-users. The aesthetic properties of a product contribute to a company's or brand's identity. 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.

8. Perception

Perception is reality. The product or service may possess adequate or even superior dimensions of quality, but still fall victim to negative customer or public perceptions.

As an example, a high quality product may get the reputation for being low quality based on poor service by installation or field technicians. If the product is not installed or maintained properly and fails as a result, the failure is often associated with the product's quality rather than the quality of the service it receives.

Q3. Discuss the Quality Dimensions for Services.

Ans : **(Imp.)**

Five key dimensions of service quality contribute to customer perceptions:

- **Reliability**

  The ability to provide what was promised, dependably and accurately. Ex: providing error free invoices, making repairs correctly first time.

- **Assurance**

  The knowledge and courtesy of employees, and their ability to convey trust and confidence. Ex: ability to answer questions, having capability to do the necessary work, avoiding possible fraud with the system of operations.

- **Tangibles**

  The physical facilities of the equipment, and the appearance of personnel. Attractive front office, well dressed employees, well designed forms etc.

- **Empathy**

  The degree of caring and individual attention provided by the customers. Ex: willingness to schedule deliveries at the customer's convenience, explaining technical jargon in a layman's language.

- **Responsiveness**

  The willingness to help customers and provide prompt service. Ex: acting quickly to resolve problems, promptly crediting returned materials.

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1.3 THE CONCEPT OF TQM

Q4. Define TQM. Explain the basic concepts of TQM.

Ans :

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

Basic Concepts

TQM requires six basic concepts.

1. A committed and Involved Management

TQM is a continual long term activity that must be imbibed in the culture of the organization. Everything begins with the long-term-top-to-bottom organization support. Management must participate in the quality program, establish a council to develop clear vision, set goals and direct the programs.

2. An unwavering Focus on the Customer

Customers are the very purpose of any organization. Key to an effective TQM is orienting all activities towards the need of the customer, both internally and externally.

3. Effective Involvement and Achievement of the Entire Work Force

Implementing TQM is everyone's responsibility. Employees are the future of any organization. All personnel must be trained in TQM, its tools. They must be empowered to perform processes in an optimal manner.

4. Continuous improvement of the Business and Production Processes

All employees must continually strive to improve all business and production systems.

5. Treating Suppliers as Partners

40 to 60 % of the product cost is outsourced. So all supplier organizations have to be treated as extension of one's organisations.

6. Establish Performance Measures

Measure and prosper. Measures should be available to note downtimes, nonconformities and satisfaction of customers, absenteeism etc.

Q5. Explain the features of TQM.

Ans :

Features

1. Customer Focus

TQM Palaces emphasis in meeting the requirement of both the internal as well as the external customer. In order to meet the requirements for the external customer, it is necessary to meet the needs of the internal customer. The initial focus should be on meeting needs of internal customer before an attempt is made to meet the requirements of the external customers.

2. Continuous Process

TQM is a continuous process. Constant and continuous efforts are made to improve the quality, and to reduce internal costs. Quality improvement helps the organization to face the challenges of the competitors and to meet the requirements of the customers. TQM is a process which goes on forever, because at no time the quality can be 100% right. There is always a possibility for new and better way of doing things.

3. Defect-free Approach

TQM place emphasis on the defect-free work most of the time. The defect free approach is phrased in various ways as right first time, working smarter or zero defects.

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4. Employees Involvement

In TQM everyone is involved in the process from the management director to the junior clerk or worker in the organization. It is not just manufacturing people, but also the accounting, finance, marketing, and even the canteen people are involved in the TQM process.

5. Recognition and Rewards

Recognition and rewards is an integral part of company's TQM Programme. Positive reinforcement through recognition and reward is essential to maintain achievement and continuous improvement in quality.

6. Synergy in Team Work

The Japanese are great believers in synergy (to work together). Engineers, technicians, and workers look upon themselves as equals and communicate easily as they work side by side. They create what professor Okuda has called a 'synergetic Partnership'.

7. Techniques:

TQM can take place by following various techniques such as quality circle, value engineering, statistical process control, etc. Through such techniques it is possible to improve systems and procedures.

8. System Approach

TQM is a system approach to managing the business and improving the performance. Without the total commitment on the part of chief executive officer and his senior executives.

1.4 Evolution of TQM – Inspection, SQC, QA and TQM

Q6. Explain the evolution of TQM.

(OR)

Bring out the historical perspective of TQM.

(OR)

Evaluate the historical perspective of TQM.

Ans : **(Aug.-21, June-18, Imp.)**

The concepts and ideas of TQM were formalized based on the foundations of the work done over the last few centuries. This entry outlines the evolution of TQM, from inspection through to the present-day concepts of total quality.

Quality management started with a simple inspection-based system, where a product was compared with a product standard by a team of inspectors. The first revolutionary change in the form of a system of quality control accompanied World War II. At that time, quality was achieved through control systems, which included product testing and documentation.

In the quality assurance stage, there was a shift in focus from product quality to systems quality. Quality manuals, quality planning and advanced document control were typical of this stage. Quality assurance was, however, a preventive measure.

The fourth stage of development brought about total quality management. A clear and unambiguous vision, few interdepartmental barriers, staff training, excellent customer relations, emphasis on continuous improvement and quality of the company as a whole were seen as being typical of a TQM environment.

The Four Stages of TQM

The following four stages can be identified in the evolution of TQM are

1. Inspection-based
2. System of quality control
3. Quality assurance
4. Total quality management

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1. Inspection-Based

The quality movement traces its root back to medieval Europe, when craftsmen began organizing themselves into unions called guilds in the late thirteenth century.

Until the early nineteenth century, manufacturing in the industrialized world tended to follow this model. The factory system, with its emphasis on product inspection, began in Great Britain in the mid-1750s and grew into the Industrial Revolution in the early 1800s. In the early twentieth century, manufacturers began to include quality processes in quality practices.

During the early days of manufacturing, an operative's work was inspected and a decision whether to accept or reject it was made. As businesses expanded, so too did this role, and full-time inspection job s were created. This brought about the following other problems:

- Technical problems requiring specialized skills, often not possessed by production workers, occurred.
- Some of the inspectors lacked training.
- Inspectors were ordered to accept defective goods to increase output.
- Skilled workers were promoted to other roles, leaving less skilled workers to perform operational jobs, such as manufacturing.
- These changes led to the birth of a separate inspection department with a "chief inspector," reporting to either the person in charge of manufacturing or the works manager.
- With the creation of this new department there came newer services such as standards, training, recording of data and the accuracy of measuring equipment. It became clear that the responsibilities of the "chief inspector" included more than just product acceptance, and a need to address defect prevention emerged.

2. System of Quality Control

The quality control department evolved with an intention to undertake actions and measures to control quality in a desired manner. The "quality control manager" heading this department was responsible for inspection services and quality control engineering.

In the 1920s, statistical theory began to be applied effectively to quality control and in 1924, Shewart made the first sketch of a modern control chart. His work was later developed by Deming. The early works of Shewart, Deming, Dodge and Romig constitutes much of what comprises the theory of statistical process control (SPC), today. However, there was little use of these techniques in manufacturing companies until the late 1940s.

At that time, Japan's industrial system had been virtually destroyed and it had gained a reputation as a producer of cheap, imitation products and an illiterate workforce. The Japanese recognized these problems and set about solving them with the help of some notable quality gurus — Juran, Deming and Feigenbaum.

In the early 1950s, quality management practices developed rapidly in Japanese plants and become a major theme in Japanese management philosophy. By 1960s, quality control and management had become a national preoccupation. Quality control, however, is not an independent act; rather, it works in accordance with the guidelines set by quality assurance. The whole idea is to see whether planned quality is actually being achieved. Thus, quality assurance is more comprehensive and quality control is a part of it.

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By the late 1960s and early 1970s, Japan's imports into the US and Europe increased significantly due to its cheaper through better quality products compared to its Western counterparts.

In a Department of Trade and Industry publication of 1982, it was stated that Britain's world trade share was declining and this was having a dramatic effect on the standard of living in the country. There was intense global competition and any country's economic performance and reputation for quality was made up of the reputation and performances of its individual companies and products/ services.

The British Standard (BS) 5750 for quality systems had been published in 1979. In 1983, the National Quality Campaign was launched using the BS 5750 as its main theme. The aim was to bring to the attention of industry the importance of quality for competitiveness and survival in the world market.

3. Quality Assurance

The International Organization for Standardization (ISO) 9000 has become the internationally recognized standard for quality management systems. It comprises a number of standards that specify the requirements for the documentation, implementation and maintenance of a quality system.

These standards were published for the first time in 1987. The aim was to effectively document the requirements of the quality management system, which had to be implemented to attain customer satisfaction. These standards were revised for the first time in 1994. Based on actual experiences of several thousand companies, these standards were revised again leading to an improved version being published in 2000. These standards were developed to assure quality.

4. Total Quality Management (TQM)

The birth of total quality in the United States came as a direct response to the quality revolution in Japan following World War II. The Japanese welcomed the inputs of Americans, Joseph M. Juran and W. Edwards Deming, and rather than concentrate on inspection, focused on improving all organizational processes through the people who used them.

In 1969, the first international conference on quality control sponsored by Japan, America and Europe was held in Tokyo. Feigbenbaum presented the paper, which used the term "total quality" for the first time, and referred as wider issues such as planning, organization and management responsibility.

Ishikawa presented a paper explaining how "total quality control" in Japan was different in the sense that it implied "company-wide quality control", and he described how all the employees, from the top management to the workers were required to study and participate in quality control for the process to be effective. By the 1970s, the US industrial sectors of automobiles and electronics had been broadsided by Japan's high-quality competition. The US response, emphasizing not only statistics but approaches that embraced the entire organization, became known as total quality management (TQM). TQM is now part of a much wider concept that addresses overall organizational performance and recognizes the importance of processes.

1.5 Conventional Quality Management Versus TQM

Q7. Explain the essentials elements of Conventional Quality Management.

Ans : **(July-18)**

Conventional quality management's mission and objective is to maximize the profits and returns on investment of an organization. It basically focuses on management's requirement.

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Elements of Conventional Quality Management

Following are the elements of conventional quality management,

1. Quality Planning

Setting quality objectives, identifying customers, identifying the needs and wants of the customers, developing product attributes and process attributes and setting process controls are the activities involved in 'quality planning'.

2. Quality Assurance

According to the American society for quality "Quality Assurance contains all those planned and systematic actions required to provide adequate confidence that a product or service will satisfy given requirements for quality".

Quality Assurance is an activity, which provides a proof for developing confidence that the quality related activities are effectively performed. It is also defined as, "the combination of all the organized activities, which are needed for providing adequate confidence through a product or service, for fulfilling the requirement of quality". Quality Assurance deals with quality planning, quality control, quality improvement, quality audit and reliability.

3. Quality Control

The various activities involved in the 'quality control' process are, selecting control subjects, selecting units to be controlled, establishing the goals, developing a sensor, comparing the actual performance against the standard performance, identifying the deviation between the actual and standard performance and taking corrective measures to overcome the deviation.

Q8. Distinguish between Conventional Quality Management and TQM.

Ans : **(Dec.-20)**

S.No.	Area	Traditional Quality Management	Total Quality Management
1.	Mission and objectives	Its mission and objective is to maximise the profits and return on investment of an organization.	TQM primarily aims at achieving customer satisfaction by providing best quality products and services.
2.	Focus	It basically emphasizes upon management's requirement.	TQM emphasizes upon customer satisfaction and quality.
3.	Structure of organization	Traditional structure has been vertical in nature i.e., top down management.	TQM emphasises on building up a network organization across departments and functions.
4.	Management perspective of quality	The traditional quality management approach is not much interested in developing and making use of quality control tools and techniques. It basically makes the quality department to be held responsible for the quality issues.	TQM has regarded quality management as the significant and integral part of the organizational system.

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5.	Attributes for success	The traditional quality management considered, sales growth, increased profits and quick ROIs as the important keys for the organisational success.	A TQM organization usually considers customer satisfaction and production of good quality goods and services as the key attributes for the organization's success.
6.	Status of quality	In traditional approach quality is being regarded as only a part of manufacturing department and not an important function of the whole organization.	TQM considers quality to be integral part of every department and process of the organization.
7.	Quality Dimensions	Quality is regarded in terms of single dimension and that it complies with certain specifications.	Quality is regarded in terms of multi-dimension wherein these dimensions focus upon the end users (customers).
8.	Quality Productivity relationship	It does not identify the contributions of any relationship of quality in enhancing the productivity of the product.	It identifies the existence of a direct relationship between a product's, quality and its productivity.
9.	Methods of improvement	Traditional, quality management basically improves the inspection and guaging process.	TQM methods of improvement include the process control improving the employee training, modifying the corporate culture.
10.	Employee role	It basically focuses upon the monotonous work pattern with very little opportunity for employees to take part in any activity.	It basically focuses upon the employee's motivation and provides a good opportunity to the employees to look out for new and challenging roles to play.

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Q9. Discuss the recent dimensions in quality management in Indian business organizations.

Ans : **(July-17)**

In the recent times, it is observed that many businesses are focussing on the three dimensions of quality management. They are,

1. People
2. Technique and
3. System.

Customers, shareholders and employees are the three main components of any organization and quality makes a significant impact on each of them. Effective customer service may improve customer loyalty, which also increases the revenue of an organization. Internal operations that are more efficient can lower quality cost and boost business performance. Lastly, a better quality culture where people are engaged result in higher job satisfaction and thus more motivated staff.

An organization can achieve total quality successfully in operational performance and customer service through systematic integration of all three dimensions of quality management i.e., people, technique and system. For progress, the company needs to have better understanding of the basic principles of quality management and it should also appreciate implementation approaches for practical success.

1.6 CUSTOMER SUPPLIER FOCUS IN TQM

Q10. Explain the Customer supplier focus in TQM.

Ans : **(Aug.-21)**

One basic concept of TQM is unwavering customer orientation or focus on customers, both internal and external.

In an ideal organisation, every employee would have direct contact with customers and be effective in meeting their needs. But, in reality, it is not so and most employees are shielded from customers by various layers existing in the organisation.

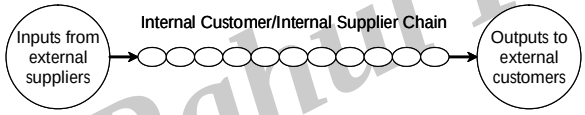

Fig.: Customer / Supplier Chain

For successful internal customer/supplier relationship, three basic questions to be asked to internal customers are :

- What do you need from me ?
- What do you do with my output ?
- Are there any gaps between what you need and what you get ?

Each department must determine what activities are important to both external and internal customers and manage quality at each and every step of the customer/supplier chain. Both requirements of external customers and what each internal customer expects must be documented.

Customer Orientation or Focus on Customers

Being customer oriented implies that an organisation is clear about who its customers are at every level and stage of the process and armed with this information, strives to provide more value to them. The process of adding value involves tasks performed by every member of the organisation. Being customer oriented does not mean being oriented towards the end-users alone. It includes focussing on the needs of the internal customers also in the value-adding chain. Conflicts frequently arise between the need of internal and external customers. In many cases, processes are designed to meet the needs of internal customers.

For example, in a hospital, the registration process is designed to meet the needs of the admitting departments, business office or medical records rather than to meet the needs of external customers that is, the patient.

Key benefits of customers / Suppliers

- Increased revenue and market share obtained through flexible and fast responses to market opportunities.
- Increased effectiveness in the use of the organization's resources to enhance customer satisfaction.
- Improved customer loyalty leading to repeat business.

Applying the principle of customer focus typically leads to

- Researching and understanding customer needs and expectations.
- Ensuring that the objectives of the organization are linked to customer needs and expectations.
- Communicating customer needs and expectations throughout the organization.
- Measuring customer satisfaction and acting on the results.
- Systematically managing customer relationships.
- Ensuring a balanced approach between satisfying customers and other interested parties (such as owners, employees, suppliers, financiers, local communities and society as a whole).

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1.7 Benefits and Costs of TQM

Q11. Bring out cost and benefits of TQM.

Ans : **(Nov.-20, Imp.)**

Benefits

1. Emphasizing the Needs of the Market

TQM helps in highlighting the needs of the market. Its application is universal and helps the organisation to identify and meet the needs the market in a better way.

2. Assures Better Quality Performance in every Sphere of Activity

Adverse and non-participative attitudes of the employees are the biggest obstacles in the organization's success, growth and advancement. TQM stresses on bringing attitudinal changes and improvements in the performance of employees by promoting proper work culture and effective team work. It provides excellent opportunities for self development and increasing employee's interest in the job.

3. Helps in checking non-productive activities and Waste

Every organisation aims at improving productivity as well as reduction in cost so as to result in increase in profitability. Under TQM, quality improvement teams are constituted to reduce waste and inefficiency of every king by introducing systematic approach. Such efforts are helpful in achieving cost-effectiveness and safety in the organisation.

4. Helpful in Meeting the Competition

TQM techniques are greatly helpful in understanding the competition and also developing an effective combating strategy. Due to the cut throat competition, the very survival of many organisations has become very vital issue. TQM helps in understanding the customers as well as the market. It provides an opportunity to the organisation to meet the competition by resorting to the techniques of TQM.

5. It helps in Developing an Adequate System of Communication

Faulty and inadequate communication and improper procedures act as stumbling blocks in the way of proper development of an organisation. It results in misunderstanding, low- productivity, poor quality, duplication of efforts and low morale. TQM techniques bind together members of various related sections, departments and levels of management for effective communication and interaction.

6. Continuous Review of Progress

TQM helps to review the process needed to develop the strategy of never ending improvement. Quality improvement efforts have to be undertaken continuously to meet the dynamic challenges. From the above, it can be concluded that TQM results in both tangible and intangible gains.

Tangible gains are in the form of better product quality, improvements in productivity, increased market share and profitability etc. Whereas intangible gains are, effective team work, enhancement of job interest, improvements in human relations, participative culture, customer satisfaction, improved communication and building better image of the company.

Costs

The reason quality has gained such prominence is that organizations have gained an understanding of the high cost of poor quality. Quality affects all aspects of the organization and has dramatic cost implications. The most obvious consequence occurs when poor quality creates dissatisfied customers and eventually leads to loss of business. However, quality has many other costs, which can be divided into two categories. The first category consists of costs necessary for achieving high quality, which are called quality control costs.

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1. **Prevention costs** are all costs incurred in the process of preventing poor quality from occurring. They include quality planning costs, such as the costs of developing and implementing a quality plan. Also included are the costs of product and process design, from collecting customer information to designing processes that achieve conformance to specifications. Employee training in quality measurement is included as part of this cost, as well as the costs of maintaining records of information and data related to quality.
2. **Appraisal costs** are incurred in the process of uncovering defects. They include the cost of quality inspections, product testing, and performing audits to make sure that quality standards are being met. Also included in this category are the costs of worker time spent measuring quality and the cost of equipment used for quality appraisal.
3. **Internal failure** costs are associated with discovering poor product quality before the product reaches the customer site. One type of internal failure cost is rework, which is the cost of correcting the defective item. Sometimes the item is so defective that it cannot be corrected and must be thrown away. This is called scrap, and its costs include all the material, labor, and machine cost spent in producing the defective product. Other types of internal failure costs include the cost of machine downtime due to failures in the process and the costs of discounting defective items for salvage value.
4. **External failure costs** are associated with quality problems that occur at the customer site. These costs can be particularly damaging because customer faith and loyalty can be difficult to regain. They include everything from customer complaints, product returns, and repairs, to warranty claims, recalls, and even litigation costs resulting from product liability issues. A final component of this cost is lost sales and lost customers.

1.8 QUALITY SYSTEM AWARDS

Q12. Briefly explain the different quality awards for TQM.

Ans : **(June-19)**

Many countries have started giving awards to the companies in order to promote quality awareness and recognize the business excellence. JUSE (Japanese Union of Scientists and Engineers) have established the "Denting Award" for organizations with outstanding TQM. In India, "The CII EXIM Bank Award for Business Excellence", is given for the organizational excellence.

Some of the quality system awards are discussed below,

1. CII-EXIM Bank Award for Business Excellence - (India)

This is the most acclaimed and honourable award. An Indian company can receive this award for its organizational excellence. It was jointly established by the Confederation of Indian Industries (CII) and the Export Import Bank (EXIM) of India in the year 1994 with the technical aid provided by the European Foundation for Quality Management.

2. Rajiv Gandhi National Quality Award

In the year 1991, the Bureau of Indian standards initiated Rajiv Gandhi National Quality Awards. The purpose of this award is to encourage manufacturing and service organizations in India to make efforts in quality excellence and also to recognize those who are considered as leaders of quality movement in India. This award was named after the Ex-prime minister Rajiv Gandhi, who encouraged the quality movement in India during the 1990s.

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1.8.1 Malcolm Baldrige National Quality Award (MBNQA)

Q13. What is Malcolm Baldrige National Quality Award (MBNQA)?

Ans : **(Dec.-20, Imp.)**

The Malcolm Baldrige Award was established in 1987 and became Public Law 100-107. It was named after the late Secretary of Commerce Malcolm Baldrige, who was an advocate of quality. The American Society for Quality administers the award, ASQ is under contract to the National Institute of Standards and Technology (NIST), which is responsible for the continuation and management of the award.

The Malcolm Baldrige National Quality Award Recognises U.S. Organisations in :

- Manufacturing
- Service company
- Small business
- Education
- Healthcare
- Non-profit organisations (NGO)

The Baldrige Award is the only formal recognition of the performance excellence of both public and private U.S. organisations given by the President of the United States. It is administered by the Baldrige Performance Excellence Program, which is based at and managed by the National Institute of Standards and Technology, an agency of the U.S. Department of Commerce. Up to 18 awards may be given annually across six eligibility categories manufacturing, service, small business, education, healthcare, and non-profit. AS of 2010, 91 organisations had received the award.

Q14. Explain the MBNQA and its requirements.

(OR)

Explain the framework of MBNQA.

Ans : **(June-19, Imp.)**

The Baldrige Award has seven categories. Each category is assigned a maximum point value as follows :

1. Leadership

i) Senior Executive Leadership

Evaluates the senior leadership and personal involvement in setting direction, developing and maintaining a performance oriented leadership system.

ii) Leadership System and Organisation

Assesses how the organisation's customer focus and performance expectations are reflected in the leadership system as well as the ensuing management and organisation.

iii) Public Responsibility and Corporate Citizenship

Evaluates how the company addresses its responsibilities to the public in its performance management practices.

2. Information and Analysis

i) Management of Information and Data

Evaluates the company's determination and management of information and data that are subsequently used for strategic planning, management, and overall performance.

ii) Competitive Comparisons and Benchmarking

Evaluates the company's processes and usage of comparison data to improve the overall performance and competitive position.

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iii) Analysis and Use of Company Level Data

Assesses how quality, customer, operational performance, and relevant financial data are analysed and used to support company level reviews, actions, and planning.

3. Strategic Planning

i) Strategic Development

Evaluates the short-term and long-term strategic planning process for competitive leadership and overall operational performance excellence.

ii) Strategic Deployment

Assesses the development and deployment of the key business drivers.

4. Human Resource Development and Management

i) Human Resource Planning and Evaluation

Assesses the human resource planning and evaluation as well as its alignment and integration into the strategic plan. The development and overall well-being of the workforce are also analysed in this section.

ii) High Performance Work Systems

Evaluates how the company's job design and recognition programs motivate the employees to high performance.

iii) Employee Education, Training, and Development

Evaluates how the education and training fit in with the company's plans, inclusive of growth of company capabilities and motivation.

iv) Employee Well-Being and Satisfaction

Evaluates bow the company maintains a conducive work environment and sustains the well-being and development of employees.

5. Process Management

i) Design and Introduction of Quality Products and Services

Evaluates how new and improved products and services are introduced and how the processes (from manufacture to delivery) are designed to accommodate key product and service quality requirements.

ii) Process Management - Product and Service Production and Delivery

Assesses the management of production and delivery processes to ensure quality and operational performance.

iii) Process Management - Support Services

Assesses key support services and the management approach to ensure quality and continuous improvement.

iv) Management of Supplier Performance

Evaluates how the company's materials, components, and other supplier-furnished services meet the company's quality requirements.

6. Business Results

i) Product and Service Quality Results

Evaluates the performance results of products and services using key performance measures and indicators.

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ii) Company Operational and Financial Results

Evaluates the operational performance, financial performance, and improvement efforts using key measures and indicators.

iii) Human Resource Results

Assesses human resource results inclusive of the development and well being of employees.

iv) Supplier Performance Results

Evaluates the results of supplier performance and process improvement initiatives using key measures and indicators.

7. Customer Focus and Satisfaction

i) Customer Market and Knowledge

Assesses how the company establishes short-term and long-term customer requirements and develops strategies to understand and anticipate customer needs.

ii) Customer Relationship Management

Evaluates management responses and follow-ups with customers in an effort to establish and build relationships, increase knowledge about their customers, improve customer performance, and generate new and improved ideas for products and services.

iii) Customer Satisfaction Determination

Assesses how the company determines customer satisfaction and how their customer satisfaction compares to competitors.

iv) Customer Satisfaction Results

Assesses how the company measures customer satisfaction using key performance measures and indicators.

Q15. Discuss the features of MBNQA.

Ans :

Fallowing are the important features of Malcolm Baldrige Award :

1. Facilitates Communication

MBNQA facilitates communication and sharing of best practices among U.S. organisations and serves as a working tool for understanding and managing performance, planning, training and assessment.

2. Promotes Quality

Malcolm Baldrige National Quality Award (MBNQA) was created to promote quality awareness identify the requirements for quality excellence, and share information about successful quality strategies and benefits.

3. Unique and Effective Scoring Component

The MBNQA criteria have an emerged as the single, most comprehensive model for the total quality management that is available. It has a unique and effective scoring component that enables a company or organisation to measure its current level of quality achievement, and to them evaluate its progress over time. No other quality management model has the vital features.

4. Categories

In MBNQA Categories are divided in Leadership, Strategic Planning, Customer and Market Focus, Information and Analysis, Human Resource Focus, Process Management and Business Results.

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5. Holistic Set of Measurement

The Baldrige criteria for the measuring performance excellence represent a comprehensive an holistic set of measure that can be used to examine individual school and school system reform efforts from a quality perspective regardless of difference in reform structure from one initiative to another.

6. Administrated and Conducted by Leading Business Experts

While the MBNQA criteria are administrated by the Department of commerce, it was designed by leading business experts, and has been enhanced since its introduction through annual. Critical review conducted by leading business practitioners, academicians and consultant. A study conducted by the United State general Accounting Office conclusively demonstrated that the application of the Malcolm Baldrige Award criteria has resulted in improved productivity, competitiveness and profitability.

1.8.2 European Foundation for Quality Management (EFQM)

Q16. Explain the European Foundation for Quality Management (EFQM).

(OR)

Explain the role of European Foundation for Quality Management (EFQM).

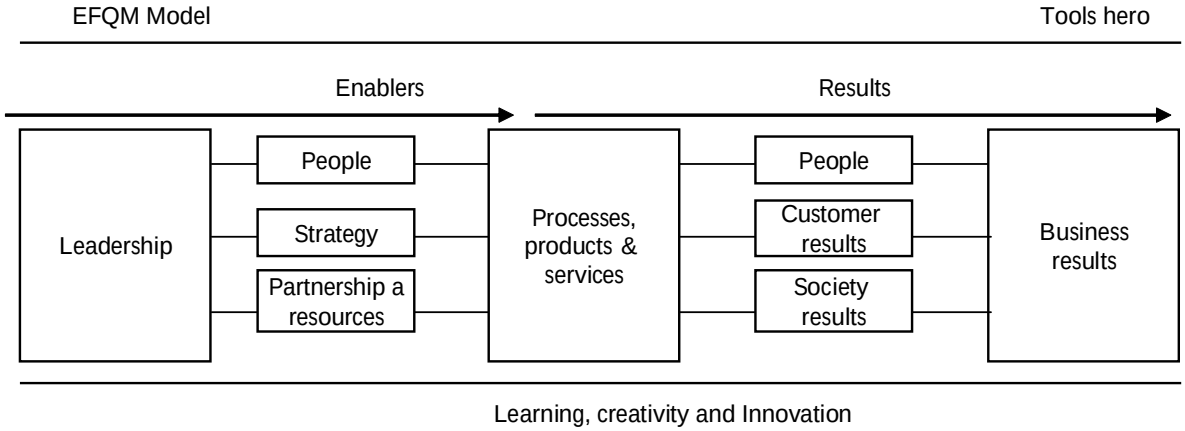
Ans : **(Dec.-20, June-18, Imp.)**

EFQM is an acronym that stands for: European Foundation for Quality Management. EFQM was founded in 1988 with the objective to create a platform where organizations can learn from each other to continuously improve their performance for the long term.

Benchmarking with other European organizations will lead to sustainable economic growth.

EFQM wants to create a culture, support managers and directors in training, sharing ideas and innovating with the aid of the so-called EFQM model as a common framework.

EFQM Model or EFQM business excellence model is the most popular quality management tool in Europe, used by more than 30.000 organisations to improve performance, create sustainable results and driving performance. It supports you to self-assess and reflect. 84% of our members say that the EFQM model helps to improve their organisation.



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1. Leadership (10%)

This criteria evaluates the role of an organizational manager or leader towards the achievement of organizational excellence. It provides answers to the questions like - How do the managers create and sustain a learning culture? How do they build relationships with customers and suppliers? How do they support and recognize the employees? Who contribute towards quality improvements?, etc. It also examines the involvement of managers in total quality development programs and polices.

2. Policies and Strategies (8%)

This criteria evaluates the organizational plans and policies, values, vision and strategies that aims towards quality improvement. It also analyses the way in which the plans are communicated and aligned with the organizational goals.

3. People Management (9%)

The EQA evaluators examine the way in which the organization develops and utilizes its human resources (people). The areas like recruitment, training, career development, empowerment of employees and effective communication are analysed by the evaluators.

4. Resources (9%)

Under this criteria, the evaluators examine the way in which the organization uses its resources according to its strategy and policy. They also examine the way in which the organization makes use of its finances, material, resources, information and technology for attaining organizational excellence.

5. Processes (14%)

Effective management of organizational processes is necessary for achieving excellence in quality. The evaluators analyse the way in which the organization identifies its key processes, measures, manages and takes steps towards process improvements.

6. People Satisfaction (9%)

This criteria measures the results of the organization with regard to its people/ employee satisfaction. The evaluators conduct interviews with the employees to judge their satisfaction levels and to get their opinions and views about the organization.

7. Customer Satisfaction (20%)

Customer satisfaction is a very important evaluation criteria, which examines the way in which the organisation attains its objectives with regard to customer satisfaction. They examine the way in which the customers perceive the organization, its products, image, services, etc.

8. Impact on Society (6%)

The evaluators carefully examine the organizational impact on the society. They examine policies which aimed at improving quality of life, conserving natural resources, reduces global warming, and being environmental friendly.

9. Business Results (15%)

'Results' is an important evaluation criteria which analyses the organization's success in achieving its business goals (profitability) and the extent to which it succeeds in satisfying all the stakeholders who have interest in the success of the organization. The evaluators closely examine the business performance of the organization. Only an organization which can achieve its business results can aim towards quality excellence.

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1.9 Quality System Guidelines – ISO

Q17. Define Quality management System (QMS). Explain the various steps involved in Quality management System.

Ans :

The Quality System Regulations (QSR) defined the Quality Management System (QMS) as follows,

"The organizational structure, responsibilities, processes, procedures and resources for implementing quality management".

"The organizational structure, processes, procedure and resources needed to implement quality management ISO 8402.

Steps

QMS includes various necessary stir: as

1. Top Management Commitment

The top managements participation in obtaining the ISO standards, which would to receive the certification because they are assigned with specific responsibilities in the standard. The Chief Executive. Officer (CEO) should willingly support the process for the success of the project.

2. Appoint the Management Representative

The next step is to appoint a management representative for the project. The responsibilities of the representative would be to coordinate the implementation and maintenance of the quality system and assures that the quality system is being effectively implemented, documented and maintained. All the members or parties involved in the process internally and externally must contact the representative and the representative must be readily available to meet them.

3. Awareness

The complete organization must be involved in the quality system as the process would influence everyone and can need their suggestions, therefore everyone must be made aware of the program. It is necessary for them to understand the quality system because they should know how the system can affect their routine operations and how it can be advantageous. The awareness can be created by providing short training sessions.

4. Appoint an Implementation Team

Once all are aware of the system, a team should be formed by including members from all levels/area of the organization. This team would be made responsible for implementation of the system and must ascertain the QMS processes. They should keep the project transparent to the whole organization i.e., their workings must be made visible to the organization.

5. Training

Training should be provided to the implementation team, supervisors and internal audit team. They can be given training by the team leaders or trainers can train all the team members through a one or two day seminar

6. Time Schedule

It takes time for the implementation and registration of the system. The size and type of the organization and the degree of its existing quality system would decide upon the time schedule of the process, mostly it takes less than 1.5 years of time.

7. Select Element Owners

For each element of the system, the team selects the owners, they can be assigned for more than one element. Owners can select a team to help in the process. Most of these owners are the members of the team.

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8. Review the Present System

The present quality system must be reviewed. It can be reviewed by getting all the copies of documents presently in use such as all the quality manuals, procedures, work instructions forms and sorting them into the system elements in order to ascertain the requirements. This process is known as gap analysis and is performed by the owners and their teams.

9. Write the Documents

A combined document of quality policy and procedure manuals must be prepared in writing. Relevant work instructions to maintain the quality must be mentioned.

10. Install the New System

Installation of policies, procedures and work instructions in the routine of organization and document the activities. All elements can be followed either simultaneously or separately.

11. Internal Audit

Auditing is required to assure that the system is functioning effectively and it help the management to obtain information for the detailed management review. The trained people of cross-section must be assigned the task of auditing,

12. Management Review

Management review should be conducted in order to ascertain the effectiveness of the system in accomplishing the specified mentioned goals of the quality system. The system can be revised as per the requirement.

13. Preassessment

This step is optional in nature and required if the performance is not effective in the previous steps, if in case it is effective than preassessment is not required.

14. Registration

The registration process includes three activities,

(a) Choosing a registrar involves cost, lead time, customer's acceptance of the registrar, official authorization given by registrar and familiarity with the industry.

(b) Submitting an application for registration requires to provide the policy and procedure manuals for the review by the registrar.

(c) Conducting the registrar's system audit, time taken for conducting this audit varies depending on the size and type of the organization and the quantity of auditors involved. The registrar's audit takes one to three days of time.

Q18. Define ISO. State the Benefits of ISO registration.

Ans :

The International organization for standardization (ISO) came into existence in 1946 in Geneva, Switzerland. Its main purpose is to faster the development of international standards which help in the exchange of goods and services around the world. ISO includes more than 90 member countries.

Benefits

1. Internal quality as measured by the percent of scrap, rework, and nonconformities at final inspection.
2. Production reliability as measured by the number of breakdowns per month, percent of time dedicated to emergencies, and percent of downtime per shift.
3. External quality as measured by product accepted by customers without inspection, claims of nonconforming product, and returned product.
4 Time performance as measured by time to market, on-time delivery, and throughput time.
5. Cost of poor quality as measured by external nonconformities, scrap, and rework.
6. On the negative side, prevention and appraisal costs increased.

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Q19. Explain the concept and objectives of ISO 9000. Explain its significance.

Ans :

In today's rapidly changing environment where customers demand quality products, the organizations are emphasizing mainly on quality. Many different organizations have developed quality standards and guidelines to produce good quality products. American National Standards Institute defined quality system as the collective plans, activities and events that are provided to ensure that a product, process or service will satisfy the given needs".

The quality management system makes sure that organizational functions are carried out in a structured and systematic manner for achieving world-class performance. ISO stands for International Organization for Standardization, which was started in the year 1946 for the purpose of standardizing the quality requirements of European countries in the common market. It consisted of representatives from national standard bodies of 91 nations and was revised in 1994 and further amended in 2000.

ISO 9000 series is the latest version of quality system standards which contains three main standards as follows,

1. ISO 9000-2000

This standard provides and specifies the terms, definitions and elements of quality management systems.

2. ISO 9001-2000

This standard specifies the prerequisites for a quality management system to fulfill the requirements of customers.

3. ISO 9004-2000

This standard provides guidance to the quality management system for improving the processes and satisfying the customers continuously.

The ISO 9000 certification ensures that the company has designed and used processes that assure delivery of quality products. The ISO 9000 quality management system helps the certified firm to be identified as world-class organization.

The ISO 9000 standard is defined as a "formal quality management which is essential to assure that the technical, administrative and human factors influencing the quality of an organization's products or services are under control".

ISO 9000 standards help a firm to implement quality systems effectively. Effective application of these systems would further help in improving the satisfaction level of the customers.

Drawings, specifications, blue prints, work instructions, test procedures, inspection reports, calibration data and quality cost reports are the important elements of ISO 9000. A three tier record retention system is developed for using these documents. The three tier system consists of,

1. Quality manual
2. Work procedures and
3. Instructions and data records.

Significance of ISO 9000

ISO 9000 is significant both internally and externally. The following is the significance of ISO 9000

Internal Significance

1. ISO 9000 acts as a medium for sustaining quality improvement gains in the organization.
2. It provides a solid foundation or basis for improving the quality of products continuously in the organization.
3. ISO 9000 helps the firm to improve the quality of products by including the non-manufacturing areas in quality and quality improvement techniques.

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4. The ISO 9000 quality management system increases the confidence level of the employees and makes sure that they are totally involved in their work.
5. The use of ISO 9000 quality management system helps the firm to decrease the cost of production by reducing and avoiding wastages.
6. ISO 9000 quality management system, provides the firm with an effective world-class management system for achieving excellent performance.

External Significance

1. ISO 9000 quality management system makes sure that the customers are satisfied by providing them quality products.
2. As world-class products and services are provided to the customers through ISO 9000 quality management system, the confidence level of the customers is also boosted up or increased.
3. Through ISO 9000 certification a firm can freely enter into export market and many domestic organizations.
4. ISO 9000 helps in maintaining and increasing the confidence level of the organization with the stakeholders like suppliers, investors, shareholders etc.
5. The responsibility which the firm has towards the society and country can be fulfilled through ISO 9000 quality management system.

Objectives of ISO 9000

The following are the objectives of ISO 9000 quality management system,

1. To continuously improve and maintain the quality of products according to the requirements of the customers.
2. To enhance the quality and standards of the organizational operations for fulfilling the needs and wants of customers as well as stakeholders.
3. To ensure that internal management and other employees are confident about improving the processes and fulfilling the quality requirements.
4. To ensure customers and stakeholders that the products delivered are upto the standards and requirements.
5. To make sure that all the quality system requirements are achieved completely.

Q20. Discuss the benefits of ISO 9000 Series.

Ans :

Some of the benefits of ISO 9000 are as follows,

1. ISO 9000 acts as a medium for sustaining quality improvement gains in the organization.
2. It provides a solid foundation or basis for improving the quality of products continuously in the organization.
3. ISO 9000 helps the firm to improve the quality of products by including the non-manufacturing areas in quality and quality improvement techniques.
4. The ISO 9000 quality management system increases the confidence level of the employees and makes sure that they are totally involved in their work.
5. ISO 9000 quality management system makes sure that the customers are satisfied by providing them quality products.
6. As world-class products and services are provided to the customers through ISO 9000 quality management system, the confidence level of the customers is also boosted up or increased.

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Q21. Explain the principles of ISO 9000.

Ans :

Following are the guidelines/principles of iso koo,

1. Customer is regarded as the 'king' by organizations. So, it is essential for the firms to determine and focus upon the needs and requirements of the customers and must try to outshine the customer expectations.
2. Leaders should create and maintain an effective internal environment in organizations so that their employees can actively participate in attaining organizational objectives.
3. It is very important for the firm to involve the employees at all levels in order to make use of their competencies and attain competitive advantage.
4. The firm should effectively manage all the activities and related resources in order to achieve the desired results.
5. All the interrelated processes should be determined, understood and managed as a system which will help the firm to increase its efficiency and effectiveness in attaining its objectives.
6. The long-term objective of the firm should be improvement of the performance of the organization.

Q22. What is ISO 14000? Discuss the principles of ISO 14000.

Ans : **(Imp.)**

The ISO 14000 standards are similar to ISO 9000 standards. It was introduced in 1996 for providing all the industries with a structure of "Environmental Management System" (EMS). ISO 14000 standards are a set of norms which makes sure that all the operational processes are carried out in a uniform and effective manner and will not act as a hurdle in achieving environmental objectives set by the organization. ISO 14000 consists of 20 different standards right from environmental labelling to assessment of the product life-cycle.

Principles

The ISO 14000 standards depends mainly on the following five principles,

1. An environment policy should be defined by the firm and it should be committed towards the EMS.
2. A plan should be designed by the firm for carrying out its environmental policy.
3. In order to achieve the environmental objectives, policies and targets, the firm must enhance those capabilities and support systems which are essential in achieving them.
4. The environmental performance must be measured, observed and assessed by the firm.
5. The environmental management system must be continuously reviewed by the firm for enhancing its overall environmental performance.

The ISO 14000 standards do not need any third party registration. It is an environment management approach which is commonly used all over the world for increasing the capability of a firm to enhance and compute its environmental performance. The ISO 14000 standards depends mainly on the following systems,

1. Management Systems

Management systems consist of those standards which develop the firm's system and the process of integration and to make environment as a major concern in their business and improve their system.

2. Operations

It consists of standards for the consumption process of natural resources and energy.

3. Environmental Related Systems

It consists of standards for measuring, analyzing and managing emission, effluents and other waste streams.

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Q23. Explain the Significance of ISO 14000.

Ans : **(Imp.)**

The following points help us to understand the significance of ISO 14000 standards or environmental management system,

1. The environmental management system helps the firm to maintain and enhance the environmental quality.
2. It helps in fulfilling the environmental expectations of the customers.
3. Good and effective relationships can be maintained between public and community through ISO 14000 standards.
4. ISO 14000 standards help the firm in satisfying the vendor investor criteria.
5. ISO 14000 certification helps the firm to enhance its image and acquire greater market share.
6. ISO 14000 standards help the firm to develop and transfer the technology effectively.
7. ISO 14000 standards help in controlling the cost effectively and limiting the liabilities.
8. Environmental management system helps the firm to safeguard its resources.
9. It makes an insurance provision for the health of the organizational employees and the environment.
10. The stakeholders and shareholders can confidently deal with the firm having ISO certification as it concentrates mainly on prevention and fulfilling the policies, objectives and targets effectively.

Q24. Explain the principles of ISO 14000.

Ans :

The ISO 14000 standards depends mainly on the following five principles,

1. An environmental policy should be defined by the firm and it should be committed towards the EMS.
2. A plan should be designed by the firm to carry out its environmental policy.
3. In order to achieve the environmental objectives, policies and targets, the firm must enhance those capabilities and support systems which are essential in achieving them.
4. The environmental performance must be measured, observed and assessed by the firm.

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Short Question and Answers

1. Quality Assurance.

Ans :

The International Organization for Standardization (ISO) 9000 has become the internationally recognized standard for quality management systems. It comprises a number of standards that specify the requirements for the documentation, implementation and maintenance of a quality system.

These standards were published for the first time in 1987. The aim was to effectively document the requirements of the quality management system, which had to be implemented to attain customer satisfaction. These standards were revised for the first time in 1994. Based on actual experiences of several thousand companies, these standards were revised again leading to an improved version being published in 2000. These standards were developed to assure quality.

2. MBNQA.

Ans :

The Malcolm Baldrige Award was established in 1987 and became Public Law 100-107. It was named after the late Secretary of Commerce Malcolm Baldrige, who was an advocate of quality. The American Society for Quality administers the award, ASQ is under contract to the National Institute of Standards and Technology (NIST), which is responsible for the continuation and management of the award.

The Malcolm Baldrige National Quality Award Recognises U.S. Organisations in :

- Manufacturing
- Service company
- Small business
- Education
- Healthcare
- Non-profit organisations (NGO)

3. State the Benefits of ISO registration.

Ans :

1. Internal quality as measured by the percent of scrap, rework, and nonconformities at final inspection.
2. Production reliability as measured by the number of breakdowns per month, percent of time dedicated to emergencies, and percent of downtime per shift.
3. External quality as measured by product accepted by customers without inspection, claims of nonconforming product, and returned product.
4 Time performance as measured by time to market, on-time delivery, and throughput time.
5. Cost of poor quality as measured by external nonconformities, scrap, and rework.
6. On the negative side, prevention and appraisal costs increased.

4. Define Quality.

Ans :

Quality is a complex phenomenon based on perceptions by individuals with different perspectives on products and services. These perceptions have been built up through the past experience of individuals and consumption in various contexts. Consequently, quality encapsulates time and other contextual dimensions that add to the complexity of what is essentially a subjective evaluation of the quality of good and/or service by the consumer.

5. Features of TQM.

Ans :

(i) Customer Focus

TQM Palaces emphasis in meeting the requirement of both the internal as well as the external customer. In order to meet the requirements for the external customer, it is

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necessary to meet the needs of the internal customer. The initial focus should be on meeting needs of internal customer before an attempt is made to meet the requirements of the external customers.

(ii) Continuous Process

TQM is a continuous process. Constant and continuous efforts are made to improve the quality, and to reduce internal costs. Quality improvement helps the organization to face the challenges of the competitors and to meet the requirements of the customers. TQM is a process which goes on forever, because at no time the quality can be 100% right. There is always a possibility for new and better way of doing things.

(iii) Defect-free Approach

TQM place emphasis on the defect-free work most of the time. The defect free approach is phrased in various ways as right first time, working smarter or zero defects.

6. Total Quality Management.

Ans :

The birth of total quality in the United States came as a direct response to the quality revolution in Japan following World War II. The Japanese welcomed the inputs of Americans, Joseph M. Juran and W. Edwards Deming, and rather than concentrate on inspection, focused on improving all organizational processes through the people who used them.

In 1969, the first international conference on quality control sponsored by Japan, America and Europe was held in Tokyo. Feigbenbaum presented the paper, which used the term "total quality" for the first time, and referred as wider issues such as planning, organization and management responsibility.

7. Features of MBNQA.

Ans :

Fallowing are the important features of Malcolm Baldrige Award :

(i) Facilitates Communication

MBNQA facilitates communication and sharing of best practices among U.S. organisations and serves as a working tool for understanding and managing performance, planning, training and assessment.

(ii) Promotes Quality

Malcolm Baldrige National Quality Award (MBNQA) was created to promote quality awareness identify the requirements for quality excellence, and share information about successful quality strategies and benefits.

(iii) Unique and Effective Scoring Component

The MBNQA criteria have an emerged as the single, most comprehensive model for the total quality management that is available. It has a unique and effective scoring component that enables a company or organisation to measure its current level of quality achievement, and to them evaluate its progress over time. No other quality management model has the vital features.

8. European Foundation for Quality Management.

Ans :

EFQM is an acronym that stands for: European Foundation for Quality Management. EFQM was founded in 1988 with the objective to create a platform where organizations can learn from each other to continuously improve their performance for the long term.

Benchmarking with other European organizations will lead to sustainable economic growth.

EFQM wants to create a culture, support managers and directors in training, sharing ideas and innovating with the aid of the so-called EFQM model as a common framework.

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9. Quality management System.

Ans :

The Quality System Regulations (QSR) defined the Quality Management System(QMS) as follows:

"The organizational structure, responsibilities, processes, procedures and resources for implementing quality management".

"The organizational structure, processes, procedure and resources needed to implement quality management ISO 8402.

10. Benefits of ISO 9000 Series.

Ans :

Some of the benefits of ISO 9000 are as follows,

1. ISO 9000 acts as a medium for sustaining quality improvement gains in the organization.
2. It provides a solid foundation or basis for improving the quality of products continuously in the organization.
3. ISO 9000 helps the firm to improve the quality of products by including the non-manufacturing areas in quality and quality improvement techniques.
4. The ISO 9000 quality management system increases the confidence level of the employees and makes sure that they are totally involved in their work.
5. ISO 9000 quality management system makes sure that the customers are satisfied by providing them quality products.

11. Uses of quality indies.

Ans :

(i) Process quality index is used to indiacate technical shortages in production system.

(ii) It measures the significant aspects related to satisfication of customer.

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Choose the Correct Answers

1. Quality usually satisfies three F's _____. [a]

   (a) Fit, Form and Function (b) First, Function and Form

   (c) Fit, Form and Final, and (d) Firm, Function and Fit.

2. _____ is one of the prerequisites for success of TQM [b]

   (a) Commitment at the bottom (b) Customer orientation

   (c) Profit oriented (d) Customer-supplier relationship.

3. The purpose of the _____ reporting system is to provide management with a tool for identifying the improvement areas. [c]

   (a) TQM (b) TPM

   (c) Cost of quality (d) Cost of maintenance.

4. _____ is nothing but TQC conducted in a systematic manner. [d]

   (a) SQC (b) TQC

   (c) COQ (d) QA

5. One of the basic concepts of the TQM philosophy is, [a]

   (a) Continuous process improvement (b) Quality improvement only

   (c) Customer satisfaction (d) Earning profits.

6. According to Kano's model, product features can be classified into _____ types [b]

   (a) Two (b) Three

   (c) Four (d) Six

7. MTBF stands for _____. [c]

   (a) Mean Time But Failure (b) Median Time By Failures

   (c) Mean Time Between Failures (d) Mode Time Between Failures.

8. ISO 14000 series is divided into _____. [d]

   (a) ISO 9000 standards

   (b) Service standards

   (c) Product and quality standards

   (d) Organizational evaluation standards and product evaluation standards.

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9. _____ refers to the percentage of products delivered that do not work at their arrival time at customer's site. [a]

(a) Dead On Arrival (DOA) (b) Complaint handling

(c) Infant mortality (d) Mean time between service calls

10. Which one of the following is an obstacle of TQM? [b]

(a) Proper planning

(b) Improper planning

(c) Adequate use of empowerment and teamwork

(d) Failure to gain profits.

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Fill in the blanks

1. _____ is defined as the ability of a product or service to meet the customer's needs.
2. _____ is an organized scientific approach towards continuous improvement of quality involving everyone in the organization, covering every function aimed at achieving total customer satisfaction.
3. _____ refers to delivery of excellent service according to the customer's expectations.
4. The Probability of Survival (PS), which provides a measure of reliability, R is expressed as _____.
5. ISO stands for _____.
6. The US congress instituted _____ in 1987 in order to recognize US companies that excel in quality achievement and quality management.
7. ISO 9001:2000 is titled as _____.
8. _____ uses process control charts for on stream monitoring and acceptance sampling plans at incoming and outgoing stages for both attributes and variables.
9. _____ is the most influential quality guru not only for the Japanese, but also for the rest of the world.
10. _____ investigates discrepancies or gaps in the customer-supplier chain in order to highlight the target areas where quality can be improved.

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ANSWERS

1. Quality
2. Total quality management
3. Service quality
4. $P = R = e^{-lt} = e^{-lt/m}$
5. International organization for standardization
6. Malcolm Baldrige National Quality Award (MBNQA)
7. Quality management systems requirements
8. Statistical Quality Control (SQC)
9. W.Edwards Deming
10. SERVQUAL model

UNIT II

TOOLS OF TQM :

Measurement Tools: Check Sheets, Histograms, Run Charts, Scatter Diagrams, Cause and Effect Diagrams, Pareto's Chart, Process Capability Measurement. Analytical Tools: Process Mapping, Regression Analysis, Resource Utilization and Customer Service Analysis, The Five Why's, Overall Equipment Effectiveness. Improvement Tools and techniques: Kaizen, JIT, Quality Circles, Forced field Analysis, Five S's. Control Tools: Gantt Chart, Network Diagram, Radar Chart, The PDCA cycle, Milestone Tracker Diagram and Earned Value Management.

2.1 MEASUREMENT TOOLS

Q1. Explain various tools used for measuring TQM.

(OR)

Describe various techniques for measuring effectiveness of TQM system.

(OR)

Briefly describe the 7QC tool for process improvement.

Ans : **(Dec.-20, June-19, Aug.-18, Imp.)**

The various tools used for measuring TQM are as follows :

1. Check Sheets

The check sheet is a simple document that is used for collecting data in real-time and at the location where the data is generated. The document is typically a blank form that is designed for the quick, easy, and efficient recording of the desired information, which can be either quantitative or qualitative. When the information is quantitative, the checksheet is sometimes called a tally sheet.

A defining characteristic of a checksheet is that data is recorded by making marks ("checks") on it. A typical checksheet is divided into regions, and marks made in different regions have different significance. Data is read by observing the location and number of marks on the sheet.

2. Histogram

Histograms display large amounts of data that are difficult to interpret in their raw form. By providing a visual summary of the data, histograms reveal whether the process is centred around a target value, the degree of variation in the data and whether the data meet specifications. Thus, histograms could help in identifying process capability relative to customer requirements.

A histogram analyses and graphically displays quantitative data rather than qualitative data. TQM practitioners use histograms to display information about process and activity performance. Histograms are most effective when they display information with some natural order, such as number of defects found.

3. Run Chart

A run chart is a graphical representation of the data which is plotted over time. Run charts are also called as trend charts or run sequence plot. A run chart is a graph that displays observed data in a time sequence. The vertical axis (y-axis) represents the measurement and the horizontal axis (x-axis) represents the time scale. A run chart displays the changes occurring in the process, performance or quality productivity during a particular period of time. Run charts are used to monitor the production volume, costs and customer satisfaction indices.

4. Scatter Diagram

Scatter diagrams or scatter plots are used to determine whether relationship really exists between two process characteristics and the direction of the relationship.

A scatter diagram graphically illustrates the relationship between variables, typically

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based on quantitative data. They reveal bivariate relationships, that is relationships between pairs of variables, such as number of defects per batch against changes in the speed of production line, or production time per unit against hours of training.'

2.1.1 Check Sheets

Q2. Explain briefly about Check Sheets.

Ans :

Meaning

The check sheet is a simple document that is used for collecting data in real-time and at the location where the data is generated. The document is typically a blank form that is designed for the quick, easy, and efficient recording of the desired information, which can be either quantitative or qualitative. When the information is quantitative, the checksheet is sometimes called a tally sheet.

A defining characteristic of a checksheet is that data is recorded by making marks ("checks") on it. A typical checksheet is divided into regions, and marks made in different regions have different significance. Data is read by observing the location and number of marks on the sheet.

Types

1. Classification

A trait such as a defect or failure mode must be classified into a category.

2. Location

The physical location of a trait is indicated on a picture of a part or item being evaluated.

3. Frequency

The presence or absence of a trait or combination of traits is indicated. Also number of occurrences of a trait on a part can be indicated.

4. Measurement Scale

A measurement scale is divided into intervals, and measurements are indicated by checking an appropriate interval.

5. Check List

The items to be performed for a task are listed so that, as each is accomplished, it can be indicated as having been completed.

2.1.2 Histograms

Q3. Define Histogram. Explain different types of Histogram.

Ans : **(Aug.-21, Imp.)**

Meaning

Histograms display large amounts of data that are difficult to interpret in their raw form. By providing a visual summary of the data, histograms reveal whether the process is centred around a target value, the degree of variation in the data and whether the data meet specifications. Thus, histograms could help in identifying process capability relative to customer requirements.

A histogram analyses and graphically displays quantitative data rather than qualitative data. TQM practitioners use histograms to display information about process and activity performance. Histograms are most effective when they display information with some natural order, such as number of defects found.

Histograms help managers to achieve deeper insight into the characteristics of data distributions associated with activities. Practitioners of TQM use histograms to summarise data and display patterns. They know that any set of observations must display some variation. Histograms present graphic pictures that quickly summarise this variation. Figure shows an example of histogram. Pattern of histograms capture three critical traits of distribution:

- **Centre of the Distribution** : This point usually coincides with the mean of the overall distribution. The theoretical mean should fall at the centre of the histogram's graphic picture of the distribution.
- **Width of the Distribution** : In statistics, the difference between the highest and lowest value in a distribution is its range. A histogram graphically shows the range as the width of the distribution, which often indicates how predictably the activity that generated the distribution operates. A wider distribution represents a less predictable activity, a narrower distribution indicates a more predictable activity.

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➢ **Sample of the Distribution** : The overall shape of the distribution often indicates different problems in the data or influences on the overall distribution.

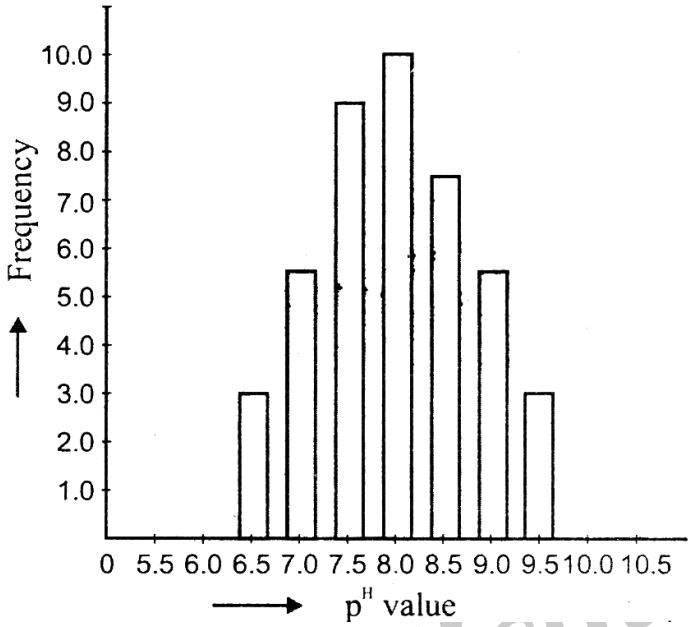


Figure: Histogram : Effluent Analysis - pH

Types

The histograms in Figure show five different types of distributions and each indicate a very different type of behaviour. The various types of distributions are:

(i) Bell shaped distribution

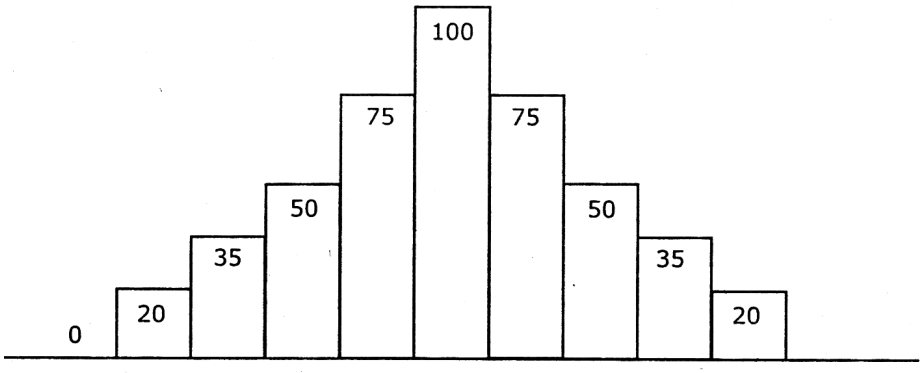
(ii) Double-peaked distribution,

(iii) Plateau distribution

(iv) Comb distribution and

(v) Skewed distribution.

(i) Bell-shaped distribution



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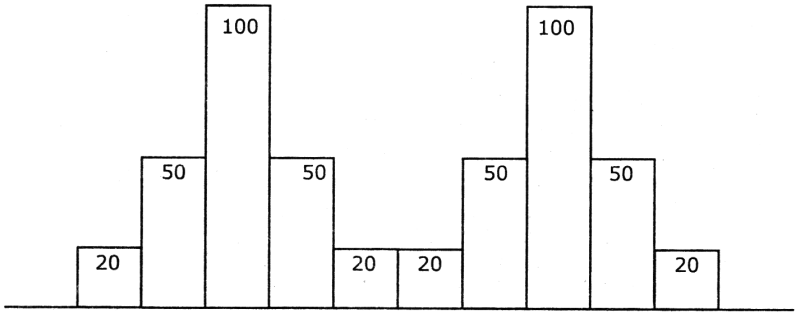
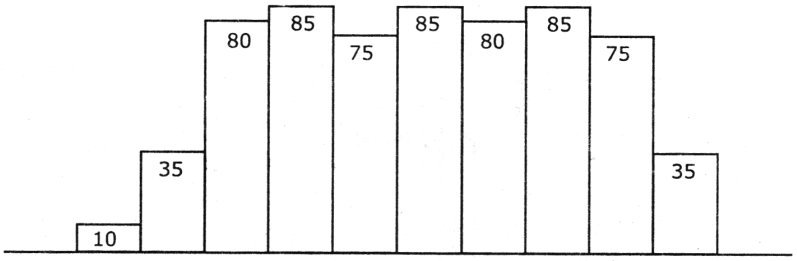
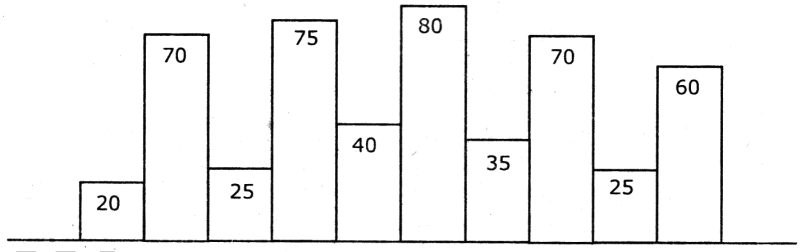
(ii) Double - peaked distribution



(iii) Plateau distribution



(iv) Comb distribution



(v) Skewed distribution

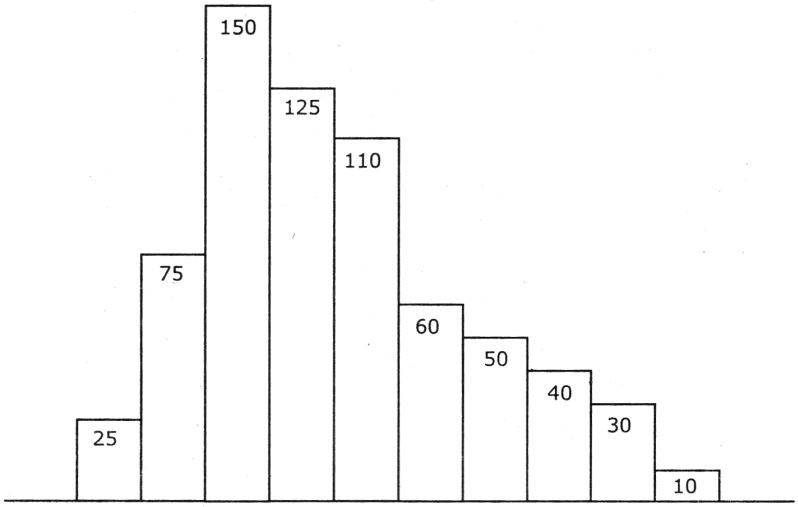


Fig.: Common Shapes of Distribution

Histograms are easy to construct but more difficult to interpret. To get meaningful data, one must select the category sizps carefully. Too many categories spread data too thinly across the histogram, breaking down potential patterns into scattered points, too few categories lump together conflicting data, observing patterns that might otherwise emerge.

Q4. Discuss the applications of Histogram.

Ans : **(Aug.-21)**

Applications

The histogram is the most commonly used graphical form for any frequency distribution. Diagrammatic representation has its perks. Data as histogram examples can be visually represented in a variety of fields, such as:

- It can be used to identify the most efficient pricing plans in the context of sales and marketing. The most practical pricing plans are then used to streamline the marketing campaigns.
- In the operations field, these graphs are used in Six Sigma. Six Sigma is a technique used in operations research to identify process variations. The frequency of delays in each step can help determine the issues with a certain process. The project managers use error data on graphs to identify issues and develop solutions.
- They can be used in the restaurant business to determine when peak customer traffic occurs. The restaurant can then manage the workforce based on peak customer demand. Alternatively, during the lean season, they can maintain a lower staff.
- In hospitals, Staff members can track patient entries to determine the peak resource demand. The process can be better managed as a result of this.
- It can be used to identify the trading potential at different places or groups of investors.
- In medical research, it can provide information on identifying whether or not the patient suffers from others.

2.1.3 Run Charts

Q5. Define run chart. Explain the steps involved in construction of run chart.

Ans : **(Aug.-21)**

Meaning

A run chart is a graphical representation of the data which is plotted over time. Run charts are also called as trend charts or run sequence plot. A run chart is a graph that displays observed data in a time sequence. The vertical axis (y-axis) represents the measurement and the horizontal axis (x-axis) represents the time scale. A run chart displays the changes occurring in the process, performance or quality productivity during a particular period of time. Run charts are used to monitor the production volume, costs and customer satisfaction indices.

Steps

Run charts are constructed in the following manner,

Step 1

The first step involved in the construction of a run chart is to collect the data. In this step, the data about a particular process is collected.

Step 2

In the second step, the different types of data is examined and analyzed.

Step 3

In the third step, all the points are plotted on the chart. After plotting the points, they are joined.

Step 4

Finally, the average of all the plotted points is calculated and a horizontal line is drawn through the data which is called as the "center line of the chart'.

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Q6. Discuss the applications of Run Charts.

Ans : **(Aug.-21)**

Applications

These are the key areas where you should use run charts:

1. To demonstrate the operation of the process in graphic form.
2. Monitor and report achievements efficiently.
3. To recognize the variation in the process and prevent acting inimically.

2.1.4 Scatter Diagrams

Q7. Define Scatter Diagram. Discuss the steps involved in. Construction of Scatter Diagram.

Ans : **(Aug.-21)**

Meaning

Scatter diagrams or scatter plots are used to determine whether relationship really exists between two process characteristics and the direction of the relationship.

A scatter diagram graphically illustrates the relationship between variables, typically based on quantitative data. They reveal bi-variate relationships, that is relationships between pairs of variables, such as number of defects per batch against changes in the speed of production line, or production time per unit against hours of training.'

Steps

Step 1

Collect 50 to 100 samples of data whose relationship you wish to investigate and enter them on a data sheet.

Step 2

Draw the horizontal and vertical axis and plot the readings. If the relationship between two kinds of data is that of cause and effect, the cause values are usually marked on 'X' axis and the effect values on the 'Y' axis. 'X' value is an independent variable and the 'Y' a dependent value (variable).

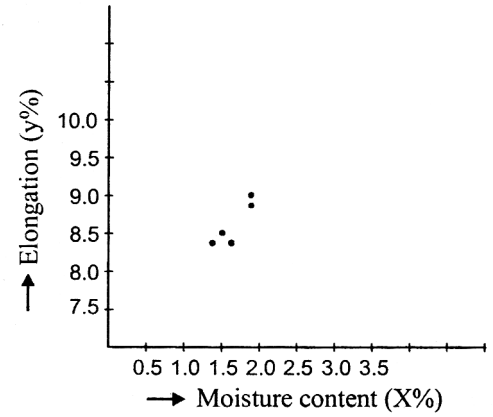

Fig.: Scatter Diagram for Moisture Content (%ge) Vs Elongation (%ge)

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Step 3

If data values are repeated and fall on the same point, mark concentric circles as needed.

Scatter diagrams are the graphical component of regression analysis. They point out important relationships between variables, such as the percentage of an ingredient in an alloy and hardness of the alloy. Typically, the variables in question represent possible causes and effects obtained from Ishikawa diagrams. Statistical correlation analysis is used to interpret scatter diagrams. Figure shows three types of correlation.

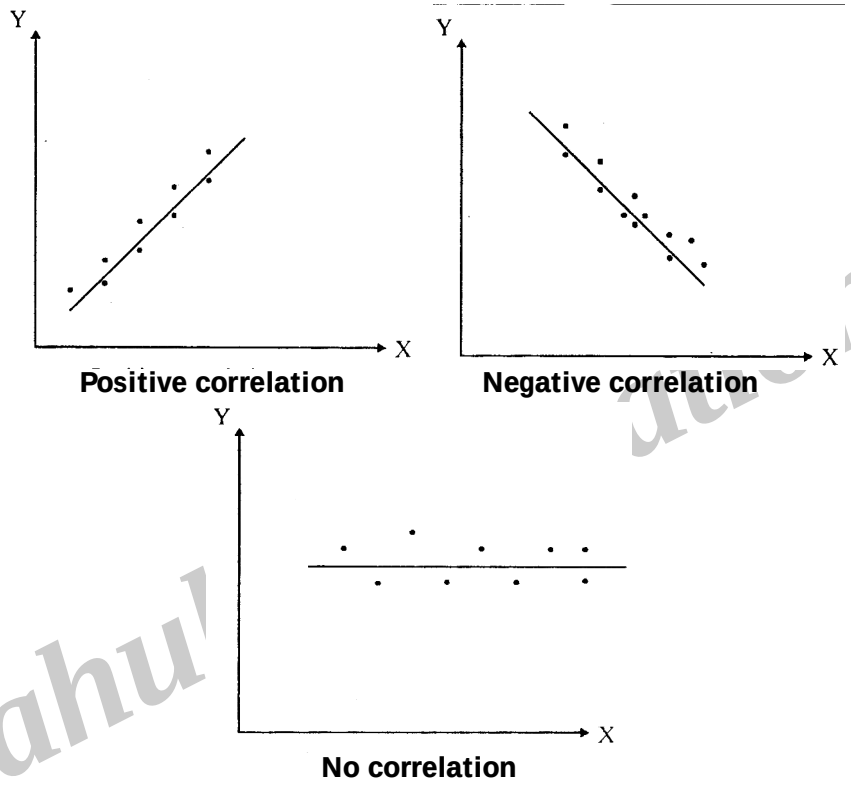


Fig.: Three Types of Correlation

If the correlation is positive, an increase in variable x is related to an increase in variable y, if the correlative is negative, an increase in x is related to a decrease in y and if the correlation is close to zero, the variables have no linear relationship.

Q8. Discuss the applications of Scatter Diagrams.

Ans : **(Aug.-21)**

Applications

1. Demonstration of the Relationship between Two Variables

The most common use of the scatter plot is to display the relationship between two variables and observe the nature of the relationship. The relationships observed can either be positive or negative, non-linear or linear, and/or, strong or weak.

The data points or dots, which appear on a scatter plot, represent the individual values of each of those data points and also allow pattern identification when looking at the data holistically.

2. Identification of Correlational Relationships

Another common use of scatter plots is that they enable the identification of correlational relationships. Scatter plots tend to have independent variables on the horizontal axis and dependent variables on the vertical axis. It allows the observer to know or get an idea of what the possible vertical value may be, provided there is information on the horizontal value.

3. Identification of Data Patterns

Data pattern identification is also possible with scatter plots. Data points can be grouped together based on how close their values are, and this also makes it easy to identify any outlier points when there are data gaps.

Seeing as scatter plots aid in the identification of correlations between variables, the nature of the correlations can also be estimated based on a specific confidence level.

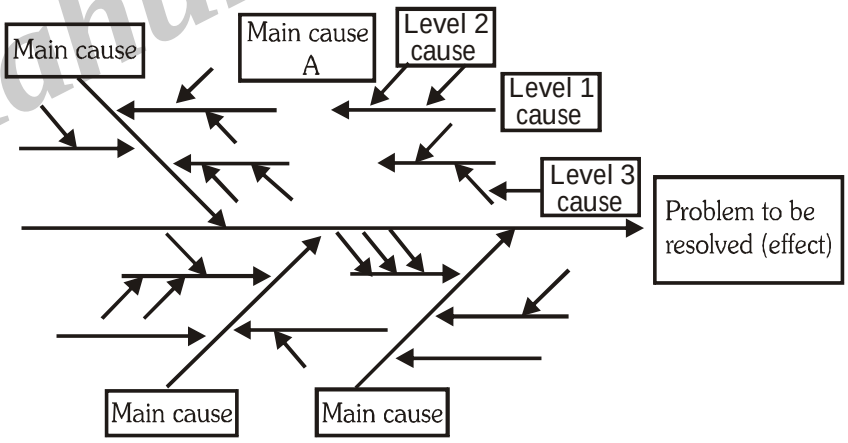
- Positive correlation depicts a rise, and it is seen on the diagram as data points slope upwards from the lower-left corner of the chart towards the upper-right.
- Negative correlation depicts a fall, and this is seen on the chart as data points slope downwards from the upper-left corner of the chart towards the lower-right.
- Data that is neither positively nor negatively correlated is considered uncorrelated (null).

2.1.5 Cause and Effect Diagrams

Q9. What do you understand by Cause and Effect diagram?

Ans : **(Imp.)**

A cause and effect (C&E) diagram is a picture composed of lines and symbols designed to represent a meaningful relationship between an effect and its causes. It was developed by Dr.Kaour Ishikawa in 1943 and is sometimes referred to as an Ishikawa diagram or a fish bone diagram because of its shape.



C&E diagrams are used to investigate either a "bad" effect and to take action to correct the causes or a "good" effect and to learn those causes that are responsible. For every effect, there are likely to be numerous causes. Figure illustrates a C&E diagram with the effect on the right and causes on the left. The effect is the quality characteristic that needs improvement. Causes are sometimes broken down into the major causes of work methods, materials, measurement, people, equipment, and the environment. Other major causes could be used for service-type problems, as indicated in the chapter on customer satisfaction.

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Each major cause is further subdivided into numerous minor causes. For example, under work methods, we might have training, knowledge, ability, physical characteristics, and so forth. C&E diagrams are the means of picturing all these major and minor causes. Figure:

The C&E diagram has nearly unlimited application in research, manufacturing, marketing, office operations, service, and so forth. One of its strongest assets is the participation and contribution of everyone involved in the brainstorming process.

- Analyze actual conditions for the purpose of product or service quality improvement, more efficient use of resources, and reduced costs.
- Eliminate conditions causing non-conformities and customer complaints.
- Standardize existing and proposed operations.
- Educate and train personnel in decision-making and corrective-action activities.
- Analyze actual conditions for the purpose of product or service quality improvement, more efficient use of resources, and reduced costs.
- Eliminate conditions causing non-conformities and customer complaints.
- Standardize existing and proposed operations.
- Educate and train personnel in decision-making and corrective-action activities.

2.1.6 Pareto's Chart

Q10. What are Pareto charts? What are the steps involved in constructing a Pareto chart? State the uses/benefits of Pareto chart (or Pareto analysis).

Ans :

Meaning

Pareto charts are the bar charts which explain the frequency of the cost of a set of items. Pareto chart displays the data in the descending order of their significance from left to right. The pareto analysis follows the principle, "The vital few and the trivial many" which means that the most essential/ vital items form less quantity and the least essential or unimportant items form the larger quantity. The pareto principle is also known as "80-20 rule" which means that 20 percent of the people control the 80 percent of society's wealth. Pareto analysis is also called 'Pareto Diagrams' or 'Pareto Charts'.

Steps

The following are the steps involved in constructing a pareto chart,

1. In the first step, the problems or causes which need to be compared are identified and organized in few categories.
2. In the second step, a standard unit of measurement and the time period for the study must be selected for measuring the factors such as defects, errors, cost overruns etc. On the basis of the factors identified in the surveys, the causes of the problem can be determined.
3. In the third step, data must be collected and summarized. A table consisting of three columns with the headings problem category, frequency and percent of total must be created. The problem category column must be filled up with problems or causes. The frequency column is filled up with the sum of different categories and percent of total column shows the values which are obtained after dividing the number of frequency column with the total number of measurements.
4. In the fourth step, one horizontal and two vertical axes of the pareto chart are drawn. The horizontal axis represents the problems or causes or defects in a descending order, while vertical axes on the extreme left side represents the frequencies and the one on the extreme right side represents the percentage of total.
5. In the fifth step, the bars are plotted in descending order from left to right with the help of a frequency scale which is on the left vertical axis. In order to plot the cumulative

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percentage line, the dots are placed above each bar proportionate to the height of the right vertical axis scale. All these dots are connected from left to right till the 100 percent point.

6. Finally, in the last step, the pareto chart is interpreted and all the angles are examined for solving the problems.

2.1.7 Process Capability Measurement

Q11. Discuss in detail about Process Capability Measurement.

Ans :

Process capability is defined as a statistical measure of the inherent process variability of a given characteristic. You can use a process-capability study to assess the ability of a process to meet specifications.

During a quality improvement initiative, such as Six Sigma, a capability estimate is typically obtained at the start and end of the study to reflect the level of improvement that occurred.

Several capability estimates are in widespread use, including:

- Potential capability (C_p) and actual capability during production (C_{pk}) are process capability estimates. C_p and C_{pk} show how capable a process is of meeting its specification limits, used with continuous data. They are valuable tools for evaluating initial and ongoing capability of parts and processes.
- "Sigma" is a capability estimate typically used with attribute data (i.e., with defect rates).

Capability estimates like these essentially reflect the nonconformance rate of a process by expressing this performance in the form of a single number. Typically this involves calculating some ratio of the specification limits to process spread.

Assessing Process Capability

Assessing process capability is not easy. Some textbooks teach users to wait until the process reaches equilibrium, take roughly 30 samples and calculate their standard deviation; however, it is difficult to know when the process reaches a state of equilibrium and if the recommended samples are representative of the process. The measurement of process capability is more complicated than that.

For example, suppose you have a rotary tablet press that produces 30 tablets, one from each of 30 pockets per rotation. If you're interested in tablet thickness, you might want to base your estimate of process capability on the standard deviation calculated from 30 consecutive tablets. Better yet, you might assure representation by taking those 30 consecutive tablets repeatedly over eight time periods spaced evenly throughout a production run (Table 1). You would pool the eight individual standard deviations yielding a thickness capability estimate based on (8 × (30 – 1)) = 232 degrees of freedom.

Table : Assessing Process Capability: Sampling Scheme Example

	Period			
Sample	1	2	...	8
1	x	x	...	x
2	x	x	...	x
-	-	-		-
30	x	x	...	x

For greater assurance yet, you might want to include several production runs with perhaps fewer sampling times per production run. Estimates of the process capability made this way would be representative and independent of process mean changes that might take place from one sampling time to the next. Because the pooled, within-group standard deviation is calculated on observations taken close together in time, there is no opportunity for it to be contaminated by assignable sources of variation. It is as close to pure capability as you're likely to get.

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2.2 ANALYTICAL TOOLS

Q12. Explain various Analytical Tools for TQM.

Ans : **(Aug.-17)**

The various Analytical Tools for TQM are as follows :

1. Process Mapping

Process mapping provides a process tool with which to understand and change the processes to help improve the bottom-line and competitive position.

2. Regression Analysis

Regression analysis is a statistical tool used to find a model for relationship between pairs of numerical data. The model is a straight line (linear regression) or a curve (non-linear regression) that fits the data best. The results of a regression analysis are an equation for that line or curve, a value called r^2 that indicates how good the fit is and other statistical measures that tell how well the data match the model.

3. Resource Utilization and Customer Service Analysis.

Resources management" is focused on the effective use and maintenance of the organisation's physical assets (buildings, finance, information, technology, suppliers and materials) "Utilisation" can be thought of as the percentage that a resource (e.g. machine, server, cashier, inspector etc.) is used.

"Resources" refer to tangible assets that help transform inputs into outputs in a process. Two categories of resources are:

(i) Capital resources which include fixed assets such as level, building, facilities, equipment, machines and information systems.

(ii) Labor or human resources which include people such as engineers, operations, customer service representatives and sales staff. Resource utilisation may refer to utilisation of various kinds of resources e.g. equipment or machine utilisation, rental equipment utilisation, human resource utilisation, land unitisation, building space utilisation, shop floor utilisation, storage space utilisation, supply chain utilisation and so on.

4. The Five Why's

The "Five Whys" technique or "Why-Why diagram" helps to identify the root causes of a problem. The method helps the problem-solving team to reorganise the broad network of promem causes and the relationship among these causes. It can indicate the best areas to address for short and long-term solutions.

2.2.1 Process Mapping

Q13. Explain Process Mapping analysis in TQM.

Ans : **(Nov.-21, June-18)**

Process mapping provides a process tool with which to understand and change the processes to help improve the bottom-line and competitive position.

Process

Three categories of the process mapping tools are:

1. Flow Diagramming Tools
2. Case Tools and
3. Simulation Tools

These are briefly discussed below:

1. Flow Diagramming Tools

These are the basic level tools that help define processes and workflows by linking text descriptions of processes to symbols. Typically, flow chart models provide limited analysis capability.

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2. CASE Tools

These tools provide a conceptual framework for modeling hierarchies and process definitions. They are typically built on relational data bases and include functions that provide linear, static and deterministic analysis capability.

3. Simulation Tools

Simulation tools provide continuous or discrete-event, dynamic and more sophisticated analysis capability. Simulation tools typically provide animation capabilities that allow the process designer to see how customers and/or work objects flow through the system.

Q14. Explain the merits and demeris of Process Mapping.

Ans : **(Nov.-20)**

Merits

The merits of process mapping are divided into three categories,

1. Recognition

Process mapping helps a company as follows,

(a) It helps the stakeholders identify the problems or areas of concern in the process.

(b) With the help of process mapping, stakeholders will be able to understand their role and responsibilities in the process.

(c) Process mapping enables the stakeholder to understand the status as well as the flow of process.

(d) Through process mapping, stakeholders can identify the interdependencies in the process i.e., they get an idea of how others are influenced by them in the process.

2. Facilitation

Process mapping facilitates or helps the company as follows,

(a) It helps to understand performance characteristics and feedback.

(b) The process map enables effective communication.

(c) Lastly, the process maps help the stakeholder in identifying the improvement methods that can increase value and decrease waste resulting in continuous improvement.

3. Enabling

The last benefit offered by process mapping is enabling. The recognition and facilitation merits help or enable the stakeholders to be confident while taking decisions as they now have better understanding of how their decisions can impact the complete process.

Limitations

Following are the limitations of process mapping,

1. Process mapping is done based on individual's or group's perception due to lack of sufficient data. Dependence on perception results in inaccuracy.
2. Preparation of process maps for complex process involves more time and energy,

2.2.2 Regression Analysis

Q15. Explain briefly about Regression Analysis in TQM.

Ans : **(Imp.)**

Meaning

Regression analysis is a statistical tool used to find a model for relationship between pairs of numerical data. The model is a straight line (linear regression) or a curve (non-linear regression) that fits the data best. The results of a regression analysis are an equation for that line or curve, a value called r^2 that indicates how good the fit is and other statistical measures that tell how well the data match the model.

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The Linear regression identifies the best straight line through a scatter diagram of the data. The type of regression is the most straight forward analytical tool used in statistical analysis. Non linear regression looks for a curve that best fits the data. Multiple regression is used when several independent variables affect one dependent variable. Non-linear and multiple regressions are more complicated then linear regression.

Application

Regression analysis is generally used:

(a) When we have paired numerical data,

(b) After drawing a scatter diagram of the data

(c) When we want to know how a change in the independent variable affects the dependent variable.

(d) When we want to be able to predict the dependent variable if we know the independent variable.

(e) When we want a statistical measure of how well a line or curve fits the data.

The objective of linear regression analysis is to determine the values of a and b that minimises the sum of the squared deviations of the actual data points from the graphed straight line. Two measures commonly used are the sample correlation coefficient and the sample coefficient of determination.

The sample coefficient of correlation y measures the direction and strength of the relationship between the independent variable and the dependent variable. The value of y varies from – 1 to +1.

The sample coefficient of determination measures the amount of variation in the dependent variable about its mean and is explained by the regression line. It is the square of the coefficient of correlation (i.e., y^2), and its value varies from 0 to 1.

2.2.3 Resource Utilization and Customer Service Analysis

Q16. State the role of TQM in Resource Utilization and Customer Service Analysis.

Ans : **(Aug.-18)**

Resources management" is focused on the effective use and maintenance of the organisation's physical assets (buildings, finance, information, technology, suppliers and materials) "Utilisation" can be thought of as the percentage that a resource (e.g. machine, server, cashier, inspector etc.) is used.

"Resources" refer to tangible assets that help transform inputs into outputs in a process. Two categories of resources are:

1. Capital resources which include fixed assets such as level, building, facilities, equipment, machines and information systems.

2. Labor or human resources which include people such as engineers, operations, customer service representatives and sales staff. Resource utilisation may refer to utilisation of various kinds of resources e.g. equipment or machine utilisation, rental equipment utilisation, human resource utilisation, land unitisation, building space utilisation, shop floor utilisation, storage space utilisation, supply chain utilisation and so on.

In the case of equipment or machine utilisation, resource utilisation refers to the percentage of hours actually worked when compared with possible working hours. Capacity utilisation of a resource pool is the degree to which resources are utilised by a process, the rates of through-put and the critical capacity of resource pool.

$$\text{Utilisation} = \frac{\text{Actual work done (Hours)}}{\text{Total available capacity (Hours)}}$$

In production, an increase of the utilisation of equipment or a machine will require more preventive maintenance and more wear and tear

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on the machine. The objective of operations management is to increase the utilisation of production resources by reducing the idle time and down time of the productive assets to the extent possible.

Customer Service Analysis

Customer service can be defined as a process which takes place between the buyer, seller and third party. The process results in a value addition to the product or service exchanged. The value added might be short term as in a single transaction or long-term as in a contractual relationship. The benefits of value addition are shared by each of the partners to the transaction or contract and they are better off after the completion of the transaction. Thus, in a process view, customer service is a process of providing significant value added benefits to the supply chain in a cost effective way. Customer service can be thought of as something a firm or service provider provides to those who purchases its products or services. Customer service frequently affects every area of the firm by attempting to ensure customer satisfaction through the provision of service to the customer.

Customer service analysis investigates customer interactions with an organisation including point-of-sale, service delivery and follow-on-support, to ensure customers are being serviced well. Executives and marketers monitor service and satisfaction levels over time to measure business effectiveness in retaining and attracting customers.

2.2.4 The Five Why's

Q17. What is meant by Five Why's technique? When it is used.

(OR)

Discuss the procedure used in the The Five Why's techniques.

Ans :

The "Five Whys" technique or "Why-Why diagram" helps to identify the root causes of a problem. The method helps the problem-solving team to reorganise the broad network of promem causes and the relationship among these causes. It can indicate the best areas to address for short and long-term solutions.

When to use

(i) When the team needs to probe for the root cause of a problem.

(ii) When the team's analysis of a problem is too superficial.

(iii) When the many contributing cause to a problem are confusing.

(iv) As a graphic communication tool, to explain to others the many causes of a problem.

Procedure

1. Develop a statement of the specific problem for which the causes are to be found. Write it on a note pad or flip chart or white board.
2. Ask "Why?" this problem does or could occur. List all these causes on notes and place them in a column immediately to the right of the problem.
3. Each of the cause statements becomes a new problem statement. Again ask "Why?"- Why does this situation cause the problem? Create another column of cause statements. Show the relationships to the first column of causes with arrows.
4. Continue to turn each cause into a problem and ask "Why?". Do not stop until you reach an answer that is fundamental (company policy or procedures, systems, training needs and so forth). Figure shows "Five Whys" work sheet.

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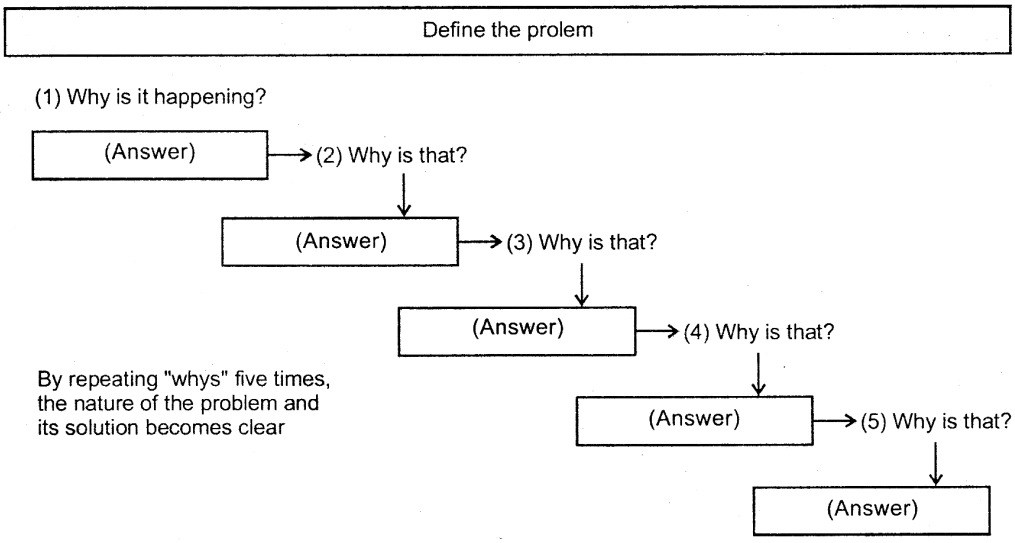

Fig.: "Five Whys" work sheet.

2.2.5 Overall Equipment Effectiveness

Q18. What is meant by Overall Equipment Effectiveness? Discuss the various factors involved in Overall Equipment Effectiveness.

Ans :

Overall equipment effectiveness (OEE) is a measure of total (complete, inclusive, whole) equipment performance- the degree to which the asset in doing what it is supposed to do. OEE is a "best practice" way to monitor and improve the effectiveness of the manufacturing processes *(i.e.* machines, manufacturing cells, assembly lines etc.).

OEE takes into consideration the most common and important sources of manufacturing productivity loss, places them into three primary categories and distills them into metrics that provide an excellent gauge for measuring where we are and how we can improve.

OEE is frequently used as a key metric in total productivity maintenance (TPM) and Lean manufacturing programs.

OEE percentage is useful when tracking and trending the performance effectiveness (reliability) of a single piece of equipment or single-stream process over a period of time.

The formulas are given below.

OEE (percentage) = Availability (percentage)

× Performance efficiency (percentage) × Quality rate (Percentage).

$$\text{Availability (\%)} = \frac{\text{Actual operating time}}{\text{Gross available time}}$$

$$\text{Performance efficiency (\%)} = \frac{\text{Actual production rate}}{\text{Designed production rate}} \times 100$$

$$\text{Quality rate (\%)} = \frac{\text{(Total unit produced) - (Defective units produced)}}{\text{Total units produced}} \times 100$$

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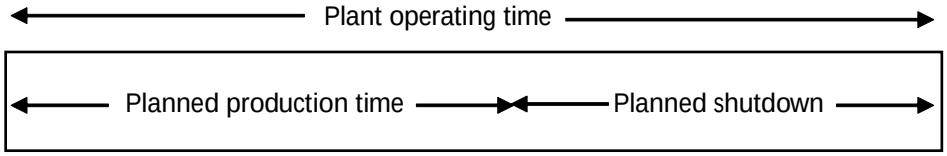
OEE Factors

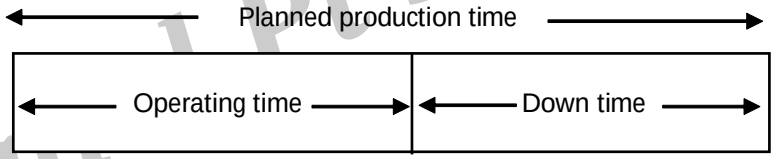
1. OEE analysis starts with plant operation time which is the time the facility is open and available for equipment operation.
2. From plant operating time, the "planned shutdown" time is subtracted to obtain "planned production time". It is shown below in the form of a horizontal bar chart.



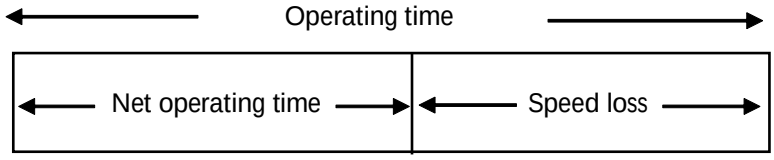
The planned shutdown includes all events that should be excluded from efficiency analysis because there was no intention of running production (e.g. lunch and coffee breaks, scheduled maintenance, or periods where there is nothing to produce).

OEE begins with planned production time and scrutinises efficiency and productivity losses that occur, with the goal of reducing or eliminating these losses. There are three general categories of loss to consider: (i) Down time loss, (ii) Speed loss and (iii) Quality loss.

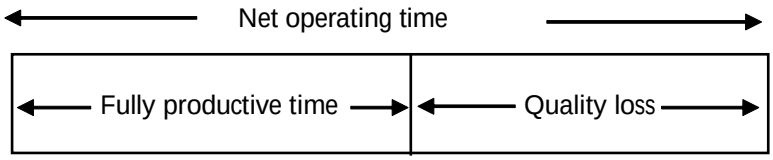
3. Availability: Availability takes into account "down time loss" which includes any events that stop planned production for an appreciable length of time. Examples include equipment failure, material shortages, and change over times (which is a form of equipment downtime). While it may not be possible to eliminate change over time, in many cases it can be reduced (for e.g. using single minute exchange of dies-SMED). The operating time is obtained by subtracting down time loss from planned production time.



4. Performance: Performance takes into account "speed loss" which includes any factors that cause the process to operate at less than the maximum possible speed, when running, Examples include machine wear, substandard materials, misfeeds, and operator efficiency. The remaining available time is called "net operating time".



5. Quality: Quality takes into account "quality loss" which accounts for produced pieces that do not met quality standards, including pieces that require rework. The remaining time is called "fully production time"



2.3 IMPROVEMENT TOOLS AND TECHNIQUES

Q19. Narrate various Tools and Techniques used for improving TQM.

Ans : **(Dec.-20, Imp.)**

The various Tools and Techniques used for improving TQM are as follows :

1. Kaizen

Kaizen is a Japanese term used to explain the significance of continuous improvement. The concept of Kaizen was started by Masaaki Imai. According to Kaizen philosophy, the success and survival of an organization is possible only when all its organizational members determine and execute improvements regularly. In order to improve the quality of an organization, all the departments or segments such as cost, employee safety, skill development, supplier relations, new product development and meeting delivery schedules need improvement.

2. JIT

Just-in-time (or JIT) is defined as "a philosophy of manufacturing based on planned elimination of all wastes and continuous improvement of productivity".

JIT is an approach that seeks to eliminate all sources of waste in production activities by providing the right part at the right place at the right time.

3. Quality Circles

"Quality circle is a small group of employees in the same work area or doing similar type of work who voluntarily meet regularly for about an hour every week to identify, analyse and resolve work-related problems, leading to improvement in their total performance and enrichment of their work life."

Although the concept has had some success in white collar operations, the major impact has been among "direct labour" employees in manufacturing where concerns are primarily with quality, cost, specifications, productivity and schedules. By their very nature, quality circles were limited to concerns of the small group of members and few cross-sectional problems were considered.

4. Forced Field Analysis

Force-field analysis was developed by Kurt Lewin. It identifies forces that help and those that hinder reaching the desired outcome. It depicts a situation as a balance between two sets of forces: one that tries to change the status quo and one that tries to maintain it. Force-field analysis focuses our attention on ways of reducing the hindering forces and encouraging the positive ones. Force-field analysis encourages agreement and reflection in a group through discussion of the underlying causes of a problem.

2.3.1 Kaizen

Q20. Explain the concept of Kaizen. What are the steps involved in the implementation of continuous improvement strategy in an organization?

Ans : **(June-19)**

Meaning

Kaizen is a Japanese term used to explain the significance of continuous improvement. The concept of Kaizen was started by Masaaki Imai. According to Kaizen philosophy, the success and survival of an organization is possible only when all its organizational members determine and execute improvements regularly. In order to improve the quality of an organization, all the departments or segments such as cost, employee safety, skill development, supplier relations, new product development and meeting delivery schedules need improvement.

Steps

The following are the steps involved in implementing continuous improvement strategy in an organization,

Step-1: Define Current Strategies

The first step in the implementation of continuous improvement strategy is to define the

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current organizational quality strategy/status such as number of defects, cost of defects, customer satisfaction indices etc.

Step-2: Define the Objectives of Continuous Improvement

Soon after determining the current organizational quality status, continuous improvement objectives are set. These objectives are based on the realistic appraisal which helps in determining the organizational capability to achieve the objectives using the available resources. Thus, in the initial stage itself, moderate continuous improvement objectives should be set in order to be successful and for motivating the employees towards continuous improvement. Unrealistic objectives would result in demotivating the employees.

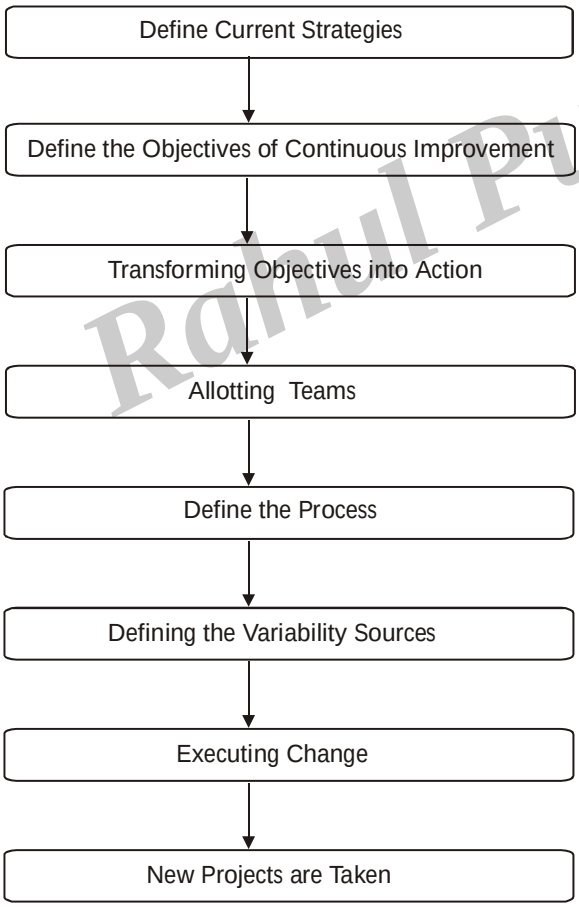

Fig.: Steps of Kaizen Policy

Step-3: Transforming Objectives into Action

In this step, continuous improvement projects are taken up for transforming the continuous improvement objectives into action. These projects provide the structure for organizational action plans for achieving continuous improvement in an organization.

Step -4 : Allotting Teams

In this step, teams are formed and the individuals are assigned different teams, so that they can work on continuous Improvement projects. The employees are also given the required level of authority and power for achieving the continuous improvement objectives.

Step-5: Define the Process

Once the teams are allotted for continuous improvement projects, the teams should define the process for improving it. Flow charts are used for defining the process of improvement projects as it shows a clear picture of the process to all the individuals involved in the process. If the human input need is identified, then possible sources of variability must be included in the process. The variability and human inputs should be controlled for attaining continuous improvement.

Step-6: Defining the Variability Sources

In this step, the areas through which the variability can inter into the process is identified. The team must reduce the variability in order to improve the quality. The variability can be reduced though problem solving, systems failure analysis, Statistical Process Control (SPC), Taguchi method and supplier teeming. The variability is identified with the help of three approaches - brainstorming between ream members, cause and effect analysis and the process flow chart. Determination of the variability sources helps in the potential improvements.

Step-7: Executing Change

It is very important for the team to evaluate the process improvements before implementing, as it helps in managing the risk effectively. This evaluation is made in the following steps,

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(a) The tests or experiments are designed for evaluating the feasibility of any process modification

(b) The updates of the process are incorporated as a pilot program in a small area before implementation

(c) The measurement criteria which targeted the improvement process is used for monitoring the pilot program

(d) Once the upgrade is executed, the process will continue to be monitored with the same measurement criteria.

Step-8: New Projects are Taken

The continuous improvement process is a never ending process. After the effective implementation of continuous improvement process, the firm identifies additional improvement benefits and takes up new projects.

Q21. Explain the principles of Kaizen.

Ans :

Kaizen focuses upon continuous improvement at all levels for developing three guiding principles as follows,

1. Process View of the System

Kaizen mainly deals with analyzing the process which influences the procedures for making or designing a product among several other processes.

2. Achieving Success through People

The success of the Kaizen program mainly depends upon the knowledge of the employees regarding the firm's processes and their strong determination towards improving them. With the improvement in the quality of people, the quality of product will automatically improve. Success can be achieved through discipline, employee participation, skill development and effective communication.

3. A Sense of Urgency

In order to make Kaizen successful all the organizational members should constantly identify the need for change. They should always try to improve their performances and should not consider the existing process as good/adequate. Complacency and over confidence acts as a hurdle in the Kaizen process. Everyone in the organization must participate in the continuous improvement process. A Kaizen can be successful greatly through employee involvement, training and new improvement practices.

Q22. State the advantages of Kaizen.

Ans :

1. Improved teamwork

One of the major kaizen advantages is improved teamwork. Kaizen is a quality improvement tool driven by teamwork. It does not benefit only a selected few, but everyone involved in the business process. As the kaizen team solves problems together, they develop a bond and build team spirit. Thus, employees are able to work with a fresh perspective, an unbiased mind and without prejudice.

2. It builds leadership skills

Every kaizen team must have a team leader. The team leader is responsible for organizing the kaizen team and coordinating implementation. The kaizen team leader makes sure that everyone is performing their roles successfully. The team leader is also responsible for sourcing for help when additional resources are required. Never the less he does not have to be in a management role to qualify as a team leader. Thus, another kaizen advantage is that it presents an opportunity for employees to take on leadership roles.

3. Improved efficiency

A major kaizen advantage is improved efficiency. Kaizen improvements boost the quality of services. It helps businesses implement new process improvements, boost efficiency and enhance time management.

For example, Toyota Manufacturing Company employs kaizen in its production process. First of all, they deploy muscle-memory training to train their employees on

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how to assemble a car. Muscle-memory training helps them to achieve accurate results. Hence, their employees are able to work with precision.

4. Improved employee satisfaction

Another kaizen advantage is that it improves employee satisfaction. Kaizen involves the employees when implementing changes for improvements. Employees can make suggestions and creative input for changes through a suggestion system like team meetings. When employees are involved in decision making, it gives them a sense of belonging and worth. They are eager to implement changes and think of new ways to improve the processes. By so doing, the employees are motivated and productivity increases. Also, employees are more willing to take ownership of process improvements. Rather than falling back on old methods, they become advocates of quality improvements.

5. Better safety

Improving safety on the work floor is a kaizen advantage for business. Safety is improved when businesses implement ideas that clean up and organize workspace. By so doing, employees have better control of business process equipment. Employees are also encouraged to make suggestions to improve safety on the work floor. This helps to minimize accidents and other related injuries. Hence, employees become more efficient and manage their time properly. However, safety is a responsibility of management as well.

2.3.2 JIT

Q23. Explain briefly about JIT.

Ans : **(June-19)**

Meaning

Just-in-time (or JIT) is defined as "a philosophy of manufacturing based on planned elimination of all wastes and continuous improvement of productivity".

JIT is an approach that seeks to eliminate all sources of waste in production activities by providing the right part at the right place at the right time.

JIT encompasses the successful execution of all manufacturing activities required to produce a final product, from design to delivery and including all stages of conversion from raw materials onward. The primary elements of JIT are to have only the required inventory when needed, to improve quality to zero defects, to reduce lead times by reducing set-up times, que-lengths and lot sizes, to incrementally revise the operations themselves and to accomplish these things at minimum cost.

In short, JIT means :

(i) Producing the quantity of units that is needed, no more or no less.

(ii) Producing them 011 the date and at the time required, not before, not after.

Objectives

The ultimate goal or objective of JIT system is a balanced system, that is one that achieves a smooth, rapid flow of materials through the system. The idea is to reduce the process time to as low as possible by making best of the resources. The specific goal or objective is to provide the right quality level at the right place. JIT tries to build only what internal (employees) and external customers want and when they want it. The supporting goals or objectives of JIT are :

(i) Produce only the products that customers want.

(ii) Produce products only as quickly as customers want to use them.

(iii) Produce products with perfect quality.

(iv) Produce products with features that customers want.

(v) Produce with no waste of labour, materials or equipment and with zero inventory.

Q24. Explain the benefits of JIT.

Ans :

(i) Inventory levels are drastically reduced and high inventory turnovers (50 to 100 times per year) have been achieved.

(ii) Reduced production cycle time or product throughput time.

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(iii) Improved product quality and minimum scrap.

(iv) Root-cause elimination approach to solve production problems.

(v) Multiskilled and flexible work-force reduces worker idle time, overheads, fewer lay-offs etc.

(vi) Elimination of unpleasant suppliers.

(vii) Reduced customer-related problems.

(viii) Near zero defects.

(ix) Improved communications.

(x) Lesser work-in-process and finished goods inventory.

(xi) Shorter procurement lead times.

(xii) Improved employee morale due to high employee involvement and employee empowerment.

(xiii) Reduced amount of inspection.

Q25. What is JIT in services? Explain how it is implemented in services.

Ans : **(Aug.-21)**

Meaning

Just-in-time management approach aims at waste elimination. It is a process oriented approach, contributed to produce better service, with least possible prices and higher efficiency. In 1990's, the application of JIT approach extended to service sector as well. The principles of JIT are applicable to manufacturing as well as service firms. Information Technology (IT) plays a significant role in the implementation of JIT system.

Implementation of JIT in Services

Following activities must be carried out while implementing JIT in services,

1. Avoid disturbances in flow of work of employees.
2. Make service system flexible and train workers, so that they can do any type of work.
3. Spare parts and tools which are frequently used should be made available to reduce set up times.
4. Errors and duplicate work should be avoided to eliminate waste.
5. Make arrangements to reduce work in process.
6. Make the process very simple when customers are part of system retail operations.

2.3.3 Quality Circles

Q26. Define Quality Circles. State the characteristics of Quality Circles.

Ans :

Meaning

"Quality circle is a small group of employees in the same work area or doing similar type of work who voluntarily meet regularly for about an hour every week to identify, analyse and resolve work-related problems, leading to improvement in their total performance and enrichment of their work life."

Although the concept has had some success in white collar operations, the major impact has been among "direct labour" employees in manufacturing where concerns are primarily with quality, cost, specifications, productivity and schedules. By their very nature, quality circles were limited to concerns of the small group of members and few cross-sectional problems were considered.

The major growth of quality circles occurred in the late 1970s and early 1980s, as thousands of companies adopted the concept. However, the concept never met expectations and widespread abandonment resulted by the late 1980s. The major reason for failure was a general lack of commitment to the concept of participation and the lack of interest and participation by the management. From a TQM perspective, quality circles lack the prerequisities of integration with strategy, company goals and management systems. Organisations can up beyond using quality circles by creating task forces, work teams and cross-functional teams.

Characteristics

(i) Small Groups of Employees

It has been learnt by experience that the optimum number of members in any quality circle is about 8 to 10. The minimum and maximum number of members recommended are 5 and 15 respectively to avoid a circle

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becoming inactive (if members are less than 5) or resulting in deprivation of opportunity for active participation by every member (if members are more than 15).

(ii) Members are from the Same Work Area or doing Similar type of Work :

A quality circle is a homogeneous group and not an inter-departmental or interdisciplinary group (for example, in' an assembly area, welding section, stores department etc.).

(iii) Membership of the Quality Circle is Voluntary

Employees decide to join the quality circles voluntarily. No coercion or pressure is to be exerted on them to join or not to join. Nor can any one be barred from joining quality circles by virtue of his being a union leader or for lack of qualification.

(iv) Members meet Regularly for about an Hour every Week

The members of quality circles should meet regularly once in a week for an hour after their working hours or during working hours to discuss the problems related to their work and find solutions to the problems.

(v) Members meet to identify, Analyse and Resolve Work-related Problems

Employees who work in a work place, know best what problems are hindering achievement of good quality, productivity and optimum performance and also how those problems could be solved. It should be noted that only work-related problems -come under the purview of the quality circles and not other issues such as personal grievances or demands.

(vi) Members resolve Work related Problems Leading to Improvement in their Total Performance

As a result of quality circles resolving work related problems relating to quality, productivity, cost reduction, safety etc., the total performance of the work-unit improves, resulting in both tangible and intangible gains to the whole organisation.

(vii) Quality Circles enrich the Work life of the Employees

Quality circles help in enriching the work life of the employees apart from attitudinal changes, cohesive team culture etc. This is because of avoidance of rework, greater job satisfaction, improved working environment and better human relationships among employees. The quality of work life (QWL) of any individual is said to be good only if he/she is enjoying the work that he/she is doing and is happy in the work-environment and finds his/her work meaningful.

Q27. Discuss the potential benefits of Quality Circles.

Ans :

Potential Benefits of Quality Circles are,

1. Effect on individual's characteristics

- Enable the individual to improve personal capabilities.
- Improve the individual's self-respect.
- Help employees change certain personality characteristics.

2. Effect on individual's relations with others

- Increase the respect of the supervisor for employees.
- Increase employee's understanding of the difficulties faced by supervisors.
- Increase management's respect for employees.

3. Effect on employees and their attitudes towards the company

- Change some employees' negative attitude.
- Reduce conflict stemming from the working environment.
- Help employees to understand better the reasons why many problems cannot be solved quickly.
- Instill in the employees a better understanding of the importance of quality.

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2.3.4 Forced field Analysis

Q28. Explain briefly about Forced field Analysis.

(OR)

What is force field analysis?

Ans :

Force-field analysis was developed by Kurt Lewin. It identifies forces that help and those that hinder reaching the desired outcome. It depicts a situation as a balance between two sets of forces: one that tries to change the status quo and one that tries to maintain it. Force-field analysis focuses our attention on ways of reducing the hindering forces and encouraging the positive ones. Force-field analysis encourages agreement and reflection in a group through discussion of the underlying causes of a problem.

When to Use It

Because force-field analysis causes people to think together about what works for and against the status quo, it helps team members to view each case as two sets of offsetting factors. It can be used to study existing problems, or to anticipate and plan more effectively for implementing change. When used in problem analysis, force-field analysis is especially helpful in defining more subjective issues, such as morale, management, effectiveness, and work climate.

Force-field analysis also helps keep team members grounded in reality when they start planning a change by making them systematically anticipate what kind of resistance they could meet. Conducting a force-field analysis can help build consensus by making it easy to discuss people's objections and by examining how to address these concerns.

How to Use It

Step 1

State the problem or desired state and make sure that all team members understand. You can construct the statement in terms of factors working for and against a desired state or in terms of factors working for and against the status quo or problem state.

Step 2

Brainstorm the positive and negative forces.

Step 3

Review and clarify each force or factor. What is behind each factor? What works to balance the situation?

Step 4

Determine how strong the hindering forces are (high, medium, low) in achieving the desired state or from improving the problem state. When the force-field is used for problem analysis, the forces with the biggest impact should be tested as likely causes. If the force-field is used to develop solutions, those factors with the biggest impact may become the focus of plans to reduce resistance to change.

Step 5

Develop an action plan to address the largest hindering forces.

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An example will illustrate the tool.

Promoting	→ ←	**Inhibiting Force**
Poor Health	→ ←	Habit
Smelly Clothing	→ ←	Addiction
Poor Example	→ ←	Taste
Cost	→ ←	Inhibiting Force

Fig. : Objective : Stop smoking

Q29. State the benefits of force field analysis.

Ans :

The following are the benefits of force field analysis

1. Force field analysis helps the team to identify the forces or factors which cause problems.
2. It helps in better understanding of driving and restraining forces, so that the negative factors contributing towards the problem may be reduced or eliminated and the positive factors can be encouraged.
3. The competing forces can be agreed and prioritized with the help of force field analysis.

Thus, force field analysis is one of the important management techniques used for diagnosing the situations.

2.3.5 Five S's

Q30. Explain the components of Five S's tools of TQM.

Ans : **(Nov.-20)**

The 5s are (i) Seiri, (ii) Seiton, (iii) Seiso, (iv) Seiketsu and (v) Shitsuke. These 5s wards comprise a step-wise approach for quality improvement. These are also known as house-keeping steps for quality improvement.

(i) Seiri (means to straighten-up)

It includes : (a) work-in-process (b) unnecessary tools (c) unused machinery (d) defective products and (e) papers and documents.

Differentiate between the necessary and unnecessary and discard the unnecessary.

(ii) Seiton (means putting things in order)

Keep the things in order so that they are ready for use when required, (This will avoid waste of time due to searching for things such as tools, parts, components and the like) "Everything should be at its place and there should be place for everything."

(iii) Seiso (means to clean up)

Every individual should clean the workplace everyday before starting the day's work and also at the time of closing the work. Japanese firms strongly believe in the slogan "keep the work place clean".

(iv) Seiketsu (means personal cleanliness)

Every worker or manager should make it a point to give special attention to his or her , personal cleanliness. Some of the Japanese beliefs are,

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- "There is a healthy mind in a healthy body."
- "Cleanliness is necessary for Godliness."
- "Make it a habit to be clean and tidy, starting with your own person."

All these mean good housekeeping practices.

(v) Shitsuke (means discipline)

Every worker and manager has to follow procedures in the workplace and workshop with utmost sense of discipline. Japanese believe that only with discipline and sincerity in following the principles and procedures, one can contribute significantly to personal and organisational success. It is necessary at have discipline in all aspects of our work to improve quality of products and work life.

2.4 CONTROL TOOLS

Q31. Describe the salient features of Control Tools in the implementation of TQM.

Ans : **(Aug.-17)**

The various Control Tools in the implementation of TQM are as follows :

1. Gantt Chart

This chart is the most frequently used tool to manage small projects. The chart indicates - what must be done and when it must be done. As the project progresses, the chart is updated to indicate the amount of accomplishment toward the plan. In this way the project managers can compare actual project work accomplishment with planned project progress. This chart time-phases activities. Every activity should have a start date and finish date.

2. Network diagram

Network diagram can be defined as the technique of arranging the activities in proper sequence which shows the relationship and dependency of each activity with one another. It usually shows a process or sequence as how a task to be performed effectively. The activities under network diagram represents events using arrows, circles, arcs and nodes respectively.

3. Radar Chart

Also called as web-chart, spider chart and star chart, the radar chart is a graph that looks like a spider web, with spokes radiating from a central point and lines connecting them.

It shows measurements, where several variables contribute to the overall picture. All variables are considered to be of equal importance on a radar chart. Radar chart is used to track or report performance or progress on multiple criteria.

2.4.1 Gantt Chart

Q32. What are Gantt Chart? Explain the steps involved in preparing Gantt Chart.

Ans :

This chart is the most frequently used tool to manage small projects. The chart indicates - what must be done and when it must be done. As the project progresses, the chart is updated to indicate the amount of accomplishment toward the plan. In this way the project managers can compare actual project work accomplishment with planned project progress. This chart time-phases activities. Every activity should have a start date and finish date.

Steps Involved in Preparing a Gantt Chart

The following are the steps involved in preparing a Gantt chart

1. In the first step, the implementation plan is divided into achievable tasks and activities.
2. A realistic completion date is set by estimating the time taken by each task.
3. In this step, all the tasks are divided logically. Lines are used for showing the start and end of a task.

   These lines also depict the relationship between each task.
4. Finally, all the steps are analyzed for determining the issues/obstacles in completing the stated task and any dependent task before starting up of another task.

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2.4.2 Network Diagram

Q33. What is network diagram? State the rules for drawing network.

Ans : **(Imp.)**

Network diagram can be defined as the technique of arranging the activities in proper sequence which shows the relationship and dependency of each activity with one another. It usually shows a process or sequence as how a task to be performed effectively. The activities under network diagram represents events using arrows, circles, arcs and nodes respectively.

Rules

1. Each activity is represented by only one arrow in the network.
2. Network should be developed on the basis of logical or technical dependencies between various activities of the project.
3. The arrow representing activities are indicative of the logical precedence only.
4. The arrow direction indicates the general progression in time.
5. When a number of activities terminate at one event, it indicates that no activity emanating from that event may start unless all activities terminating there have been completed.
6. Events (or) nodes are identified by numbers.
7. The activities are identified by the numbers of their starting and ending events.
8. A network should have only one initial and one terminal node.
9. An event may be a merge, burst or merge and burst event.
10. Dummy activities have to be used, if parallel activities between two events exist without intervening events.
11. Dummy activities have to be used when two or more activities have some of their immediate predecessor activities in common.
12. Looping is not permitted in a network.
13. Errors like dangling and redundancy are to be avoided.

2.4.3 Radar Chart

Q34. Narrate the Radar Chart of TQM.

Ans : **(June-18)**

Also called as web-chart, spider chart and star chart, the radar chart is a graph that looks like a spider web, with spokes radiating from a central point and lines connecting them.

It shows measurements, where several variables contribute to the overall picture. All variables are considered to be of equal importance on a radar chart. Radar chart is used to track or report performance or progress on multiple criteria.

Radar charts are used:

(i) To visually depict the incremental improvements over a period of time

(ii) To measure performance against benchmarks

(iii) As a visual snap shot of progress over several criteria

When to Use

(i) When tracking or reporting performance or progress

(ii) When several variables are being measured to assess overall performance and,

(iii) When it is not necessary to weight the relative importance of the variable, for example, when team members need motivation to achieve results against difficult targets, radar charts are used to show how their performance compares with the best achievable. Radar charts give a very visible way of showing progress and performance against the several targets at the same time.

Construction

The steps involved are:

1. Identify the variables that will be measured. These may come from customer requirements, key performance indicators or organisational goals.

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2. For each variable, determine the measurement scale. It is simplest for each variable to have the same measurement scale such as 1 to 5 or a percentage. However different scales can be used if necessary. Determine which end of the scale represents desirable performance, (i.e. 1 or 5)

3. To draw the chart, divide 360 degrees by the number of criteria to determine the angle between spokes. (For example, if there are four variables, then the angle between stokes is 360/4 or 90 degrees).

   Draw spokes of equal lengths radiating from a central point and spaced evenly around the circle. Label each spoke with its variable. Mark the measurement scale on the spokes, with undesirable performance at the center.

4. For each variable, mark its measurement on the spoke with a large dot. Connect the dots,

5. To show performance at a different time or by another subject, repeat step 4., using different line styles. Add a legend or labels to identify line styles. To show performance of multiple subjects or at multiple times, draw a separate chart for each subject or each time,

6. Assess overall performance and determine needed improvement by observing where the 'web" lies closest to the center point.

2.4.4 The PDCA Cycle

Q35. State PDCA cycle as a tool for assuring continuous process improvement.

Ans : **(June-18, Imp)**

The P-D-C-A cycle was introduced by Edward Deming. P-D-C-A cycle is also called "Deming Wheel" or "Deming Cycle". PDCA cycle is a problem solving process implemented/practised by the companies who aim at continuous improvement. PDCA stands for plan, do, check and act. PDCA has four steps which are repeated in the same sequence again and again to achieve continuous improvement.

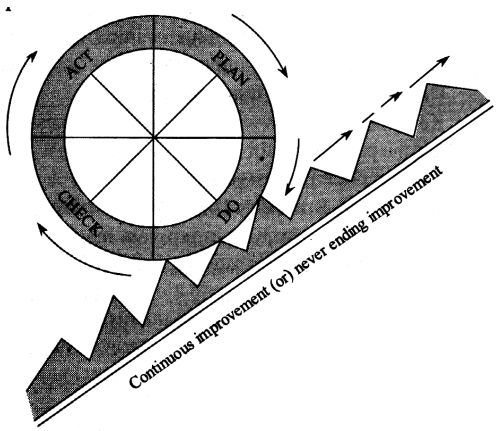

Fig.: Deming Wheel or P-D-C-A Cycle

The four steps of P-D-C-A cycle are,

1. Plan
2. Do
3. Check and
4. Act.

1. Plan

In this step, a team is formed in order to identify the process which requires improvement. The identified process is recorded, qualitative objectives for improvement are set and several techniques for achieving such objectives are discussed. The costs and benefits involved in each alternative is determined and once the alternatives are analyzed a plan is formulated to implement the best alternative with quantifiable measures of improvement.

2. Do

In the second step the team follows the plan and checks the growth or development level. Data is gathered on an on-going basis to assess process improvements. If any variations or deviations are found/traced between what is planned and what is implemented, then such variations are recorded so that appropriate actions are taken against such changes.

3. Check

The data collected by the team at the 'do' step is clearly analyzed in order to determine

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whether the outcomes of the process corresponds to the quantitative objectives set at the 'plan' step. If process outcomes are not according to the planned objectives, then the team either re-assesses the plan or ends the project.

4. Act/Action

If the process is successful in meeting the planned objectives, then the revised process is documented and is regarded as a standard method for all the people who list to use it.

Therefore, the P-D-C-A cycle represents a step -by- step program aiming at continuous improvement. P - D - C - A - cycle process starts with examining the existing situations while collecting data which is used in formulating a plan for improvement (i.e., an effective process is planet for improvement). As soon as the plan is finalized, it is implemented. After finalizing the plan, the implementation progress is properly checked in order to find out whether the process is successful in achieving the improvement or not. If the process is successful, then that process is standardize to practice it continuously for continuous improvement. The complete process of P-D-C-A cycle emphasize preventing the problem instead of finding a solution for it.

2.4.5 Milestone Tracker Diagram

Q36. What is a Milestone Tracker Diagram?

Ans :

"Milestone tackier diagrams are another powerful tool for monitoring time. They are also referred to as **mile-stone slip diagrams** which are based on the assumption that milestones are going to slip.

Milestone tracker diagrams make it impossible to lie. What you are trying to avoid is the common syndrome when the team track the last milestone only, and for the first 11 months of a 12 months project it is on time and then suddenly, two weeks from the end, it is 12 months late.

In the diagram the horizontal dimension represents the planned date. The vertical dimension is the date of the report. Along the top abscissa, the milestones are lined at their original planned data. At each subsequent reporting date their current planned date is shown. If the project goes exactly to schedule, the milestone planned dates will appear as vertical lines going down until they cut the diagonal, when they will stop. However if things are not going according to plan it becomes almost impossible to lie about actual programs.

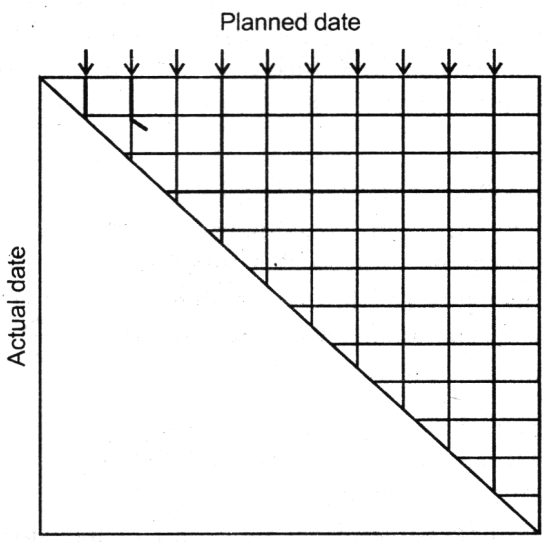

Figure: Milestone tracker

- Say the first milestone is not critical, ask to be convinced and ask why it was chosen. Not all milestones are critical, but ask to be convinced.
- When the first milestone almost hits the diagonal and then starts being shown at every report as slipping down the diagonal and being 99 percent complete, you will be asking just how complete is it.
- If in every report all the milestones are shown as having slipped a week since the last report two weeks ago, you will tell the team to stop lying and just tell you when they actually will finish. You don't want to see milestones slipped every report. You want to see them slipped once and that date then held.

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The milestone tracker diagram can use a colour scheme developed by the Lockheed Aircraft Corporation in the U.S.

- Green means going according to plan.
- Amber means not going according to plan, but containable.
- Red means not going according to plan, with serious impact on the project.

2.4.6 Earned Value Management

Q37. What is Earned Value Management?

Ans :

Earned Value Management (EVM) is a project management technique for measuring project performance and progress in an objective manner. EVM has the ability to combine measurements of scope, schedule, and cost in a single integrated system. Earned Value Management is significant for its ability to provide accurate forecasts of project performance problems.

Earned Value Management is a project management system that combines schedule performance and cost performance to answer the question "what did we get for the money we spent?"

Earned Value Management helps project managers to measure project performance. It is a systematic project management process used to find variances in projects based on the comparison of work performed and work planned. EVM is used on the cost and schedule control and can be very useful in project forecasting. The project base line is an essential component of EVM and serves as a reference point for all EVM related activities. EVM provides quantitative data for project decision making.

Basic Concepts of EVM

(i) All project steps earn value as work is completed,

(ii) The Earned Value (EV) can then be compared to actual costs and planned costs to determine project performance and predict future performance trends,

(iii) Physical progress is measured in terms of money (rupees) so schedule performance and cost performance can be analysed in the same terms.

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Short Question and Answers

1. Check Sheets.

Ans :

The check sheet is a simple document that is used for collecting data in real-time and at the location where the data is generated. The document is typically a blank form that is designed for the quick, easy, and efficient recording of the desired information, which can be either quantitative or qualitative. When the information is quantitative, the checksheet is sometimes called a tally sheet.

A defining characteristic of a checksheet is that data is recorded by making marks ("checks") on it. A typical checksheet is divided into regions, and marks made in different regions have different significance. Data is read by observing the location and number of marks on the sheet.

2. Define Histogram.

Ans :

Histograms display large amounts of data that are difficult to interpret in their raw form. By providing a visual summary of the data, histograms reveal whether the process is centred around a target value, the degree of variation in the data and whether the data meet specifications. Thus, histograms could help in identifying process capability relative to customer requirements.

A histogram analyses and graphically displays quantitative data rather than qualitative data. TQM practitioners use histograms to display information about process and activity performance. Histograms are most effective when they display information with some natural order, such as number of defects found.

3. Run Chart.

Ans :

A run chart is a graphical representation of the data which is plotted over time. Run charts are also called as trend charts or run sequence plot. A run chart is a graph that displays observed data in a time sequence. The vertical axis (y-axis) represents the measurement and the horizontal axis (x-axis) represents the time scale. A run chart displays the changes occurring in the process, performance or quality productivity during a particular period of time. Run charts are used to monitor the production volume, costs and customer satisfaction indices.

4. Define Scatter Diagram.

Ans :

Scatter diagrams or scatter plots are used to determine whether relationship really exists between two process characteristics and the direction of the relationship.

A scatter diagram graphically illustrates the relationship between variables, typically based on quantitative data. They reveal bi-variate relationships, that is relationships between pairs of variables, such as number of defects per batch against changes in the speed of production line, or production time per unit against hours of training.'

5. Process Mapping.

Ans :

Process mapping provides a process tool with which to understand and change the processes to help improve the bottom-line and competitive position.

6. Regression Analysis.

Ans :

Regression analysis is a statistical tool used to find a model for relationship between pairs of numerical data. The model is a straight line (linear regression) or a curve (non-linear regression) that fits the data best. The results of a regression analysis are an equation for that line or curve, a value called r^2 that indicates how good the fit is and other statistical measures that tell how well the data match the model.

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7. Resource Utilization and Customer Service Analysis.

Ans :

Resources management" is focused on the effective use and maintenance of the organisation's physical assets (buildings, finance, information, technology, suppliers and materials) "Utilisation" can be thought of as the percentage that a resource (e.g. machine, server, cashier, inspector etc.) is used.

"Resources" refer to tangible assets that help transform inputs into outputs in a process. Two categories of resources are:

1. Capital resources which include fixed assets such as level, building, facilities, equipment, machines and information systems.
2. Labor or human resources which include people such as engineers, operations, customer service representatives and sales staff. Resource utilisation may refer to utilisation of various kinds of resources e.g. equipment or machine utilisation, rental equipment utilisation, human resource utilisation, land unitisation, building space utilisation, shop floor utilisation, storage space utilisation, supply chain utilisation and so on.

8. The Five Why's.

Ans :

The "Five Whys" technique or "Why-Why diagram" helps to identify the root causes of a problem. The method helps the problem-solving team to reorganise the broad network of promem causes and the relationship among these causes. It can indicate the best areas to address for short and long-term solutions.

9. Kaizen.

Ans :

Kaizen is a Japanese term used to explain the significance of continuous improvement. The concept of Kaizen was started by Masaaki Imai. According to Kaizen philosophy, the success and survival of an organization is possible only when all its organizational members determine and execute improvements regularly. In order to improve the quality of an organization, all the departments or segments such as cost, employee safety, skill development, supplier relations, new product development and meeting delivery schedules need improvement.

10. JIT.

Ans :

Just-in-time (or JIT) is defined as "a philosophy of manufacturing based on planned elimination of all wastes and continuous improvement of productivity".

JIT is an approach that seeks to eliminate all sources of waste in production activities by providing the right part at the right place at the right time.

11. Quality Circles.

Ans :

"Quality circle is a small group of employees in the same work area or doing similar type of work who voluntarily meet regularly for about an hour every week to identify, analyse and resolve work-related problems, leading to improvement in their total performance and enrichment of their work life."

Although the concept has had some success in white collar operations, the major impact has been among "direct labour" employees in manufacturing where concerns are primarily with quality, cost, specifications, productivity and schedules. By their very nature, quality circles were limited to concerns of the small group of members and few cross-sectional problems were considered.

12. Force field analysis.

Ans :

Force-field analysis was developed by Kurt Lewin. It identifies forces that help and those that hinder reaching the desired outcome. It depicts a situation as a balance between two sets of forces: one that tries to change the status quo and one that tries to maintain it. Force-field analysis focuses our attention on ways of reducing the hindering forces and encouraging the positive ones. Force-field analysis encourages agreement and reflection in a group through discussion of the underlying causes of a problem.

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13. Gantt Chart.

Ans :

This chart is the most frequently used tool to manage small projects. The chart indicates - what must be done and when it must be done. As the project progresses, the chart is updated to indicate the amount of accomplishment toward the plan. In this way the project managers can compare actual project work accomplishment with planned project progress. This chart time-phases activities. Every activity should have a start date and finish date.

14. Network diagram.

Ans :

Network diagram can be defined as the technique of arranging the activities in proper sequence which shows the relationship and dependency of each activity with one another. It usually shows a process or sequence as how a task to be performed effectively. The activities under network diagram represents events using arrows, circles, arcs and nodes respectively.

15. Radar Chart.

Ans :

Also called as web-chart, spider chart and star chart, the radar chart is a graph that looks like a spider web, with spokes radiating from a central point and lines connecting them.

It shows measurements, where several variables contribute to the overall picture. All variables are considered to be of equal importance on a radar chart. Radar chart is used to track or report performance or progress on multiple criteria.

16. Earned Value Management.

Ans :

Earned Value Management (EVM) is a project management technique for measuring project performance and progress in an objective manner. EVM has the ability to combine measurements of scope, schedule, and cost in a single integrated system. Earned Value Management is significant for its ability to provide accurate forecasts of project performance problems.

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Choose the Correct Answers

1. _____ is an important management tool which helps in collecting and examining the data systematically. [c]
   (a) Histogram (b) Force-field analysis
   (c) Check sheets (d) Tree diagram.
2. Mean charts and range charts are the types of _____. [a]
   (a) Control charts (b) Gantt charts
   (c) Run charts (d) None
3. The patterns of scatter diagram are _____. [d]
   (a) Positive correlation (b) Negative correlation
   (c) Correlation by stratification (d) All the above.
4. Cause-and-effect diagram is also known as _____. [c]
   (a) Ishikawa diagram (b) Fish bone diagram
   (c) Both (a) and (b) (d) Scatter diagram.
5. "Vital few and the trivial many" is the principle followed by _____. [b]
   (a) Cost-benefit analysis (b) Pareto analysis
   (c) Cause and effect analysis (d) Force field analysis.
6. A measure of process capability is given by the capability index (C_p) = [a]
   (a) $\frac{USL - LSL}{6\sigma}$ (b) $\frac{LSL - LSL}{6\sigma}$
   (c) $\frac{6\sigma}{USL - LSL}$ (d) None
7. _____ is a systematic technique which is used for analyzing the problems both in manufacturing and service operations. [c]
   (a) RU/CS analysis (b) SWOT analysis
   (c) Five why's (d) PESTLE analysis.
8. The cause and effect diagram is broadly classified into. [d]
   (a) Root cause analysis (b) Process analysis
   (c) Interrelationship diagram (d) All the above
9. The Japanese term 'Seiton' represents. [b]
   (a) Organization (b) Neatness
   (c) Cleaning (d) Discipline.
10. _____ is a polar graph with appearance of a spider diagram. [a]
    (a) Radar chart (b) Control chart
    (c) Pareto chart (d) None

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Fill in the blanks

1. _____ is an analysis which helps in determining those forces and factors which drives them towards achieving the goal.
2. Deming wheel is also called as _____
3. _____ is a small group team of employees who work on the same task and meet regularly for determining, analyzing and resolving work related problems/issues.
4. _____ is a tool developed in Japan for improving the housekeeping of an operation.
5. A tool which is used to establish the 'best fit' linear relationship between two variables is _____
6. A graphical representation of the recorded values in a data set according to the frequency of its occurrence is called a _____.
7. The check sheets are very easily used for recording the _____ data and events.
8. _____ is an index of measuring the delivered performance of a plant or an equipment on the basis of good output.
9. A Gantt chart is also known as _____.
10. The purpose of _____ is to assess the achievement or slippage of the progress.

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ANSWERS

1. Force-field analysis
2. PDCA cycle
3. Quality circle
4. Five S
5. Regression analysis
6. Histogram
7. Non-conforming
8. Overall Equipment Effectiveness (OEE)
9. Bar chart
10. Milestone tracker diagram.

UNIT III

Techniques of TQM:

Quantitative techniques: Failure Mode Effect Analysis (FMEA), Statistical Process Control (SPC), Quality Function Deployment (QFD), Design of Experiments (DOE), Quality by Design and Monte Carlo Technique (MCT). Qualitative techniques: Benchmarking, The Balanced Scorecard, Sales and Operations Planning, Kanban and Activity Based Costing (ABC). Taguchi methods: Quality loss function, Orthogonal arrays, Signal-to-Noise ratio: Nominal- the- best, Target-the-best, Smaller- the-best, Larger-the-best. Parameter design, Tolerance design.

3.1 Quantitative Techniques of TQM

Q1. Describe various Quantitative Techniques of TQM.

Ans : **(Imp.)**

The various quantitative techniques of TQM are as follows:

1. Failure Mode Effect Analysis

Failure modes and effects analysis (FMEA) is a step-by-step approach to identify all possible failures in a design, a manufacturing or assembly process, or a finished product or a filial service. "Failure modes" means the ways or modes, in which something may fail. "Failures" are errors or defects which affect the customer and can be potential or actual failures. "Effects analysis" refers to the study of the consequences or effects of those failures.

Failure modes and effects analysis (FMEA) is also called as "potential failure modes and effects analysis", or "failure mode, effects and critically analysis" (FMECA).

Definitions

(i) FMEA is one of the tools of total quality management which helps in finding out the possible failure modes of a design, product, process or service and setting up ways of preventing their recurrences.

(ii) It is a methodology to assess and reduce risk in systems, products or services. It aims to define, identify, prioritise and eliminate known or potential failures at an early stage as possible.

2. Statistical Process Control

Statistical Process Control (SPC) is the application of statistical techniques to determine whether the output of a process conforms to the product or service design. In SPC, control charts are used primarily to detect production of defective products or services or to indicate that the production process has changed and that products or services will deviate from their design specifications unless something is done to correct "the situation."

3. Quality Function Deployment

The Japanese developed an approach called "quality function deployment" (QFD) to meet customer's requirements throughout the design process and also in the design of production systems. Quality function deployment is a method by which cross-sectional teams translate customer requirements into appropriate design requirements at each stage of the product development process.

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4. Design of Experiments

Design of experiments (DOE) is defined as a branch of applied statistics that deals with planning, conducting, analyzing, and interpreting controlled tests to evaluate the factors that control the value of a parameter or group of parameters. DOE is a powerful data collection and analysis tool that can be used in a variety of experimental situations.

It allows for multiple input factors to be manipulated, determining their effect on a desired output (response). By manipulating multiple inputs at the same time, DOE can identify important interactions that may be missed when experimenting with one factor at a time. All possible combinations can be investigated (full factorial) or only a portion of the possible combinations (fractional factorial).

QFD is an excellent way for firms to capture the "voice of the customer". It ensures that the customer is the focus of all design activities and "dictates" all design trade-offs. QFD is a customer-driven planning process to guide the design, manufacturing and marketing of goods. It tries to eliminate the gap between what customers want in a new product and what the product must deliver.

5. Quality by Design

Quality by design" is the practice of using a multidisciplinary team to conduct conceptual thinking, product design and production planning all at one time. It is also known as "concurrent engineering", "simultaneous engineering" ox "parallel engineering". The team is composed of specialists from business, engineering, production and customer base. Suppliers of process equipment, purchased parts, and services are also included on the team at appropriate times. "Quality by design" has recently encouraged changes in management structures.

3.1.1 Failure Mode Effect Analysis (FMEA)

Q2. Examine Failure Mode Effect Analysis (FMEA) in detail.

Ans : **(Dec.-20)**

Failure modes and effects analysis (FMEA) is a step-by-step approach to identify all possible failures in a design, a manufacturing or assembly process, or a finished product or a filial service. "Failure modes" means the ways or modes, in which something may fail. "Failures" are errors or defects which affect the customer and can be potential or actual failures. "Effects analysis" refers to the study of the consequences or effects of those failures.

Failure modes and effects analysis (FMEA) is also called as "potential failure modes and effects analysis", or "failure mode, effects and critically analysis" (FMECA).

Definitions

(i) FMEA is one of the tools of total quality management which helps in finding out the possible failure modes of a design, product, process or service and setting up ways of preventing their recurrences.

(ii) It is a methodology to assess and reduce risk in systems, products or services. It aims to define, identify, prioritise and eliminate known or potential failures at an early stage as possible.

(iii) FMEA is a preventive approach for systematically mapping the causes, effects and possible actions regarding the observed problems or failures.

(iv) FMEA is a pro-active tool which is used to foresee the probqble failures which can occur at a later stage. It involves critical analysis of each and every process with the aim of identifying problems which may emerge in the future.

FMEA is used during design stage to prevent failures, before and during on going operation of

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the process for controlling the process. Ideally, FMEA begins during the earliest conceptual stages of design and continues throughout the life of the product or service.

FMEA emphasises the analysis of the processes, whereby answers to the following questions are sought in advance for each process step:

(i) How can process execution fail?

(ii) What are the possible causes of this failure?

(iii) How important is the prevention of this failure?

(iv) Who is responsible for the implementation of the solution to this problem?

(v) When will this be executed.

Q3. What are the different types of FEMA?

Ans :

Types

Some of the types of FMEA are as follow,

Service FMEA

Service FMEA focuses on the failure that occurs in providing service to the customers and this is usually seen in the service industry. It is used to analyze the defect in the service and take corrective actions to provide better services to the customers.

2. Maintenance FMEA

Maintenance FMEA is used to identify a fault or problem in the assembly line or to test the potential failure of tool or equipment before the final product reaches the customer.

3. System FMEA

Under System FMEA, each design stage is evaluated along with function of each subsystem to detect the problem or failure.

4. Design FMEA

Design FMEA is used to reduce the faults in design before the process reaches the manufacturing stage.

5. Process FMEA

Process FMEA is used to detect causes of failure in the manufacturing process by identifying the causes of failure.

Q4. State the objectives and benefits of FEMA.

Ans :

Objectives

1. The objective of FEMA is to anticipate failures and prevent them from occurring. FEMA prioritizes failures and attempts to eliminate their causes.
2. FEMA is an engineering technique is used to define, identify and eliminate known and or potential failures, problems, errors which occur in the system, design, process and service before they reach the customer.

Benefits

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

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3.1.2 Statistical Process Control (SPC)

Q5. Examine Statistical Process Control (SPC) in detail.

Ans : **(Dec.-20, Imp.)**

Statistical Process Control (SPC) is the application of statistical techniques to determine whether the output of a process conforms to the product or service design. In SPC, control charts are used primarily to detect production of defective products or services or to indicate that the production process has changed and that products or services will deviate from their design specifications unless something is done to correct "the situation."

Measurement Tools of SPC (Statistical process Control)

The various measurement tools of SPC are,

1. Check sheets
2. Histogram
3. Run charts
4. Control charts
5. Flow charts
6. Scatter diagram
7. Pareto diagrams
8. Cause and effect analysis
9. Process capability measurement.

Q6. Define Control charts. Explain different types of control charts.

Ans :

A control chart is a statistical tool used to distinguish between variation in a process resulting from common causes and variation resulting from special causes. It presents a graphic display of process stability or instability over time. Every process has variation. Some variation may be the result of causes which are not normally present in the process. This could be special cause variation. Some variation is simply the result of numerous, ever-present differences in the process. This is common cause variation. Control Charts differentiate between these two types of variation

Types of Control Charts

There are two main categories of Control Charts, those that display attribute data, and those that display variables data.

1. Attribute Data

This category of Control Chart displays data that result from counting the number of occurrences or items in a single category of similar items or occurrences. These "count" data may be expressed as pass/fail, yes/no, or presence/absence of a defect.

It is quite difficult to represent the quality features numerically. So, all the inspected products are categorized into conformity or non-conformity items on the basis of quality characteristic specifications. Control charts for attributes assume two values such as good or bad, pass or fail, defective or non-defective.

The control charts for attributes helps in determining whether the items are according to the standard or not. The control charts for attributes are further classified into two types. They are,

(a) Number of defective charts

(b) Charts for defects.

(a) Number of Defective Charts: The number of defective charts are further classified into two types as,

(i) p chart

(ii) np chart.

(i) p Chart: p chart is one type of attribute control chart which helps the firm to exercise control over the percentage or proportion of defective items per sample, p charts are also called 'control charts for fraction non-conforming'. A firm makes use of p charts

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when the size of the sub-groups is not equal. The upper control limit and lower control limit of p charts are calculated using the following formulae,

$$\boxed{\begin{array}{l}UCL = \bar{p} + 3\sigma \\ LCL = \bar{p} - 3\sigma\end{array}} \quad \begin{array}{l}UCL = \bar{p} + 3\sqrt{\dfrac{(1-\bar{p})\bar{p}}{n}} \\ LCL = \bar{p} - 3\sqrt{\dfrac{(1-\bar{p})\bar{p}}{n}}\end{array}$$

Value of $\bar{P}$ = Center Line (CL)

ii) np Chart: The *np* chart is another type of attribute control chart applied when the size of the sample is constant and the size of the subgroups is equal. The upper control limit and lower control limit of these charts are calculated with the help of the following formulae,

$$UCL = \overline{np} + 3\sqrt{\overline{np}+(1-\bar{p})}$$

$$LCL = \overline{np} - 3\sqrt{np+(1-\bar{P})}$$

Value of $n\ \bar{p}$ = Center Line (CL)

(b) Charts for Defects: The charts for defects help in identifying the defects in an item. With the help of these charts, the quality assurance personnel determines the number of defects in an item. These charts are of two types. They are,

(i) C charts

(ii) μ charts.

(i) C Charts

C charts are the control charts for determining defects which help the firm in reducing the defects per unit. These charts are mainly used in the manufacturing and inspection processes or organizations. The upper control limit and lower control limit of *C* charts are calculated with the help of the following formulae,

$$\boxed{\begin{array}{l}UCL = \bar{C} + 3\sqrt{\bar{C}} \\ LCL = \bar{C} - 3\sqrt{\bar{C}}\end{array}}$$

Value of $\bar{C}$ = Center Line (CL)

(ii) μ Charts

The μ charts are mainly used for determining the non-conformities per unit produced by a manufacturing process. The upper control limit and lower control limit of these charts are calculated with the help of the following formulae,

$$\boxed{\begin{array}{l}UCL = \bar{\mu} + 3\sqrt{\dfrac{\bar{\mu}}{n(i)}} \\ LCL = \bar{\mu} - 3\sqrt{\dfrac{\bar{\mu}}{n(i)}}\end{array}}$$

$$\bar{\mu} = \frac{\text{Total non-conformities in k sub-groups}}{\text{Total number of inspection units}}$$

i.e., $$\bar{\mu} = \frac{C(1)+C(2)+....\ C(k)}{n(1)+n(2)+....n(k)}$$

Where,

n(i) = Number of inspection units and

C(z) = Number of non-conformities

Value of $\bar{\mu}$ = Center Line (CL).

2. Variables Data

This category of Control Chart displays values resulting from the measurement of a continuous variable. Examples of variables data are elapsed time, temperature, and radiation dose.

1. Control Charts for Variables

Variable is a single measurable quality characteristic. Dimension, weight or volume are the examples of variables. The quality features of variables are measured on variable scale of values.

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Temperature, pressure, tensile strength and hardness are the common examples of variable characteristics. Variable charts not only control the mean value of the quality characteristic but also control its variability. The control chart for variables helps in providing more information about the performance of the process than the control chart for attributes. The control chart for variables is further classified into three types as follows,

(a) Mean chart - X chart

(b) Range chart - *R* chart

(c) a charts for standard deviation.

(a) Mean Chart - $\bar{X}$ Chart

The control chart for means (averages) controls the process average or mean quality level. These charts are also called ' *X* chart'. The Upper Control Limit (UCL) and Lower Control Limit (LCL) for the ~*X* charts are calculated with the help of following formulae,

$UCL_{\bar{X}} = \bar{\bar{X}} + A_2\bar{R}$

$LCL_{\bar{X}} = \bar{\bar{X}} + A_2\bar{R}$

Value $\bar{\bar{X}}$ – Center Line (CL).

(b) Range Chart (R Chart)

The control chart for range controls the process range. These charts are also called as *R* charts. The upper control limit (UCL) and lower control limit (LCL) for the *R* charts are calculated as follows,

$UCL_R = D_4\bar{R}$

$LCL_R = D_3\bar{R}$

Value of $\bar{R}$ = Center line.

(c) σ Charts for Standard Deviation

The charts for standard deviation are also called 'S charts', 'σ' charts are mainly used for controlling the variability of larger sample sizes. The Upper Control Limit (UCL) and Lower Control Limit (LCL) of S charts are calculated with the help of following formulae,

$UCL_S = B_4\bar{S}$

$LCL_S = B_3\bar{S}$

Value of $\bar{S}$ = Center Line)

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PROBLEMS

1. A company bottles soft drinks. The bottle comes in only one flavour and only one size (16 ounces).

The first daily samples of till weights of 20 bottles are,

Sample	$\bar{X}$	R
1	16.05	0.20
2	16.04	0.25
3	15.98	0.62
4	15.91	0.71
5	16.02	0.58
6	16.09	0.37
7	15.95	0.35
8	16.06	0.21
9	15.94	0.29
10	15.97	0.46

Given

$A_2 = 0.180$

$D_3 = 0.414$

$D_4 = 1.586$

(i) Compute the control limits draw X and R charts.

(ii) Plot the 10 points and discuss whether the production process is in control.

Sol : **(Imp.)**

Step 1:

Calculate the overall mean $\bar{\bar{X}}$ of all groups and average range $\bar{R}$ for all groups.

$$\bar{\bar{X}} = \frac{\Sigma X}{k}$$

Where,

k = number of samples

$$= \frac{16.05+16.04+15.98+15.91+16.02+16.09+15.95+16.06+15.94+15.97}{10}$$

$$= \frac{160.01}{10} = 16.001$$

$$\bar{R} = \frac{\Sigma R}{K} = \frac{0.20+0.25+0.62+0.71+0.58+0.37+0.35+0.21+0.29+0.46}{10}$$

$$= \frac{4.04}{10} = 0.404$$

Number of observations = 20 (Given)

$\therefore$ n = 20

For n = 20, $A_2 = 0.180$, $D_3 = 0.414$, $D_4 = 1.586$.

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Step 2 :

Mean Chart ($\bar{X}$ Chart)

Upper Control Limit

$$UCL_{\bar{X}} = \bar{\bar{X}} + A_2\bar{R} = 16.001 + 0.180(0.404)$$

$$= 16.001 + 0.0727 = 16.0737$$

Lower Control Limit

$$LCL_{\bar{X}} = \bar{\bar{X}} - A_2\bar{R} = 16.001 - 0.180(0.404)$$

$$= 16.001 - 0.0727 = 15.9283$$

Central Line

$$\bar{\bar{X}} = 16.001$$

Step 3

Range Chart (R-chart)

Upper Control Limit

$$UCL_R = D_4\bar{R} = 1.586 \times 0.404$$

$$= 0.6407$$

Lower Control Limit

$$LCL_R = D_3\bar{R} = 0.414 \times 0.404$$

$$= 0.1673$$

Central Line

$\therefore \quad \bar{R} = 0.404$

Therefore, $n = 20$

Mean Chart ($\bar{X}$)

$$\bar{\bar{X}} = 16.001$$

$$UCL_{\bar{X}} = 16.0737$$

$$LCL_{\bar{X}} = 15.9283$$

Range Chart (R)

$$\bar{R} = 0.404$$

$$UCL_R = 0.6407$$

$$LCL_R = 0.1673$$

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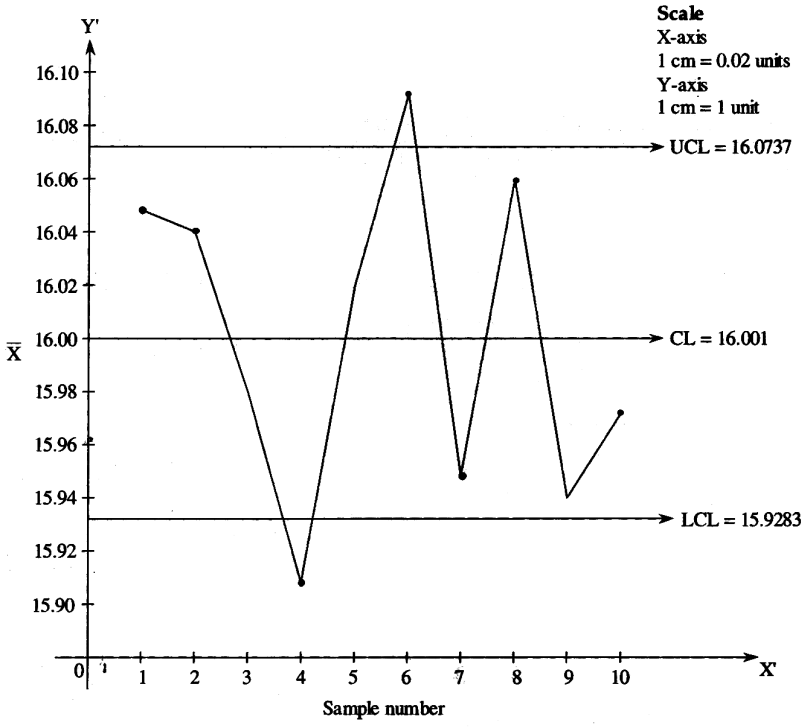
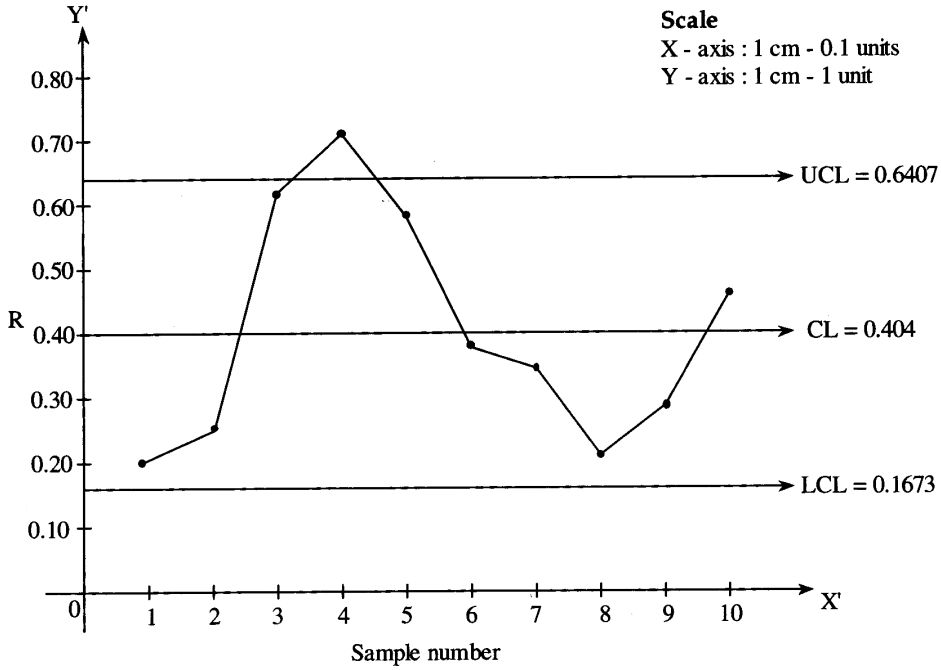
Mean Graph



Comment

Here, there are two points, one lie outside the UCL and one point below the LCL. Hence, we can say that production process is out of control.

Range Graph



2. Construct a fraction defective control chart to the data given below which represents the number of defective items obtained in different sample of size 10.

Sample No	1	2	3	4	5	6	7	8
Defectives	3	2	1	9	3	2	1	1

Sol. :

n = 10, k = 8

S.No.	Defectives (d_i)	$P = d_i/n$
1	3	0.3
2	2	0.2
3	1	0.1
4	9	0.9
5	3	0.3
6	2	0.2
7	1	0.1
8	1	0.1
		2.2

$$\bar{P} = \frac{1}{k}\sum P_i = \frac{1}{8}(2.2) = \frac{2.2}{8} \qquad \bar{q} = 1 - \bar{p} = 1 - 0.275 = 0.725$$

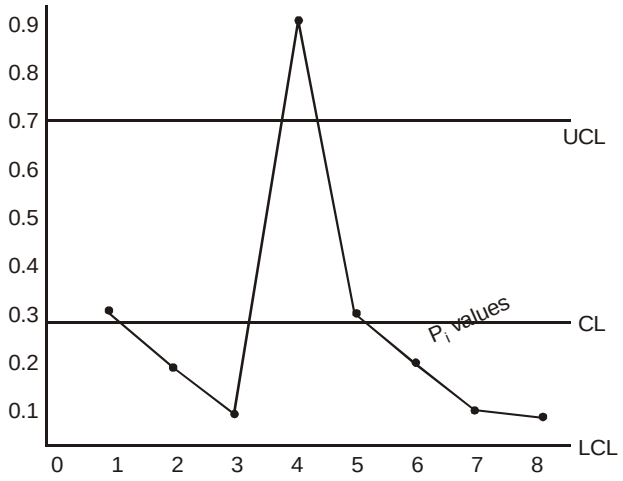
$$\bar{P} = 0.275$$

The control limits are :

$$CL = \bar{p} = 0.275$$

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}\bar{q}}{n}} = 0.275 + 3\sqrt{\frac{(0.275)(0.275)}{10}} = 0.698$$

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}\bar{q}}{n}} = 0.275 - 3\sqrt{\frac{0.275(0.725)}{10}} = -0.148$$



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Conclusion

The points are falling outside UCL & LCL therefore we conclude that it is out of control.

3. Construct the fractional defective control chart for the following data which gives the number of defectives in 10 samples containing 2000 items each.

Sample No.	1	2	3	4	5	6	7	8	9	10
Defective	425	430	216	341	225	322	280	306	337	305

Sol. :

K = 10, n = 2000

S.No.	Defectives	Pi = d_i/n
1	425	0.2125
2	430	0.215
3	216	0.108
4	341	0.1705
5	225	0.1125
6	322	0.161
7	280	0.14
8	306	0.153
9	337	0.1685
10	305	0.1525
		1.5935

$$\bar{P} = \frac{1}{k}\sum P_i$$

$$= \frac{1}{10}(1.5935)$$

$$= 0.1595$$

$$\bar{q} = 1 - \bar{p}$$

$$= 0.8405$$

$$CL = \bar{p}$$

$$= 0.1595$$

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$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}\bar{q}}{n}}$$

$$= 0.1595 + 3\sqrt{\frac{0.1595 \times 0.8405}{2000}}$$

$$= 0.1595 + 3\sqrt{\frac{0.13405975}{2000}}$$

$$= 0.1595 + 3\sqrt{0.0000670}$$

$$= 0.1595 + 3\ (0.008187)$$

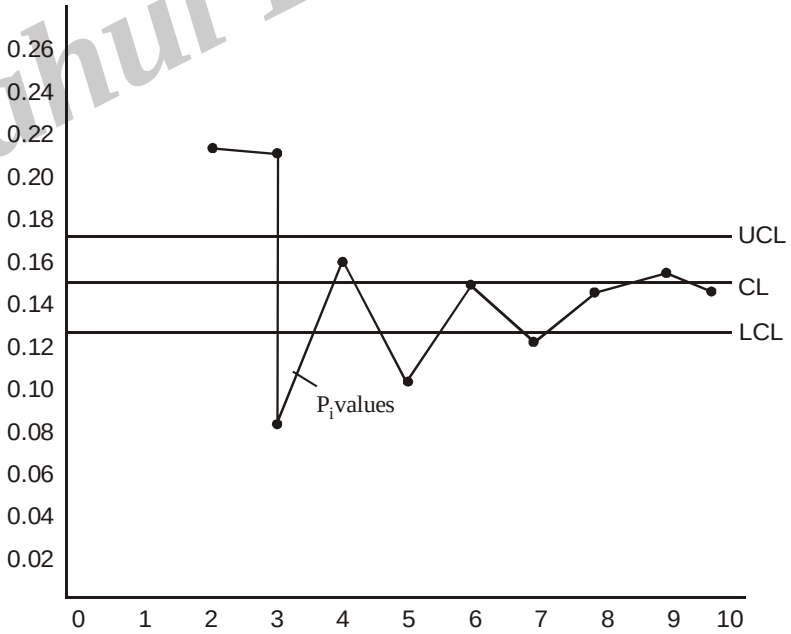
$$= 0.1595 + 0.024561 = 0.1840$$

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}\bar{q}}{n}} = 0.1595 - 3\sqrt{\frac{0.1595 \times 0.8405}{2000}}$$

$$= 0.1595 - 3\sqrt{\frac{0.13405975}{2000}}$$

$$= 0.1595 - 3\sqrt{0.0000670}$$

$$= 0.1595 - 3\ (0.008187) = 0.1595 - 0.024561 = 0.13493$$



Conclusion

The points are falling outside UCL and LCL therefore we conclude that it is out of control.

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3.1.3 Quality Function Deployment (QFD)

Q7. Describe Quality Function Deployment (QFD) as a tool of TQM.

Ans : **(Jan.-17, Imp.)**

The Japanese developed an approach called "quality function deployment" (QFD) to meet customer's requirements throughout the design process and also in the design of production systems. Quality function deployment is a method by which cross-sectional teams translate customer requirements into appropriate design requirements at each stage of the product development process.

QFD is an excellent way for firms to capture the "voice of the customer". It ensures that the customer is the focus of all design activities and "dictates" all design trade-offs. QFD is a customer-driven planning process to guide the design, manufacturing and marketing of goods. It tries to eliminate the gap between what customers want in a new product and what the product must deliver.

Quality function deployment refers to both determining what will satisfy the customer and secondly, translating those customer desires into the target design. QFD is used early in the production process to determine what will satisfy the customer and also where to deploy quality efforts.

QFD originated as a formal concept at Kobe Shipyards of Mitsubishi Heavy Industries in 1972 and quickly spread to other Japanese industries, particularly the automobile industry. Companies that use QFD claim that design cycle time can be cut in half, engineering changes can be reduced by two-thirds and customer demands can be met better than ever before.

At the strategic level, QFD represents a challenge and the opportunity for the top management to break out of its traditional narrow focus on results which can only be measured after the fact, and to view the broader process of how results are obtained. At the tactical and operation levels, QFD departs from the traditional product planning in which product concepts are originated by design teams or research and development groups, tested and refined, produced and marketed. A considerable amount of wasted effort and time is spent redesigning products and production systems until customer needs are met. If customer needs can be identified properly in the first place, then such wasteful effort is eliminated. This is the principal focus of QFD.)

Q8. Explain the principles of QFD.

Ans : **(Nov.-21)**

Principles of QFD

1. Analysis and Integration

- Careful analysis is an important aspect of quality deployment.
- Separate a product's main functions from the quality needed to achieve that functionality.
- Separate the required quality of the world of the market from the quality characteristics of the world of technology.

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- Separate cost issues from quality issues.
- Organize the deployment table so that items are first analyzed and then reintegrated.
- Analysis and integration is the first principle of QFD.

2. Diversification and Visualization

- Study items that have been analyzed and summarized in the deployment table from a variety of perspectives.
- A house of quality is a two-dimensional matrix studying the world of the market and the world of technology.
- Deployment tables and matrices are visualizations of data that can be viewed by a third party.
- Visualization of data makes it possible to obtain corrections and comments from a third party.
- Diversification and visualization is the second principle of QFD.

3. Generalization and Localization

- Use a bird's-eye view of the whole to ascertain critical components.
- Critical components can be expanded and studied in detail.
- What is optimal for a particular component is not necessarily optimal for the whole.
- It is important to achieve a balance between generalization and localization.
- Generalization and localization is the third principle of QFD.

Q9. Explain the applications of QFD.

Ans : **(Nov.-21)**

Applications of QFD

1. Formulating planned quality and design quality.
2. Benchmarking the products of the competitors
3. Developing new product which help in differentiating the firm from its competitors
4. Interpreting and collecting the market quality information.
5. Transmitting the relevant quality information to further processes.
6. Using the fixed design into manufacturing.
7. Finding out the control points for the 'gemba' (a Japanese term which means a place at which the source information is learned).
8. Decreasing basic quality problems and variations in design.

Q10. What are the benefits and limitations of QFD?

Ans : **(Nov.-21)**

Benefits

1. Improves Customer Satisfaction

Quality function deployment looks past the usual customer response and attempts to define the requirements in a set of basic needs, which are compared to all competitive information. All competitors are evaluated equally from customer and technical perspectives. This information can then be prioritized using a pareto diagram. Management can then place resources where they will be the most beneficial in improving quality. Also, QFD takes the experience and information that are available within an organization and puts them together as a structured format that is easy to assimilate. This is important when an organization's employee leaves a particular project and a new employee is hired.

2. Reduces Implementation Time

Fewer engineering changes are needed when using QFD, and, when used properly, all conflicting design requirements can be

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identified and addressed prior to production. This results in a reduction in retooling, operator training, and changes in traditional quality

Control measures. By using QFD, critical items are identified and can be monitored from product inception to production. Toyota reports that the quality of their product has improved by one-third since the implementation of QFD.

3. Promotes Teamwork

Quality function deployment forces a horizontal deployment of communication channels. Inputs are required from all facets of an organization, from marketing to production to sales, thus ensuring that the voice of the customer is being heard and that each department knows what the other is doing.

4. Provides Documentation

A database for future design or process improvements is created. Data that are historically scattered within operations, frequently lost and often referenced out of context, are now saved in an orderly manner to serve future needs. This database also serves as a training tool for new engineers. Quality function deployment is also very flexible when new information is introduced or things have to be changed on the QFD matrix.

Limitations

1. In case of a new market, it is very difficult to determine the customer requirements as the customers themselves are not sure of their needs.
2. The QFD process is tedious and time consuming.
3. Sometimes the process of identifying the customer's real needs consume a lot of time which leads to delay in process.
4. QFD results in conflicts between marketing researchers and engineers at the time of translating the customer preferences into technical requirements.
5. There exists a problem in the selection of the chart or format to complete a particular project.

3.1.4 Design of Experiments (DOE)

Q11. Describe the steps involved in the Design of Experiments (DOE). And state its merits.

Ans : **(Aug.-21, Imp.)**

Meaning

Design of experiments (DOE) is defined as a branch of applied statistics that deals with planning, conducting, analyzing, and interpreting controlled tests to evaluate the factors that control the value of a parameter or group of parameters. DOE is a powerful data collection and analysis tool that can be used in a variety of experimental situations.

It allows for multiple input factors to be manipulated, determining their effect on a desired output (response). By manipulating multiple inputs at the same time, DOE can identify important interactions that may be missed when experimenting with one factor at a time. All possible combinations can be investigated (full factorial) or only a portion of the possible combinations (fractional factorial).

A strategically planned and executed experiment may provide a great deal of information about the effect on a response variable due to one or more factors. Many experiments involve holding certain factors constant and altering the levels of another variable. This "one factor at a time" (OFAT) approach to process knowledge is, however, inefficient when compared with changing factor levels simultaneously.

Many of the current statistical approaches to designed experiments originate from the work of R. A. Fisher in the early part of the 20th century.

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Fisher demonstrated how taking the time to seriously consider the design and execution of an experiment before trying it helped avoid frequently encountered problems in analysis. Key concepts in creating a designed experiment include blocking, randomization, and replication.

- **Blocking:** When randomizing a factor is impossible or too costly, blocking lets you restrict randomization by carrying out all of the trials with one setting of the factor and then all the trials with the other setting.
- **Randomization:** Refers to the order in which the trials of an experiment are performed. A randomized sequence helps eliminate effects of unknown or uncontrolled variables.
- **Replication:** Repetition of a complete experimental treatment, including the setup.

Steps

The Design of Experiment (DOE) process involves the following steps,

1. Project Definition

In the first step of DOE process, the project is defined with the help of project definition report. The project definition report consists of the following important elements,

(a) A background statement

(b) Purpose, scope and objectives of the project and

(c) Relevant statistical data.

2. Creating an IPO Diagram

IPO diagram consists of input, process and output. This diagram plays a key role in DOE as it helps in ascertaining the critical factors and the responses needed in the process. This step should be performed by the individuals who possess adequate knowledge about the process which is under the analysis.

3. Choosing the Factors to be Optimized

This step involves the selection of critical factors which have to be optimized during the experimentation process.

4. Design the Orthogonal Array

In this step, the orthogonal array is selected and designed. The selection of the orthogonal array relies on the following factors,

(a) The number of factors

(b) Member demands

(c) Cost associated with equipment and

(d) Number of levels to be observed.

If there are many observations, then in such a situation, larger design is needed which is performed by computer simulations.

5. Selecting the Levels of Control Factors and the Sample Size

The two factors based on which the levels are selected are - ease of measurement and the extent to which each level differs. The choice of sample size and levels in the experiment process also depends on the economic consideration of the experiment. The sample size can be minimized by ascertaining the highest and lowest level of noise and by controlling it.

6. Performing the Experiment

The experiments in DOE process are conducted by multi-disciplined team which follows the principles needed for this process. The aspects which are to be mentioned while carrying out the experiments are data collection, leadership and interpretation of results.

7. Examining the Data and Verifying the Results

In this step, the data is examined and results are verified. In case of advanced experiments, Taguchi suggested 'signal-to-noise' ratios as it

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can be effectively used in the situations which needs different input for different output. The orthogonal array is used only for performing a confirmation run as it is only a part of full factorial array.

8. Closing the Project

This is the last step of DOE process. After verifying the results, the project definition is assessed for ascertaining whether the objectives are fulfilled or not. The outcomes are drawn from, this process and the project is closed or terminated.

Merits

1. Multiple Point Solutions

The biggest advantage of a DOE analysis is that it provides a solution, and information about the space around that solution. This can lead to the engineer improving the design of the part, or changing an input parameter to improve the quality of the part.

2. Time to Solution

A DOE analysis requires less manual input from engineers. Setting up a DOE analysis with current software is time consuming. Die trials can typically be shortened, as you will typically know which inputs affect part quality, and which do not.

3. Improved Quality

DOE analyses can lead to solutions an engineer may not have thought of, and may help identify search directions that could improve part quality.

4. Scientific Approach to provide better part Quality

DOE analyses are robust, and have been used for a long time in engineering. Engineers typically have training in DOE, and understand the limitations. DOE analyses are an approved engineering tool. Therefore, there should be little resistance to the implementation of such tools.

5. Helps expand Knowledge

By being able to relate physical inputs to physical outputs, in a real-time intuitive way, you are undergoing a self-learning process.

3.1.5 Quality by Design

Q12. Explain briefly about Quality by Design.

Ans :

Quality by design" is the practice of using a multidisciplinary team to conduct conceptual thinking, product design and production planning all at one time. It is also known as "concurrent engineering", "simultaneous engineering" ox "parallel engineering". The team is composed of specialists from business, engineering, production and customer base. Suppliers of process equipment, purchased parts, and services are also included on the team at appropriate times. "Quality by design" has recently encouraged changes in management structures.

In "quality by design", the significant feature is a team of specialists who simultaneously design and develop a product to ensure lease of producibility and customer satisfaction. In "quality of design", engineering, production and business (such as marketing, finance, purchasing) as well as suppliers and customers brainstorm together to develop a product that considers all facets of its functionality as well as its costs. When each of the specialists has early input to the product definition and specifications, cost is minimized and performance is maximized. Thus better quality products are manufactured for less cost with shorter time to market.

Getting input at the beginning from all areas eliminates engineering changes later in the project. "Sequential engineering" requires repeated steps of redesign, reverification and re-prototype in order to compile all previous design stages. For example, during the first design phase in sequential engineering, only performance, cost, marketability and aesthetics might be considered. After verifying

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the design and building the first prototype, it is determined that the product needs to be redesigned for producibility, testability, serviceability, quality and reliability. In the "quality by design" engineering model, the initial design phase encompasses all the aforementioned attributes, thus eliminating the need for redesign.

In the traditional method of "sequential engineering" the lead time is obviously longer because each step is performed independently and sequentially one after the other. As problems are encountered, the project is sent back to the appropriate area or department and the process starts over. But the "quality by design" (or concurrent) engineering method combines all these steps into one thereby reducing the lead time considerably. The product is designed to be successful at each stage of its life cycle. It is designed correctly the first time, considering all attributes and facts of its life, such as marketability, assembly and serviceability, before release to testing and finally to bulk production.

3.1.6 Monte Carlo Technique (MCT)

Q13. Examine the design of and Monte Carlo Technique of TQM.

(OR)

Discuss Monte Carlo Technique for effective implementation of TQM.

Ans : **(Nov.-20, Aug.-17, Imp.)**

When the system being simulated includes data inputs that are random variables (i.e., the elements of the system exhibits chance in their behaviour), a technique known as Monte Carlo Simulation as used to reflect the variables as accurately as possible. The basis of Monte Carlo simulation is experimentation on the chance (or probabilistic) elements through random sampling.

Monte Carlo method uses random numbers which can either be generated by a computer program (Excel) or taken from a random number table to generate simulated events. The process of matching random numbers to simulated events is called random number mapping.

Step 1: Establishing Probability Distribution

The basic idea in Monte Carlo simulation is to generate values for the variables which make up the model under study. Real world systems consist of a lot of variables that are probabilistic in nature and that need to be simulated. Some examples of these variables are :

(i) Inventory demand (on a daily or weekly basis)

(ii) Lead time for inventory orders to arrive.

(iii) Time interval between machine breakdowns

(iv) Time interval between arrivals at a service facility

(v) Service times

(vi) Times to complete activities in a project

(vii) Number of employees absent from work each day.

Historical outcomes are examined to establish a probability distribution for a given variable. The frequency of observation is divided by the total number of observations to determine the relative frequency or the probability.

Step 2: Building a Cumulative Probability Distribution for each Variable

The regular probability distribution is converted to a cumulative probability distribution.

Step 3: Setting Random Number Intervals

After establishing a cumulative probability distribution for each variables included in the simulation, a set of numbers must be assigned to represent each possible value or outcome. These are referred to as *random number intervals* (Basically a random number is a series of digits (say 01, 02, 98, 99, 100) that have been selected by a totally random process.

Using the cumulative probability distribution computed in step 2, we can set the interval of random numbers for each level of variable. The top end of each interval is always equal to the cumulative probability percentage.

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Step 4: Generating Random Numbers

There are many ways of generating random numbers. If the problem is very large and the process being studied involves thousands of simulation trials, computer programs are available to generate the random numbers needed. The random numbers may be picked by lottery method or choosing numbers from a table of random digits which itself is generated by a computer program. It has the characteristic that every digit or number in it has an equal chance of occurring. Generation of random numbers is discussed at the end of this section.

Step 5: Simulating the Experiment

The outcomes of an experiment may be simulated by simply selecting random numbers from the table of random numbers. We can being from any . here in the random table and note the interval into which the number falls and then select the variable corresponding to that interval.

3.2 QUALITATIVE TECHNIQUES

Q14. Describe the different Qualitative Techniques for TQM implementation.

Ans : **(Aug.-18)**

The different Qualitative Techniques for TQM implementation are as follows :

1. Bench Marking

Benchmarking is a systematic method by which organizations can measure themselves against the best industry practices. It promotes superior performance by providing an organized framework through which organizations learn how the "best in class" do things, understand how these best practices differ from their own, and implement change to close the gap.

The essence of benchmarking is the process of borrowing ideas and adapting them to gain competitive advantage. It is a tool for continuous improvement.

Benchmarking is an increasingly popular tool. It is used extensively by both manufacturing and service organizations, including Xerox, AT&T, Motorola, Ford, and Toyota. Benchmarking is a common element of quality standards, such as the Chrysler, Ford, and General Motors Quality System Requirement.

2. Balanced scorecard

The Balanced Scorecard (BSC) acts as a performance management tool which deals with assessing whether the smaller scale operational functions/activities of a company are in alignment with its large-scale goals/ objectives with respect to its vision and strategy.

Balanced scorecard presents a complete picture of, the business by emphasizing not only on the financial aspects but also by emphasizing on the operational, marketing and development aspects. This complete picture of the business helps the business to take long-term decisions.

3. Sales and Operations Planning

Companies have been achieving improved business performance for quite some time by implementing and operating with an integrated business management process known as Sales and Operations Planning (S&OP). Sales and operation planning is an interactive business management process that determines the optimum level of manufacturing output. The process is built upon stake-holder agreement and an approved consensus plan.

Sales and operations planning is an integrated business management process through which the executive leadership team continually achieves focus, alignment and synchronization among all functions of the organisation. The S&OP plan includes an updated sales plan, production plan, inventory plan, customer lead time plan, new product development plan, strategies initiative plan and resulting financial plan. Plan frequency and planning horizon depends on the specifics of the industry.

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4. Kanban

Kanban is a concept related to lean and just-in-time (JIT) production. The Japanese word *kanban* is a common everyday term meaning "signboard" or "billboard" and utterly lacks the specialized meaning that this loanword has acquired in English. According to Taiichi Ohno, the man credited with developing JIT, kanban is a means through which JIT is achieved.

5. Activity-Based Costing

Activity-Based Costing (ABC) is a method for estimating the resources required to operate an organization's business processes, produce its products and serve its customers.

In a business organization, the ABC methodology assigns an organization's resource costs through activities to the products and services provided to its customers. It is generally used as a tool for understanding product and customer cost and profitability. As such, ABC has predominantly been used to support strategic decisions such as pricing, outsourcing and identification and measurement of process improvement initiatives.

3.2.1 Benchmarking

Q15. Define Bench Marking. Explain the levels of Bench Marking.

Ans :

Introduction

Benchmarking is a systematic method by which organizations can measure themselves against the best industry practices. It promotes superior performance by providing an organized framework through which organizations learn how the "best in class" do things, understand how these best practices differ from their own, and implement change to close the gap.

The essence of benchmarking is the process of borrowing ideas and adapting them to gain competitive advantage. It is a tool for continuous improvement.

Benchmarking is an increasingly popular tool. It is used extensively by both manufacturing and service organizations, including Xerox, AT&T, Motorola, Ford, and Toyota. Benchmarking is a common element of quality standards, such as the Chrysler, Ford, and General Motors Quality System Requirement.

Concept

Benchmarking is the systematic search for best practices, innovative ideas, and highly effective operating procedures.

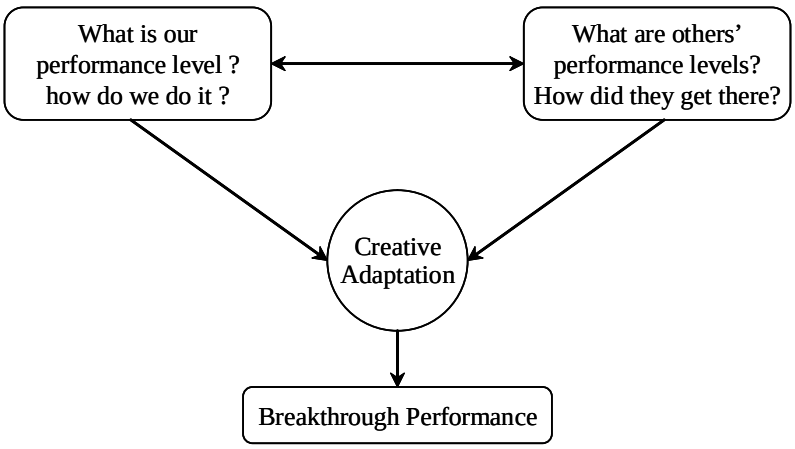

Fig. : Benchmarking Concept

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As shown in Figure benchmarking measures performance against that of best-in-class organizations, determines how the best in class achieve those performance levels, and uses the information as the basis for adaptive creativity and breakthrough performance.

Implicit in the definition of benchmarking are two key elements. First, measuring performance requires some sort of units of measure. These are called metrics and are usually expressed numerically. The numbers achieved by the best-in-class benchmark are the target. An organization seeking improvement then plots its own performance against the target. Second, benchmarking requires that managers understand why their performance differs.

Bench markers must develop a thorough and in-depth knowledge of both their own processes and the processes of the best-in class organization. An under standing of the differences allows managers to organize their improvement efforts to meet the goal. Benchmarking is about setting goals and objectives and about meeting them by improving processes.

Levels

In order to have a better comparison of business procedures between two or more companies; company can use four types of approaches they are,

1. Internal benchmarking
2. Competitive benchmarking
3. Non-competitive benchmarking
4. World class benchmarking.

1. Internal Benchmarking

In this level of Benchmarking the firms compares its organization with is own branch office as it allows easy gathering of data and information and protects the confidentiality of company's secret information.

2. Competitive Benchmarking

It is done when the firm compares its performance and practices with the competitors which serve as benchmark for the firm and helps in improving their performance. Data gathering is difficult in competitive benchmarking as the competitor will not disclose their strategies to them for this a survey conducted by a neutral party is helpful in determining competitors strategies.

3. Non-competitive Benchmarking

As the name indicates that it does not involve any competition between the companies. The firm tries to benchmark the processes that needs improvement which can be related or unrelated to same or belong to different industry.

4. World Class Benchmarking

This level of benchmarking looks for a benchmark which is widely recognized in the whole world for the processes they use and which can also serve as an objective and target to be achieved for making their company same and even more better than the benchmarking company.

Q16. Explain different types of Benchmarking.

Ans :

1. Performance Measure Benchmarking

In this type of benchmarking the cost, quality, reliability and response of the product are compared and measured with order companies (selected benchmark company) and several other features characteristics, pricing, strategies are also taken into consideration. It includes direct comparison and analysis of the competitor's products and services. Performance benchmarking is also referred as operational or competitive benchmarking in which there is an in-depth analysis of products and services all the firms belonging to the similar processes industry.

2. Process/Generic Benchmarking

Process benchmarking involves the basic process of billing, recruitment and training. These processes are studied by the business to improve their own process. Process benchmarking is beneficial if it is done outside the same industry, as only the process is benchmarked it can be taken from any industry which is successful and experienced

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in those areas because it brings lot of creative ideas and innovative techniques of enhancing the process. So, the process is preferred from a different industry from the same industry.

3. Strategic Benchmarking

Strategic benchmarking studies how the other companies formulate strategies that can bring large market share and also bring a competitive advantage over other firms in the industry and grant success in the market. A key success factor matrix can help a company to compare the major areas of business such as sales forces, suppliers and distributors, research and development, services referred, cost structure of the company etc.

4. Functional Benchmarking

It is one of the frequently used method of benchmarking where the same processes are compared within the same industry but not with direct competitors. It is mainly indulged with the performance of products in their competition. According to quality gurus like Juran, Crosby they emphasized on quality as fitness for use, performance of product as a key factor for becoming a leader in the market. So, it is essentially for any company to go for functional benchmarking if they want to in the market.

Q17. Explain the Approaches and Phases of Benchmarking.

Ans :

Approaches

Approaches are some of the guidelines followed by reputed companies, IBM, XEROX company using number of steps which are general for benchmarking.

1. Area to be Benchmarking

Before going for a benchmarking process a company should select a particular area such as finance, quality, customer service/ satisfaction, accounts payable and delivery time and then make a through study of that area by reviewing the entire process and procedures before selecting a company for benchmarking in same area.

2. Involve Employees

Employees are the individuals who work in the organization. They are the people who implement the changes that are needed in organization, such employees visit the benchmark company have a discussion with people working there which can help them in understanding their work pattern. This visit is short and has a team of very few people.

3. Exchange Information

There should be clear exchange of information between the two companies. Where the answers for any question asked by the benchmarking company are provided easily without any confusion.

4. Legal Problems

Companies should avoid illegal activities of price fixing, allocation of market share and other illegal activities. Benchmarking should be a learning process rather than a copying process companies should focus on important areas like customers satisfaction, best business practices and human resources.

5. Confidentiality

Information exchanged for business use should be kept secret and it should not be disclosed to other competitors.

Phases

There are four phases of benchmarking as,

1. Planning

Collecting the gathering data, measuring of performance, identifying the product services and process to be benchmarked.

2. Analysis

Analyze the gap between the present performance of the company against the benchmark company, and the reasons for deviations.

3. Integration

Setting goals and gaining the support of the top management in supplying of resources to achieve those goals.

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4. Action

Developing an action committee or team which are suffering from those changes and assigning work to the teams checking their progress and implementing plans to take actions and improve the affected areas of business.

Q18. Describe the steps involved in Bench Marking.

Ans : **(June-19)**

Organizations that benchmark, adapt the process to best fit their own needs and culture. Although the 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 current performance
3. Plan
4. Study others
5. Learn from the data
6. Use the findings

1. Decide what to Benchmarking

Bench marking can be applied to any business or production process. Improvement to best-in-class levels in some areas will contribute greatly to market and financial success. Most organizations have a strategy that defines how the firm want to position it self and compete in the market place. This strategy is usually expressed in terms of mission and vision statements.

2. Understand Current Performance

To compare to practices to out side benchmarks, it is first necessary to thoroughly understand and document the current process. It is essential that the organization's performance is well understood. Several techniques, such as flow diagrams and cause-and-effect diagrams, and understanding. Attention must be paid to inputs and outputs.

The bench marking team should be comprised of those who own or work in the process to ensure suggested changes are actually implemented. When the documenting the process, it is important to quantify it, Units of measure must be determined.

3. Planning

Once Internal process are understood and documented, it is possible to make decisions about how to conduct the study. If not already selected a bench marking team should by chosen. The team should decide what type of benchmarking to perform, what type of date are to collected, and the method of collection.

Benchmarking is a learning process. There are three type of bench-marking like internal, competitive, and process.

4. Studying Others

Benchmarking studies look for two types of information: a description of how best-in-class process are practiced and measurable results of these practices.

5. Learning from the Data

Learning from the data collected in a benchmarking study involves answering a series of questions

- It there a gab the organization's performance and the performance of the best-in-class organizations?
- What is the gap? How much is it?
- What is there a gap? What doe the best-in-class do differently that is better
- If best-in-class practices were adopted, what would be the resulting improvement.

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Bench marking studies can reveal three different out comes.

1. External Processes may be significantly better than internal process (a Negative gap)
2. process performance may be approximately equal (parity)
3. The Internal process may be better than that found in external organization's (positive Gap).

- Negative gap call for a major improvement efforts
- Parity requires further investigation to determine if improvement opportunities exist.
- Finally, the finding of a positive gap should result in recognition for the internal process.

6. Using the Findings

When a benchmarking study reveals a negative in performance, the objective is to change the process to close the gap. Bench marking is a wast of time if change does not occur as a result. To effect change, the findings must be communicated to the people within the organization who can enable improvement.

The findings must translate to goals and objectives, and action plans must be developed to implement new processes.

The Generic steps for the development and execution of action plans are:

- Specify tasks
- Sequence tasks
- Determine resource needs
- Establish task schedule
- Assign responsibility for each task
- Describe expected results
- Specify methods for monitoring results.

Goals and objectives should consistent with the execution of the action plan so that the end result is process superiority. The best results are obtained when process owners fully participate in the design and execution of the plan.

Q19. Explain the parameters to be considered while bench marking a financial institution.

Ans : **(June-19)**

The parameter that are to be considered while benchmarking banks (one of the financial institutions) are,

1. Loan Processing

Loan processing is one of the most important parameter that should be considered while benchmarking, as customers always expect low processing times.

2. Front Line Services

Front Line services are another important parameter that should be considered while benchmarking. Most of the banks focus on setting certain standards to maintain high quality front line services. The front line services should be fast and convincing to deal with different types of customers.

3. Cheque Clearance Time

Reduced cheque clearing time is also one of the important parameter which need to be benchmarked.

3.2.2 The Balanced Scorecard

Q20. What is a balanced scorecard ? Explain its history and process ?

Ans : **(Jan.-18)**

The Balanced Scorecard (BSC) acts as a performance management tool which deals with assessing whether the smaller scale operational functions/activities of a company are in alignment with its large-scale goals/ objectives with respect to its vision and strategy.

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Balanced scorecard presents a complete picture of, the business by emphasizing not only on the financial aspects but also by emphasizing on the operational, marketing and development aspects. This complete picture of the business helps the business to take long-term decisions.

The organizations with the help of BSC were motivated to assess the factors effecting the financial outcomes along with the assessment of the financial outputs/outcomes. Few factors which affect the financial outcomes are the process performance, market penetration, long-term learning and skills development and so on.

The reason why the organizations cannot directly measure the factors that effect the financial outcomes is that these factors are the "lag" measures and the use of such financial measures alone to get the information about the strategic control is considered to be vague.

Early scorecards have been successful in achieving the degree of "balance" in selection of performance measures from the perspectives, namely,

i) Customer

ii) Internal business processes, and

iii) Learning and growth.

History of BSC

Robert S .Kaplan and David P. Norton has played an important role in propagating the concept of balanced scorecard. In the year 1993, they wrote several journal articles on balanced scorecard, in order to popularise it. Ultimately with the aim of maximizing its popularity they wrote a book and published it in 1996 and titled the book as, 'The Balanced Scorecard'.

Since its inception balanced scorecard is being used as a fertile field of theory, research and consulting practise. The balanced scorecard has been evolving as a measurement selection frame work.'

Inspite of the sound principles, most of the Kaplan's and Norton's original approach aspects were not practised. Even in firms of Kaplan and Norton i.e., Renaissance solutions Inc., and BSCOL and other firms such as Cepro in Sweden, and 2GC Active Management in UK, earlier the design process was not focused much but the introduction of balanced scorecard started emphasizing on the design process.

The branding and the consulting offerings of balanced scorecard is also witnessing rapid development. Kaplan and Norton after a decade revisited balanced scorecards and made changes in the original articles.

Thus, the balanced scorecard acts as a performance management and measurement tool having similar management by objectives principles.

Process of Balanced Scorecards

The implementation of balanced scorecards has four processes as follows,

1. Transforming the vision into operational goals.
2. Transmitting and linking/associating the vision to individual performance.
3. Business planning, and
4. Feedback and learning and adapting/altering the strategy accordingly

Balanced scorecard is a structure which has the features of "strategic management system", that contends to include all quantitative and abstract measures of significance to the organization,

Kaplan and Norton define, "The balanced scorecard provides managers with the instrumentation they need to navigate to future competitive success".

Hence, balanced scorecard is the "strategic linkage model" or "strategy map". Eventhough balanced scorecard assists the managers to emphasize on strategic issues and the strategy implementation, yet it does not play any role in strategy formation. Balanced scorecard can be used along With strategic planning systems and other tools.

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Q21. Explain the importance of BSC?

Ans :

It highlights the importance of non-financial drivers of performance, and clarifies vision throughout the organization. Specifically the benefits are :

1. Greater Participation

After constructing the Balanced Scorecard leaders cascade strategy down to business units, divisions and support functions. In doing so, top management does not dictate strategy to operating units. Instead it recognizes that operating units have a better 'feel' for local conditions, operating technologies, and competition. So it encourages the latter to define their own strategy so as to dovetail with the organization's overall strategy.

2. Improved Communication

Top management explains the Balanced Scorecard and the strategy map through newsletters, brochures, bulletin boards, meetings, training, and education programs. This is reinforced by the top management's conviction in the efficacy of the Balanced Scorecard. This conviction gets translated into their personal behavior and their commitment is reflected in the initiatives taken to accomplish their strategy.

3. Improved Understanding of Mission

Departments performing line functions (such as the production department in a manufacturing concern) as well as those in staff functions such as human resources, purchase, finance and internal audit, are asked to define what services ought to be provided, as also the quality of these services and their cost. They examine and understand the interrelationships between each staff function and line functions. In doing so they realize what each function (whether line or staff), contributes to overall organizational success. The concept of partnerships with each other and with the corporate parent is grasped, enabling the emergence of corporate-level synergies.

4. Empowerment

Employees get a clearer understanding of what the organization wishes to accomplish, and how they can contribute to these accomplishments. They realize that their work can and does make a difference to the organization, and this increases their intrinsic motivation. They come to work with enthusiasm, creativity and initiatives, actively searching for better ways in which they can help the organization succeed. Personal objectives arc linked to team objectives. Typically a new incentive plan is drawn up that enables employees to benefit financially when targets for strategic measures are achieved.

5. Style of management

Chief executive officers (CEOs) understand that they cannot implement corporate strategy alone. They need contribution, cooperation and ideas from everyone in the organization. Persons far from corporate headquarters whether they are employees, vendors, or distributors can suggest new ways of doing business. So CEOs need to alter their style of management from autocratic to participative. They discard top down direction and embrace top down communication, helping the 'partners' learn how they can contribute to successful implementation of corporate strategy.

6. Improved Training

Top management is aware that employee skills enhance internal processes. The strategy map reveals the strategic chain of cause and effect relationships that link greater investment in improving employee skills to improved financial performance. Top management realizes the importance of skill upgradation

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and the specific skills that should be enhanced. The Balanced Scorecard shows people how improving of capabilities leads to the organization achieving it's long term financial goals. The organization implements the learning and growth objectives, by focusing on sustained investment in training.

7. Selection of Suppliers

In choosing strategic partners, the organization pays as much attention to low cost supplies as quality of supplies, lead time, on time delivery performance of suppliers, defect free supplies, and whether suppliers are electronically connected to the organization. This last factor allows the online ordering of supplies as well as online payment. Attention to cost of supplies alone is dangerous. Low cost suppliers may turn out to be extremely high cost if they fail to deliver supplies on schedule, or the deliveries do not conform to quality standards. The organization will have to spend considerable time, effort and cost, in monitoring quality, arranging for replacement of defective goods, sourcing supplies from other vendors at short notice, and stocking up of inventory when the supply is known to be erratic. By incorporating measures for superior supplier relationships into the Balanced Scorecard, employees understand the value of forging long term relationships with key suppliers. This recognition generates initiatives from the employees and feedback on the most critical elements of the supplier relationship.

8. Enhancement of value in the community

Organizations cannot afford to ignore the community within which they operate. They may wish to move beyond mere compliance, setting industry standards in areas such as corporate governance, community concern, and environmental protection. One chemical company Stated - 'Our strategy is to be seen by the community within which Mr operate, ax not only a law abiding corporate citizen, but as an outstanding. corporate citizen, measured both environmentally and by creating well paying, safe, and productive jobs. If regulations are tightened, though other firms may get affected, we expect to have earned the right to continue operations.' In recognition of this, environmental and community performance was a key part of its strategy. Such recognition enables an organization to successfully operate in markets that differ in terms of cultural, linguistic, and economic bases and geographic locations.-

Thus the balanced scorecard provides a framework to align the organization, focuses teams and individuals on strategic priorities, provides a structure for multiple initiatives, drives this capital and resource allocation process, integrates strategic management across the organization, and integrates the entire supply chain.

Q22. Explain the criticisms of BSC.

Ans :

BSC inspite of being successful suffers from few criticisms. The first criticism is that the scores are not on the basis of any proven economic or financial theory and thus has no basis in the decision making. The balanced scorecard is a subjective process and does not make any provision to evaluate quantities (i.e., risk and economic) in an economically sound way/manner.

BSC was also criticized for not providing a bottom line score or a unified view with clear recommendations. BSC was criticised for simply being a metric.

Few people have also criticised BSC by viewing that BSC receives/gets positive feedback due to placebo effect, due to the absence of empirical studies relating to the BSC's use in making better decisions for enhancing the financial performance of the companies.

The balanced scorecard had always attracted criticisms from different sources. Most of these

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criticisms were from the academic community who hated the empirical nature of the structure. Kaplan and Norton failed to include any citation of prior art in their initial topics.

Few criticisms focused upon the technical defects in the methods and design of the original balanced scorecard and has over time driven the evolution of the device through its several generations.

Pundits and consultants have criticised that the balanced scorecard does not provide a bottom line score or a unified view with clear recommendations. It is simply of list of metrics.

3.2.3 Sales and Operations Planning

Q23. Explain the concept of Sales and Operations Planning.

Ans : **(Nov.-21, June-18)**

Companies have been achieving improved business performance for quite some time by implementing and operating with an integrated business management process known as Sales and Operations Planning (S&OP). Sales and operation planning is an interactive business management process that determines the optimum level of manufacturing output. The process is built upon stake-holder agreement and an approved consensus plan.

Sales and operations planning is an integrated business management process through which the executive leadership team continually achieves focus, alignment and synchronization among all functions of the organisation. The S&OP plan includes an updated sales plan, production plan, inventory plan, customer lead time plan, new product development plan, strategies initiative plan and resulting financial plan. Plan frequency and planning horizon depends on the specifics of the industry.

A properly implemented sales and operations planning process routinely reviews customer demand and supply sources and "re-plans" quantitatively across and agreed rolling horizon. The preplanning process focuses on changes from the previously agreed sales and operations plan.

Sales and operations planning is also defined as the "function of setting the overall level of manufacturing output (production plan) and other activities to best satisfy the current planned levels of sales (sales plan and/or sales forecasts) while meting general business objectives of profitability, productivity, competitive customer lead times etc. as expressed in the overall business plan. One of its main purposes is to establish production rates that will achieve management's objective of maintaining, raising or lowering inventories or backlogs, while usually attempting to keep the work force relatively stable.

It must extend through a planning horizon sufficient to plan the labour, equipment, facilities, material and finances required to accomplish the production plan.

Sale and operations planning has also been described as "a set of decision-making processes to balance demand and supply, to integrate financial planning and operations planning, and to link high level strategic plans with day-today operations".

Benefits of Sales and Operations Planning

(i) New Products Review

Analyse the potential for new products to impact the market, considering elements such as rationalisation with channels, pricing and margin implications.

(ii) Demand Review

Anticipate total market requirements for all offerings from all perspectives, using sources such as quantitative forecasts, inputs from sales and marketing and what-if analysis-balancing orders and demand and achieving consensus on various demand scenarios.

(iii) Supply Review

Review the supply chain capacity, including inventory requirements, procurement policy,

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and logistics, to make certain that there is sufficient manufacturing and distribution capacity. In this step, we can identify any potential decision points such as the need to outsource for additional capacity.

(iv) Financial Reconciliation Review

Translate the supply and demand plan into financial terms of revenue, margin, and working capital requirements. Then balance supply and demand, making decisions with regard to potential supply issues and contingencies for the range of possible demand scenarios.

(v) Management Evaluation and Analysis:

Evaluate the results of your activities to decide how to run a business moving forward. This includes and evaluation of planned versus actual results, an analysis of profitability by customer, channel and product and a look at perfect order, cash-to-cash, and asset-performance.

3.2.4 Kanban

Q24. Explain briefly about kanban.

Ans :

Kanban is a concept related to lean and just-in-time (JIT) production. The Japanese word *kanban* is a common everyday term meaning "signboard" or "billboard" and utterly lacks the specialized meaning that this loanword has acquired in English. According to Taiichi Ohno, the man credited with developing JIT, kanban is a means through which JIT is achieved.

Kanban is a signaling system to trigger action. As its name suggests, kanban historically uses cards to signal the need for an item. However, other devices such as plastic markers (kanban squares) or balls (often golf balls) or an empty part-transport trolley or floor location can also be used to trigger the movement, production, or supply of a unit in a factory. Kanbans maintains inventory levels; a signal is sent to produce and deliver a new shipment as material is consumed. These signals are tracked through the replenishment cycle and bring extraordinary visibility to suppliers and buyers.

It was out of a need to maintain the level of improvements that the kanban system was devised by Toyota. Kanban system became an effective tool to support the running of the production system as a whole. In addition, it proved to be an excellent way for promoting improvements because reducing the number of kanban in circulation highlighted problem areas.

3.2.5 Activity Based Costing (ABC)

Q25. What is Activity Based Costing state its Characteristics.

Ans :

Activity-Based Costing (ABC) is a method for estimating the resources required to operate an organization's business processes, produce its products and serve its customers.

In a business organization, the ABC methodology assigns an organization's resource costs through activities to the products and services provided to its customers. It is generally used as a tool for understanding product and customer cost and profitability. As such, ABC has predominantly been used to support strategic decisions such as pricing, outsourcing and identification and measurement of process improvement initiatives.

Activity-based Costing (ABC) is an alternative to the traditional way of accounting. ABC is a costing model that identifies the cost pools, or activity centers, in an organization. It assigns costs to products and services (cost drivers), based on the number of events or transactions that are taking place in the process of providing a product or service. As a result, Activity-based Management can support managers to see how shareholder value can be maximized and how corporate performance can be improved.

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Characteristics of ABC

- Simple traditional distinction made between fixed and variable cost is not enough guide to provide quality information to design a cost system/
- The more appropriate distinction between cost behaviour patterns are volume related, diversity related, events related and time related.
- Cost drivers need to be identified.

Q26. State the benefits and limitations of activity based costing

Ans :

Benefits

- Identify the most profitable customers, products and channels.
- Identify the least profitable customers, products and channels.
- Determine the true contributors to- and detractors from- financial performance.
- Accurately predict costs, profits and resources requirements associated with changes in production volumes, organizational structure and costs of resources.
- Easily identify the root causes of poor financial performance.
- Track costs of activities and work processes.
- Equip managers with cost intelligence to stimulate improvements.
- Facilitate a better Marketing Mix
- Enhance the bargaining power with the customer.
- Achieve better Positioning of products

Limitations

The following are the limitations of ABC :

a) Allocation

Not all costs have appropriate or unambiguous activity or resource consumption cost drivers. Some costs require allocations to department and pre-cuts based on arbitrary volume measures because finding the activity that causes the cost is impractical. Ex : facility-sustaining costs such as cost of the information systems, factory manager's salary, factory insurance etc.

b) Omission of Costs

Product or service costs identified by an ABC system are likely to not include all costs associated with the product or service. Product or service costs typically do not include costs for such activities as marketing, advertising, research and development, and product engineering even though some of these costs can be traced to individual products or services. Product costs do not include these costs because generally accepted accounting principles (GAAP) for financial reporting require them to be treated as period costs.

c) Expense and Time

An ABC system is not cost free and is time-consuming to develop and implement. For firms or organizations that have been using a traditional volume-based costing system, installing a new ABC system is likely to be very expensive. Furthermore, like most innovative management or accounting systems, ABC usually requires a year or longer for successful development and implemen-tation.

3.3 TAGUCHI METHODS

Q27. Examine the Taguchi Methods of TQM.

(OR)

Narrate any three methods of Taguchi.

Ans : **(Dec.-20, Nov.-20, June-19, Imp.)**

The Taguchi method optimizes design parameters to minimize variation before optimizing

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design to hit mean target values for output parameters. The Taguchi method uses special orthogonal arrays to study all the design factors with minimum of experiments.

Methods

The different methods developed/contributed by Taguchi are,

1. Quality loss function.
2. Orthogonal arrays.
3. Signal-to-noise ratio.
4. Quality robustness.

1. Quality Loss Function

Taguchi's quality loss function states that any variation or fluctuation from the target value of a quality characteristics leads to extra costs to the society. According to Taguchi, quality is regarded as a social loss, loss to the producers and consumers from the time the product is developed. If the value of the social loss is small, then the product will be more attractive and valuable. Taguchi's quality loss function helps in determining the loss incurred to the society due to the failure of the product to meet the target quality standard value.

2. Orthogonal Arrays

Orthogonal array is a simple and easier method of placing an experiment together. Orthogonal arrays are also called fractional factorial designs. It helps the users in obtaining the essential information at low cost. Orthogonal arrays are mostly used in case where there exist several factors and levels.

3. Signal-to-Noise Ratio

Signal to noise ratio was proposed by Taguchi for calculating the target value for the response. It is the ratio between mean (average) and the variance. The signal to noise ratio measures p/c ratio where p is the process mean and a is the standard deviation.

The signal to noise ratio is calculated with the help of the following formula,

$$S / N \text{ Ratio} = 10 \log_{10}(a^2 / b^2)$$

There are a number of signal to noise ratios. The following are some of the important signal to noise ratios,

(a) Nominal-the-best.

(b) Smaller-the-better.

(c) Larger-the-better.

(d) Target-the-best.

4. Quality Robustness

Taguchi developed an important concept known as Robust design which has three design components as follows,

(a) System design

(b) Parameter design and

(c) Tolerance design.

(a) System Design

System design mainly includes the traditional research and development. In this design, engineering and scientific knowledge is used for setting the product and process parameters.

(b) Parameter Design

Parameter design is a process of choosing the parameters so that the product is not affected by the noise variables. The notion is to start with inferior goods, low cost components and raw materials. The control and noise factors are determined and are treated separately as they help in decreasing the variability and help in developing an innovative product of high quality and low cost.

(c) Tolerance Design

Tolerance design is a process which helps in identifying the statistical tolerance level around the target.

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3.3.1 Quality Loss Function

Q28. Discuss taguchi's Quality loss function.

Ans : **(Aug.-21)**

Taguchi asserts that the quality of a product is a function of key product characteristics referred to as "performance characteristics". The ideal value (or state) of a performance characteristic is its target value. A high-quality product performs near these target values consistently throughout its life span and under all operating conditions. Taguchi's quality loss function estimates the loss to society from the failure of a product to meet its target value for a particular performance characteristic. This loss can be incurred by the consumers (e.g., short product life, increased maintenance and repair costs), by the company (e.g., increased scrap, rework and warranty costs, damage to the company's reputation, loss of market share) or by society in general {e.g. pollution, safety).

Taguchi's quality loss function is a statement that any deviation from the target value of a quality characteristic results in extra costs to some segment of the society.

Taguchi defines quality in terms of the social loss, loss to producers and consumers front the time a product is conceived. The smaller the value of this social loss, the more desirabh is the product.

Illustrates Taguchi's Quality Loss Function.

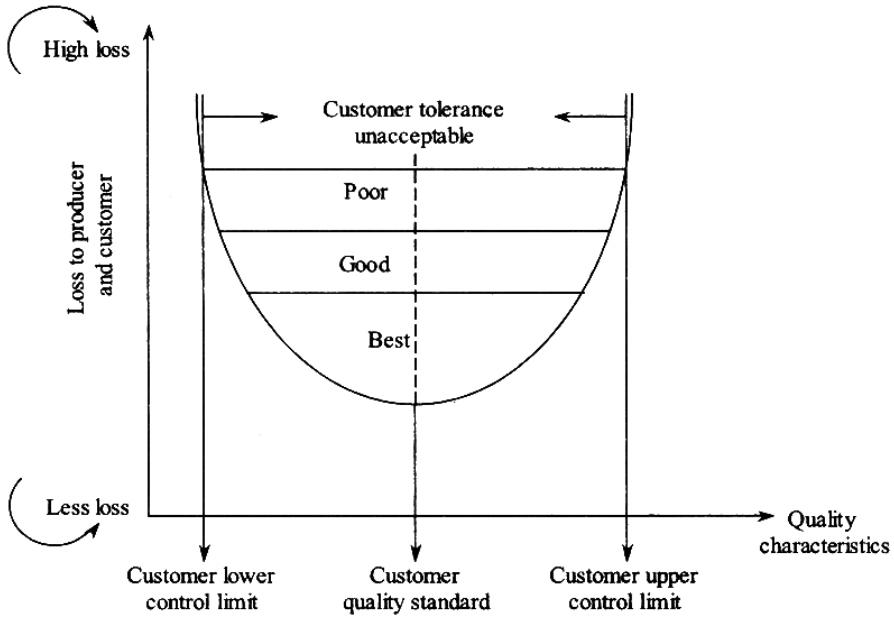

Fig. : Taguchi's Quality Loss Function

Quality loss function is expressed as:

$$L = C (X - T)^2$$

Where L = total loss

C = a cost constant

X = actual average value of quality characteristic and

T = target value of quality characteristic.

Taguchi holds that the unwelcome costs are associated with any deviation of process performance (or quality characteristic) from the quality characteristic's target value. The loss from performance variation (L) is directly related to the square of the deviation (d) of the performance characteristic (X) from its target value (T).

i.e., $L = C d^2$

$= C (X – T)^2$

Where L = Total loss

C = a cost constant

X = actual average value of quality characteristic and

T = target value of quality characteristic.

Taguchi intends that the loss function remains valid at all times during a product's life. In theory, when process output performance reaches the specification limit (upper or lower specification limit), the customer's economic interest in the item is neutral, that is, the losses will exactly offset any gain from having the item.

For Taguchi, social loss must affect quality cost management decisions, that is, investments in quality improvement should be compared with savings to society rather :han to the firm alone. Ultimately, the society will reward or penalise the firm for its record of societal savings or loss respectively. Taguchi's view is meant to be sound for business.

3.3.2 Orthogonal Arrays

Q29. What is an Orthogonal Arrays? Discuss the steps involved in determining a Orthogonal Arrays.

Ans :

Orthogonal Arrays (OA) are a simplified method of putting together an experiment. The original development of the concept was by Sir A.R.Fisher of England in the 1930s. Taguchi added three Orthogonal Arrays to the list in 1956 and the National Institute of Science and Technology of the US added three 1

(i) Fisher Orthogonal Array

Fisher took the lead on the problem of experimental size in- fractional factorial designs. His method of experimentation was to change several factors at the same time in a systematic way so as to ensure the reliable and independent study of the main factors and interaction effects. He constructed orthogonal arrays with a limited number of runs as a subset of the full factorial layout. The subsets are balanced in such a way that an even number of each level of each factor is tested during the running of the experiment (i.e., the array is balanced between columns rather than between trials). The technique of orthogonal arrays enables the size of the experiment to be reduced to a practicable level of carrying out a fraction of the total number of combination of factors. However., in doing this some interaction information will be sacrificed. It is therefore important to use the technical knowledge of those involved in the experiment to ensure that this loss of information is relatively insignificant

It can be observed that in the array the coloumns represent the independent variables or factors to be studied and tested at one of two levels and the rows represent the tests or experiments to be performed.

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In an experiment which has eight experimental runs (i.e., L_8) the first option or level of factor A is tested four times and the second option or level of factor A is also tested four times. In addition to this, during the experimental run, the array tests all the combinations of options or levels of any two factors. Thus A1 is tested against both Bland B2 as well as A2, similarly testing Bl and B2. The other properly that orthogonal arrays have, due to their full factorial heritage and balance is the ability to study the effects of interactions between factors. The number of interactions that can be studied is dependent on the size of the array.

Table : A typical Fisher Array

Runs	Factors (P)						
(N)	A	B	C	D	E	F	G
1	1	1	1	1	1	1	1
2	1	1	1	2	2	2	2
3	1	2	2	1	1	2	2
4	1	2	2	2	2	1	1
5	2	1	2	1	2	1	2
6	2	1	2	2	1	2	1
7	2	2	1	1	2	2	1
8	2	2	1	2	1	1	2

The simple analysis of an orthogonal array is done by averaging the responses that are applicable to the level of each factor. Therefore in the Fisher Array shown above, factor A at level 1 is given by averaging the results obtained from running experiment numbers 1 to 4 and factor A at level Z by averaging the results obtained from running experiments numbers 5to8. The difference between level 1 and level 2 of each factor is an indication of the significance of that factor in influencing the response measured. Generally the larger the difference the greater the significance.

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(ii) Taguchi's Orthogonal Array

The arrays suggested by Taguchi (1986) gave economies of scale and time in the cost of experimentation. They are also practiced to use in a team environment where maximum use is made of technical knowledge which exists within the team for details such as: (i) the choice of factors, (ii) the setting of the levels, (iii) whether to study an interaction between factors and (iv) the choice of responses of the experimental runs. There are a small number of orthogonal arrays or experimental designs that constitute a fundamental set of arrays, sometimes referred to as the "cook book".

In the orthogonal array shown in Table the 8 in the designation OA8 represents the number of rows, which is also the number of treatment conditions (TC) and the degrees of freedom.

Across the top of the orthogonal array is the maximum number of factors that can be used, which in this case is seven. The levels are designated by 1 and 2. If more levels occur bn the array, then 3, 4, and so forth are used.

The orthogonal property of the Orthogonal Array is not compromised by changing the tows or the columns. Taguchi changed the rows from a traditional design so the TC 1 was composed of all level Is and if the team desired, could thereby represent the existing conditions. Also the columns are switched so that the least amount of change occurs in the columns on the left. This arrangement can provide the team with the capability to assign factors with long set up times to those columns.

Table : Orthogonal Array (OA8)

TC	1	2	3	4	5	6	7
1	1	1	1	1	1	1	1
2	1	1	1	2	2	2	2
3	1	2	2	1	1	2	2
4	1	2	2	2	2	1	1
5	2	1	2	1	2	1	2
6	2	1	2	2	1	2	1
7	2	2	1	1	2	2	1
8	2	2	1	2	1	1	2

3.3.3 Signal-to-Noise Ratio

3.3.3.1 Nominal- the- best, Target-the-best, Smaller- the-best, Larger-the-best.

Q30. Discuss the essential elements in smaller the best and target the best.

(OR)

Explain the techniques of nominal the best and target the best method of TQM.

Ans : **(June-18, Aug.-17, Imp.)**

Signal to noise ratio was proposed by Taguchi for calculating the target value for the response. It is the ratio'ttetween mean (average) and the variance. The signal to noise ratio measures p/a ratio where p is the process mean and σ is the standard deviation.

The main aim of Taguchi behind devising a signal to noise ratio is to attain variability measure independent of the mean as this helps in measuring the variability control factors and target control factors independently. The signal to noise ratio is calculated with the help of the following formula,

$$\boxed{S/N \text{ Ratio} = 10\log_{10}(a^2 / b^2)}$$

Where,

a^2 = Signal factors

b^2 = Noise factors

When a person press the car break pedal to slow down the car, the amount of energy put in by a person to slow down the car is a signal and the amount of energy wasted due to pad wear, squeal etc., is a noise. Here, the formula to calculate S/N Ratio is,

$$\text{S/N Ratio} = \frac{\text{Signal}}{\text{Noise}} = \frac{\text{Amount of energy put in for inended function}}{\text{Amount of energy wasted}}$$

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There are many different S/N ratios. The basic once are:

(i) Nominal-the-Best

(ii) Target-the-Best

(iii) Smaller-the-Best

(iv) Larger-the-Best.

These ratios are discussed below:

(i) Nominal-the-Best

Here we have a fixed signal value (nominal value) and the variance around this value can be considered the result of noise factors. It is used wherever there is a nominal or target value and a variation about the value such as dimensions; voltage, weight etc. The target (T) is finite but not zero. For robust design the S/N ratio should be maximised. The nominal-the-best S/N value is a maximum when the average is large and the variance is small. The S/N ratio is given by the formula:

$$S/N_n = \log_{10}\left[\frac{(\bar{y})^2}{s^2}\right]$$

Adjusting for small sample sizes and changing from Bels to decibels by multiplying by ten, we have

$$S/N_N = 10 \log_{10}\left[\frac{(\bar{y})^2}{s^2} - \frac{1}{n}\right]$$

which is the nominal-the-best S/N_N ratio

[$\bar{y}$ = average, s = standard deviation, n = sample size (number of observations) and s^2 = variance]

(ii) Target-the-Best

When the average is off-target on the high side, the S/N_n value can give more favourable information. When off-target is on the low side, the value can give less favourable information; Taguchi's approach is to reduce variation and then bring the average on target. Another S/N_n ratio called the target-the-best eliminates these problems provided the target is known.

(iii) Smaller-the-Better:

The S/N_n ratio for smaller-the-better is used for solutions where the target value (T) is zero, such as computer response time, automotive emissions, or corrosion.

The equation is:

$$S/N_N = -10 \log_{10}[MSD]$$

$$= -10 \log_{10}\left[\frac{(\Sigma y^2)}{n}\right]$$

The negative sign is used to ensure that the largest value gives the optimum value for the response, variable and therefore robust design. Mean standard deviation (MSD) is given to show the relationship to the loss function.

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(iv) Larger-the-Better

This ratio is used where the largest value is desired such as weld strength, gasoline mileage or yield. From a mathematical view point, the target value is zero. Like the loss function, it is the reciprocal of smaller-the-better.

The equation is,

$$S/N_L = -10 \log_{10} [MSD]$$

$$= -10 \log_{10} \left[\Sigma \left(\frac{1}{y^2} \right) \Big/ n \right]$$

3.3.4 Parameter Design

Q31. Explain briefly about Parameter Design.

Ans :

The aim here is to make a product or process less variable (more robust) in the face of Wiation over which we have little or no control. The numerical values for the system variables (product and process parameters which are called factors) are chosen so that the system performs well: no matter what disturbances or noises (i.e. uncontrollable variations) are encountered by it (i.e. it is robust). The objective is to identify optimum. levels for those control factors so that the product and / or process is least sensitive to the effect of charges of noise factors. The experimentation pinpoints this combination of product/ process parameter levels. The emphasis in parameter design is on using low cost materials and processes in the production of the system. It is the key stage of designing in quality.

The parameter design focuses at establishing process and machine settings that minimise performance variation. A distinction is made at this stage between controllable and uncontrollable factors (parameters and noise). The specification criterion is for optimisation and is usually expressed as monetary loss arising from variation.

3.3.5 Tolerance Design

Q32. Explain briefly about Tolerance Design.

Ans :

Tolerance design deals with the problem of how', and when to specify tightened tolerances of a product or a process so that quality and performance / productivity are enhanced. Every product or process has a large number of components. The critical components have to be targeted when tolerances have to be tightened.

It is generally believed that the quality and performance of any item can be easily improved by merely tightening up on some or all of its tolerance requirements. For example, if the old version of an item specified machining to +1 micron, we naturally believe that we :an obtain better performance by specifying machining to ±0.5 micron. This can become expensive however, and is often not a guarantee of much better performance. Tight-Tolerance level items involve high initial and maintenance costs to realise that tolerance design therefore the selection of critical tolerances and the specification of those critical tolerances is not a task to be undertaken without careful thought. In fact, it is recommended that only after extensive parameter design studies have been completed should tolerance design be performed as a last resort to improve quality and productivity. Tolerance design is aimed at minimizing the total sum of product manufacturing and life time costs.

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Short Question and Answers

1. Failure Mode Effect Analysis

Ans :

Failure modes and effects analysis (FMEA) is a step-by-step approach to identify all possible failures in a design, a manufacturing or assembly process, or a finished product or a filial service. "Failure modes" means the ways or modes, in which something may fail. "Failures" are errors or defects which affect the customer and can be potential or actual failures. "Effects analysis" refers to the study of the consequences or effects of those failures.

Failure modes and effects analysis (FMEA) is also called as "potential failure modes and effects analysis", or "failure mode, effects and critically analysis" (FMECA).

Definitions

(i) FMEA is one of the tools of total quality management which helps in finding out the possible failure modes of a design, product, process or service and setting up ways of preventing their recurrences.

(ii) It is a methodology to assess and reduce risk in systems, products or services. It aims to define, identify, prioritise and eliminate known or potential failures at an early stage as possible.

2. Statistical Process Control

Ans :

Statistical Process Control (SPC) is the application of statistical techniques to determine whether the output of a process conforms to the product or service design. In SPC, control charts are used primarily to detect production of defective products or services or to indicate that the production process has changed and that products or services will deviate from their design specifications unless something is done to correct "the situation."

3. Quality Function Deployment

Ans :

The Japanese developed an approach called "quality function deployment" (QFD) to meet customer's requirements throughout the design process and also in the design of production systems. Quality function deployment is a method by which cross-sectional teams translate customer requirements into appropriate design requirements at each stage of the product development process.

4. Design of Experiments

Ans :

Design of experiments (DOE) is defined as a branch of applied statistics that deals with planning, conducting, analyzing, and interpreting controlled tests to evaluate the factors that control the value of a parameter or group of parameters. DOE is a power-ful data collection and analysis tool that can be used in a variety of experimental situations.

It allows for multiple input factors to be manipulated, determining their effect on a desired output (response). By manipulating multiple inputs at the same time, DOE can identify important interactions that may be missed when experimenting with one factor at a time. All possible combinations can be investigated (full factorial) or only a portion of the possible combinations (fractional factorial).

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QFD is an excellent way for firms to capture the "voice of the customer". It ensures that the customer is the focus of all design activities and "dictates" all design trade-offs. QFD is a customer-driven planning process to guide the design, manufacturing and marketing of goods. It tries to eliminate the gap between what customers want in a new product and what the product must deliver.

5. Quality by Design

Ans :

Quality by design" is the practice of using a multidisciplinary team to conduct conceptual thinking, product design and production planning all at one time. It is also known as "concurrent engineering", "simultaneous engineering" ox "parallel engineering". The team is composed of specialists from business, engineering, production and customer base. Suppliers of process equipment, purchased parts, and services are also included on the team at appropriate times. "Quality by design" has recently encouraged changes in management structures.

6. Define Bench Marking

Ans :

Benchmarking is a systematic method by which organizations can measure themselves against the best industry practices. It promotes superior performance by providing an organized framework through which organizations learn how the "best in class" do things, understand how these best practices differ from their own, and implement change to close the gap.

The essence of benchmarking is the process of borrowing ideas and adapting them to gain competitive advantage. It is a tool for continuous improvement.

Benchmarking is an increasingly popular tool. It is used extensively by both manufacturing and service organizations, including Xerox, AT&T, Motorola, Ford, and Toyota. Benchmarking is a common element of quality standards, such as the Chrysler, Ford, and General Motors Quality System Requirement.

7. Balanced scorecard

Ans :

The Balanced Scorecard (BSC) acts as a performance management tool which deals with assessing whether the smaller scale operational functions/activities of a company are in alignment with its large-scale goals/ objectives with respect to its vision and strategy.

Balanced scorecard presents a complete picture of, the business by emphasizing not only on the financial aspects but also by emphasizing on the operational, marketing and development aspects. This complete picture of the business helps the business to take long-term decisions.

8. Sales and Operations Planning

Ans :

Companies have been achieving improved business performance for quite some time by implementing and operating with an integrated business management process known as Sales and Operations Planning (S&OP). Sales and operation planning is an interactive business management process that determines the optimum level of manufacturing output. The process is built upon stake-holder agreement and an approved consensus plan.

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Sales and operations planning is an integrated business management process through which the executive leadership team continually achieves focus, alignment and synchronization among all functions of the organisation. The S&OP plan includes an updated sales plan, production plan, inventory plan, customer lead time plan, new product development plan, strategies initiative plan and resulting financial plan. Plan frequency and planning horizon depends on the specifics of the industry.

9. Kanban

Ans :

Kanban is a concept related to lean and just-in-time (JIT) production. The Japanese word *kanban* is a common everyday term meaning "signboard" or "billboard" and utterly lacks the specialized meaning that this loanword has acquired in English. According to Taiichi Ohno, the man credited with developing JIT, kanban is a means through which JIT is achieved.

10. Activity-Based Costing

Ans :

Activity-Based Costing (ABC) is a method for estimating the resources required to operate an organization's business processes, produce its products and serve its customers.

In a business organization, the ABC methodology assigns an organization's resource costs through activities to the products and services provided to its customers. It is generally used as a tool for understanding product and customer cost and profitability. As such, ABC has predominantly been used to support strategic decisions such as pricing, outsourcing and identification and measurement of process improvement initiatives.

11. Monte Carlo Technique (MCT)

Ans :

When the system being simulated includes data inputs that are random variables (i.e., the elements of the system exhibits chance in their behaviour), a technique known as Monte Carlo Simulation as used to reflect the variables as accurately as possible. The basis of Monte Carlo simulation is experimentation on the chance (or probabilistic) elements through random sampling.

Monte Carlo method uses random numbers which can either be generated by a computer program (Excel) or taken from a random number table to generate simulated events. The process of matching random numbers to simulated events is called random number mapping.

12. Signal-to-Noise Ratio

Ans :

Signal to noise ratio was proposed by Taguchi for calculating the target value for the response. It is the ratio'ttetween mean (average) and the variance. The signal to noise ratio measures p/a ratio where p is the process mean and σ is the standard deviation.

The main aim of Taguchi behind devising a signal to noise ratio is to attain variability measure independent of the mean as this helps in measuring the variability control factors and target control factors independently. The signal to noise ratio is calculated with the help of the following formula,

$$S / N \text{ Ratio} = 10 \log_{10}(a^2 / b^2)$$

Where,

a^2 = Signal factors

b^2 = Noise factors

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Choose the Currect Answers

1. Quality by design is also called as, [c]
   (a) Total productive maintenance (b) Quality function deployment
   (c) Parallel engineering (d) Just in time

2. Following are the demerits of activity based costing, [d]
   (a) Expensive (b) Transparency
   (c) Time consuming (d) All the above

3. Designing the system in such a manner that it does not undergo any variation till the end product is referred as, [a]
   (a) System design (b) Parameter design
   (c) Tolerance design (d) None

4. Following are the studies conducted in FMEA, [d]
   (a) Failure mode analysis (b) Failure effect analysis
   (c) Failure criticality analysis (d) All the above

5. In _____ matrix, the requirements and expectations of the customers are identified and are converted into technical product features. [b]
   (a) Technical feature deployment matrix (b) Customization matrix
   (c) Process planning matrix (d) Production planning matrix

6. "House of Quality" is one of the most in.r planning tool of, [c]
   (a) Design of experiments (b) Quality by design
   (c) Quality function deployment (d) None

7. In this level of benchmarking, the firm makes comparison within its organization in different branch offices or divisions. [a]
   (a) Internal benchmarking (b) Competitive benchmarking
   (c) Noncompetitive benchmarking (d) World class benchmarking

8. Variations in process can result from many causes like, [d]
   (a) Material (b) Man
   (c) Machine (d) All the above

9. In this step of sales and operations planning, a group of senior managers with CEO works on key issues of the business in order to set the busin s objectives. [b]
   (a) Demand review (b) Senior management review
   (c) Supply review (d) New product review

10. Taguchi statistical approach to quality is based on, [c]
   (a) Quality robustness (b) Taguchi loss function
   (c) Both (a) & (b) (d) Customer satisfaction

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Fill in the blanks

1. _____ is defined as the process of determining the potential failures, their effects and suggesting corrective actions.
2. Quality function deployment is also called as _____
3. The process of adopting the best practices, followed by successful and the top or the best-in-class companies is known as _____
4. _____ is regarded as an important tool for enhancing quality and increasing productivity.
5. Tolerance design is a process which helps in identifying the _____ of the target.
6. _____ is the ratio between mean and the variance.
7. _____ is regarded as heart of the just-in-time system.
8. _____ is a technique which involves stochastic process with distributions and parameters that helps in solving the complex equations.
9. A conceptual framework which is useful in transforming the strategic objectives of a firm into a set of performance indicators is known as _____
10. _____ is the control or management of the process through the use of statistical methods and tools.

ANSWERS

1. Failure mode and effect analysis
2. Voice of customer
3. Benchmarking
4. Design of Experiments (DOE)
5. Statistical tolerance level
6. Signal to noise ratio
7. Kanban
8. Monte Carlo technique
9. Balanced scorecard
10. Statistical process control.

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UNIT IV

Six Sigma:

The concept of Six Sigma, Objectives of Six Sigma, The frame-work of Six Sigma programme, Six Sigma Organization: roles and responsibilities, Six Sigma problem solving approach: The DMAIC model, Six Sigma Metrics: Cost of poor quality, Defects per million opportunities and First pass yield. Benefits and costs of Six Sigma.

4.1 THE CONCEPT OF SIX SIGMA

Q1. Define six sigma. State the features of six sigma.

Ans : **(Aug.-21, Imp.)**

Meaning

Six sigma is a statistical control limit given to the process of completing a job or task either completely or partially with a confidence level of 99.9997%.

In other words, the probability of the product being defective is only 3.4 parts per million. Six sigma is best explained as an improvement approach which aims at minimizing the defects by emphasizing on output which is important to the customer.

Six sigma is an effective strategy, which assures quick growth of an organization and it also acts as an effective technique for lowering the cost and increasing the level of production, rejection, rework etc.

Definition

"Six sigma is simply a TQM process that uses process capability analysis as a way of measuring process".

Features

Following are the features of Six Sigma,

1. Six sigma aims at continuous improvement by reducing the cost of production and increasing customer satisfaction and return on investment.
2. One of the features of six sigma is to produce the output defectless or error free.
3. It ensures quality products.
4. Six-sigma's philosophy is "Do it right the first time and every time".
5. Six sigma's principles are applied in manufacturing and service industries.
6. Six sigma is a statistical process control technique which is applied to gain complete confidence in the company's product and services and also the management.
7. It is helpful to solve problems in an organized manner.

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8. The six sigma emphasizes on the following areas,

   (a) Independent variable to the process

   (b) Eliminates the root cause of any problem and tries to prevent it

   (c) Input is given much importance than output

   (d) Emphasizes problem and not the cause

   (e) Concentrates on controlling the problem and not on monitoring.

4.1.1 Objectives of Six Sigma

Q2. State the objectives of six sigma.

Ans :

1. To Decrease Deviations

The main objective of six sigma is to achieve zero variation both in the product and the process. Zero variation would help not only the users but also the customers to gain confidence in the quality and reliability of the products and services which are provided by the organization.

2. To Bring Down Defects/Rework

Six sigma reduces defects as it is a process control technique. If six sigma is implemented properly then the number of defects/ rejections will not increase. 'Muda' is a Japanese term which means elimination of all wastages. Rejection/rework reduces the profit of the organization.

3. To Enhance the Yield/Productivity Level

Productivity levels can be enhanced if the products and services of the organization are properly utilized and if the rework is reduced or eliminated. Six sigma strives at improving the productivity of the organization by proper/ effective utilization of men, machine, material and by reducing the different types of wastages. Increase in productivity in turn leads to better quality, cost effectiveness and a competitive advantage in the market place.

4. To Improve Customer Satisfaction

The principle objective of six sigma is to achieve 'customer satisfaction' by providing good quality products and services to the customers. Customer satisfaction can also be achieved by providing those products and services which meets the needs of the customer, in right quality, right quantity, right time, right place and right cost.

5. To Enhance the Bottom Line

Improving the bottom line refers to increasing profitability and Return On Investment (ROI), which can be achieved by focusing on,

(a) Minimizing the production cost

(b) Continuous improvement in processing

(c) Elimination of wastage, rework and over-utilization of material, men or machine hours.

(d) Providing proper training and changing the mindset of the employees.

(e) Increasing employee's participation.

6. To Enhance the Top Line

Six sigma also improves the top line by maintaining the organization's reputation in the market place and providing defectless products or services. Six sigma emphasizes on producing defect free products or services not only to create a brand image but also to ensure a better work culture, relationships with customers and employees.

7. Business Transformation

Six sigma aims at work improvement through the process of business transformation, so that the organization can achieve the set objectives.

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8. Strategic Improvement

Six sigma also analyses its strengths, weaknesses and opportunities in order to overcome its weakness and make use of the opportunities to bring continuous improvement in the process.

Q3. Explain the principle of six sigma.

Ans :

1. To Decrease Variations

Six sigma aims to assure uniformity in the performance, as it helps the users and customers to build confidence in the quality and reliability in various products and services provided by the firm. The six sigma focuses on minimizing the variations by creating a manufacturing and service set up having a zero variation in the product and process.

2. To Decrease Defects/Rework

The six sigma technique aims to remove or decrease the rejects and defects to zero. This technique controls the process which helps in creating the products without any defects.

3. To Enhance Yield/Productivity

Saving an individual rejection helps in producing an extra piece of product. The time saved in reworking can be used for producing the products and services effectively which in turn increases the productivity. The six sigma technique aims to enhance the productivity by making the maximum utilization of human resource, material and machinery. It also focuses on the elimination of wastages. With an increase in productivity, the cost of production reduces and the quality and competitiveness in the market increases.

4. To Improve Customer Satisfaction

By offering the right quality of products and services, in right quantity, at the right time, right place and at right cost a firm can attain the customer satisfaction. The products should also be produced in accordance with the needs of the customers. Attaining customer satisfaction is one of the significant objective of six sigma as it is very important for the survival of the firm. The concept of six sigma helps in offering defect free products and services which in turn improves the satisfaction of the customers.

5. To Enhance the Bottom Line

The six sigma approach also aims at enhancing the profits and the return on investment by decreasing the production costs and processing costs through continuous process improvement. The profit levels and ROI can also be enhanced by decreasing and removing the wastages and the additional consumption of material, machine hours or personnel. The six sigma practice, helps in enhancing the bottom line by providing training, changing the attitudes of the employees and encouraging them to participate in the organizational activities.

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6. To Enhance the Top Line

Six sigma aims to enhance the reputation of the firm in the market and the society. This objective can be attained by offering good quality products and services without any variations in its performance and reliability. This also helps in building a strong brand image in market which in turn increases the sales. The six sigma also helps in creating a congenial work atmosphere, maintaining good relationships with employees and customers and enhances the top line significantly.

Q4. Bring out the differences between six sigma and TQM.

Ans :

Sl.No.	Six Sigma	Sl.No.	TQM
1.	Six sigma possesses higher quality of products or services which holds the probability of only 3.4 defects per million opportunities (DPMO)	1.	Total quality management aims at enchancing the quality through continuous improvement in order to either meet or exceed the customer satisfaction.
2.	Six sigma is a problem solving methodology which helps in reducing defects and its related costs.	2.	TQM ensures empowerment of employees and proper measurement of critical performance variable which are related with the company's operations and to enhance continuous improved performances.
3.	Six sigma considers the process management, improvement, measurement as daily activities for improving the process management.	3.	TQM requires the support of the top management in carrying out the operations effectively.
4.	Six sigma not only produces defect free goods or services or continuous improvement but also helps in reinvention/reinnovation of the business.	4.	TQM is associated with responsibilities for "quality control" or "quality assurance" and always focuses on producing superior "quality in the company's operations.
5.	Six sigma's implementation in the company brings standard improvement in the performance.	5.	TQM's implementation in the company ensures effective quality resulting in customer satisfaction.
6.	Six sigma's uses 'critical -to-quality' aspect which is most crucial from the customer's point of view.	6.	TQM builds a competitive environment in the organization, increases profitability, productivity improvement which in turn leads to build company's image

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7.	Six sigma also solves the customer's problems effectively.	7.	Total quality management strives at customer -orientation and is basically a long - term plan.
8.	In six sigma, Champions, black belts, master block belts and green belts are used for successful implementation of six sigma projects	8.	To carry out the project effectively in TQM, all the employees who are engaged in the process must be trained in the quality improvement skills and Statistical Process Control (SPC) techniques.
9.	The ISO, CMM and six sigma are integrated together in the system in order to improve the efficiency of the services which helps in Solving the problems.	9.	TQM continuously strives at quality improvement projects like on-time delivery, order entry efficiency, customer satisfaction, cycle-time etc. Statistical techniques include SPC, bench marking, Quality Function Deployment (QFD) ISO 9000 etc, are used for solving problems effectively
10.	Six sigma follows, "do it right the first time" philosophy.	10.	TQM performance measures include uptime, percent non-conforming, absenteeism, and customer satisfaction which are examined at each functional area.

Q5. How can six sigma be helpful in achieving quality objectives of a firm.

Ans : **(June-19)**

Six sigma is used for achieving various objectives. Some of the important objectives expected out of six sigma initiative are, saving cost (money), achieving competitive advantages, growth, customer satisfaction and quality.

Today six sigma is gaining popularity very rapidly iay-by-day as its aim is simple i.e., minimizing defects.

Various advantages which can be gained by the company by improving its quality levels are,

1. Quality leads to minimization of costs.
2. Quality improves customer satisfaction levels.
3. It motivates the employees to work more effectively.
4. It builds a good working environment.
5. It builds the reputation of the company not only in the market but also in the society.
6. It attracts the investors to invest in the company.

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(i) Control Chart

Control chart helps six sigma in identifying the problem and taking corrective action. The control chart consists of the Lower Control Limit (LCL) and the Upper Control Limit (UCL) which marks the minimum and maximum inherent limits of the process collected from data in the six sigma process.

(ii) Design of Experiment (DOE)

DOE acts as a tool for testing and optimizing the performance of a process, product, service or solution. It analyses the relationship between input and output. Design of experiment helps in planning and controlling the variables through an experiment. It helps the six sigma process in testing various combinations of possible solutions to find all optimal improvement strategy. It also helps in identifying problems and reducing defects through evaluation of product or service designs.

(iii) Hypothesis Testing

Hypothesis testing determines the probability value. Hypothesis testing analyzes the problem, statistically tests the data assumptions, selects samples and determines whether or not the probability of defect arises by random chance or by some other factor. It emphasizes on the critical improvement of the process.

(iv) Statistical Process Control

The techniques/tools which are included in Statistical Process Control (SPC) are graphical analysis, correlation, mean, median, mode, histogram etc. These tools are used by six sigma to measure and evaluate the variations in a process and help in controlling them. Zero or no variations in the process, increases the customer's confidence in the quality of product/service.

4.2 THE FRAME-WORK OF SIX SIGMA PROGRAMME

Q6. Explain theoretical Frame-work of Six Sigma Programme.

(OR)

Draw and explain the framework of six sigma.

(OR)

Describe the framework of six sigma programme.

Ans : **(Aug.-21, Dec.-20, Aug.-18)**

There are three **key elements** of Six Sigma Process Improvement.

1. Customers
2. Processes
3. Employees

1. The Customer

Customers define quality. They expect performance, reliability, competitive prices, on-time delivery, service, clear and correct transaction processing and more.

Today, Delighting a customer is a necessity. Because if we don't do it, someone else will.

2. The Processes

Defining Processes and defining Metrics and Measures for Processes is the key element of Six Sigma.

Quality requires to look at a business from the customer's perspective, In other words, we must look at defined processes from the outside-in.

By understanding the transaction lifecycle from the customer's needs and processes, we can discover what they are seeing and feeling. This will give a chance to identify week area with in a process and then we can improve them.

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3. The Employees

The company must involve all employees in Six Sigma Program. Company must provide opportunities and incentives for employees to focus their talents and ability to satisfy customers.

This is important to six sigma that all team members should have a well defined role with measurable objectives.

4.3 SIX SIGMA ORGANIZATION: ROLES AND RESPONSIBILITIES

Q7. Describe the Roles and Responsibilities Six Sigma Organization.

(OR)

Explain the Roles and Responsibilities Six Sigma Organization.

Ans : **(Nov.-20, Aug.-17)**

The success of Six-Sigma relies on the people who are responsible for implementing it. Six-Sigma provides some powerful techniques and tools, but success depends on the people who play the primary roles and assume the central responsibilities for using those techniques and tools to work for their organization.

Six-Sigma invariably disturbs the status-quo. It creates a major interruption as job descriptions are redefined and activities are radically changed in order to bring real, permanent changes. Everyone is a player in the implementation of Six-Sigma, regardless of individual organizational positions.

However, not every one is slated for full Six-Sigma responsibilities. People should be chosen to run the projects, participate on teams and to pursue the objective using Six- Sigma tools like metrics and other statistical measurements. The right mix of right talents is needed to refocus on Six-Sigma projects.

The roles and responsibilities of these Key Players are briefly discussed in the following paragraphs.

1. Executive Leaders

The key role of executive leaders is to decide to do Six-Sigma and to endorse it publicly, throughout the organization. They kick-off and reinforce the comprehensive scope of Six-Sigma to ensure participation and support of everyone in the organization. Six-Sigma being a company-wide initiative involving major permanent changes, requires visible leadership to signal its importance to the organization.

Executive leadership can be built on some essential aspects such as determination, confidence, integrity and patience. Executive leaders need to show determination in their actions. They need to be resolute in believing that Six-Sigma will succeed. They should be determined to get the training, understand the savings, perpetuate the use of metrics and show-case achievements of black belts, mark key milestones and keep the overall initiative on track. For example, Jack Welch, The CEO of General Electric in the US could be considered the ideal executive leaders for Six-Sigma. From the top down and throughout all points in the organization, executive leaders can inspire and promote a' Six- Sigma culture that continually produce results.

2. Champions

The success or failure of a Six-Sigma project critically depends on the champions. A champion is an advocate who fights for the cause of black belts and to remove functional, financial or personal barriers so as to enable black belts to do their work efficiently.

Champions know the process very well and can be considered as the 'owners' of the process in every respect. The champions are drawn from the ranks of managers and executives depending on the size of the organization. They are responsible for the daily oversight and management of each critical element. They are responsible for

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reporting to top management about progress of the project and also for supporting their teams. They must ensure that the projects they select align with the executive strategy and can be easily understood and embraced by project teams.

3. Master Black Belt

Often, a member of the implementation partner's (consultant's teamunay fulfill the role of Master Black Belt in the initial stages. He / She serves as the trainer, mentor and guide for the firm's project team. The master black belt is responsible for selecting the right people and assisting in screening and selecting projects that will best achieve the firm's objectives.

Once the firm has firmly established Six-Sigma activities in place and designated an < trained people in their roles, started projects and achieved some desired results, the member of the project teams can be elevated to the rank of master black belts J

4. Black Belts

Black belts have multiple roles and responsibilities. They work full- timWon selected projects. Black belts are not masters of the process under study but masters of the change process. They act as full-time change agents. They supervise the green belts working on a Six-Sigma project. Black belts are trained to dig into the chronic and high impact issues and fix them with Six-Sigma techniques, and practices.

Other roles and responsibilities of a black belt are:

(i) Preparing a draft project charter for the Six-Sigma projects under his her supervision.

(ii) Working closely with a project team to keep it functioning and progressing toward speedy and effective conclusion to the Six-Sigma project.

(iii) Communication with the individual responsible for the financial and political well-being of the team (called a champion)

(iv) Serving as the team leader for Six-Sigma projects because of his / her expertise in Six-Sigma theory, tools and method.

(v) Helping team members analyze data and design experiments.

(vi) Providing training to the team members in Six-Sigma theory, tools and methods.

(vii) Helping team members prepare for management reviews.

(viii) Recommending Six-Sigma teams for Six-Sigma projects.

(ix) Leading and coaching green belts dealing simpler Six-Sigma projects.

5. Green Belts

Most green belts serve as team member on Six-Sigma projects. They to black belts in their functional areas. They apply Six-Sigma tools to examine and solve chronic problems on projects within their regular jobs. They also help black belts in collecting or analyzing data, running experiments or conducting other important tasks in a project. However, if a green belt acts as a team leader for simpler projects, then he or she has the following responsibilities;

(i) Preparing a draft charter for the Six-Sigma project

(ii) Selecting team members for Six-Sigma projects

(iii) Communicating with the champion, black belt and process owners concerning the status of the project.

(iv) Facilitating the Six-Sigma project team members and

(v) Providing training to team members in basic Six-Sigma tools and methods.

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6. Process Owners

A process owner is the individual who has the ultimate authority to change a process. The process owner should be identified for every project or task that is entered on to an organization's metric tracking system. The roles and responsibilities of a process owner are:

(i) Monitoring the performance of his / her process through key indicators

(ii) Empowering the people who work in his / her process

(iii) Working with all Six-Sigma project teams in his / her area to enable them to successfully complete their projects.

(iv) Managing the process after completion of the Six-Sigma project to sustain the gains made by the Six-Sigma project team and

(v) Continuing to improve and / or innovate, his / her process through the application PDCA Cycle. A process owner should pass the champion certification examination because he / she should have Six-Sigma knowledge to be effective. A process owner must understand the PDSA cycle to accept a project from control phase of the DMAIC model.

4.4 Six Sigma Problem Solving Approach

4.4.1 The DMAIC Model

Q8. Explain the Six Sigma Problem Solving Approach.

(OR)

Describe the problem solving approach of six sigma.

(OR)

State and explain DMAIC Model.

Ans : **(Aug.-21, Aug.-18, June-18)**

DMAIC model is one of the six sigma problem solving approach. The five phases in DMAIC model are,

(a) D-Define Phase

The define phase helps in defining the problem clearly as and when they occur. This is the first step in six sigma methodology. Define phase identifies those factors which are to be measured, analyzed, improved and controlled for greater revenue and needs improvement to carry out the project successfully.

(b) M - Measure Phase

Measure phase is used to identify the critical internal processes which directly affects the CTQ (Critical To Quality) measurements. Once the problem is defined, then the measure phase starts wherein it measures or evaluates the problems in the process which affects the CTQ standard.

(c) A - Analyze Phase

Under this phase, the defects which are affecting the Critical-to-Quality (CTQ) are analyzed. Hypothesis and statistical test are used to determine the factors which are critical to the outcome.

(d) I - Improve Phase

Once the factors which effect the variables are measured and analyzed, the improve phase begins in order to rectify the defects. In improve phase, all those factors are improved which affect the Critical-To-Quality (CTQ) outcomes.

(e) C - Control Phase

Control phase is used to maintain continuous improvement and in some cases control phase does not exist because mostly the problem gets eliminated in the first four phases. Control phase ensures quality, productivity and improvement in the processes continuously.

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Q9. Explain various quantitative techniques of six sigma in TQM.

Ans : **(Nov.-21)**

1. Statistical Process Control

The techniques/tools which are included in Statistical Process Control (SPC) are graphical analysis, correlation, mean, median, mode, histogram etc. These tools are used by six sigma to measure and evaluate the variations in a process and help in controlling them. Zero or no variations in the process, increases the customer's confidence in the quality of product/service.

2. Process Mapping

It is an important technique/tool used in DMAIC. Process mapping helps in identifying the input and output of the process to effectively minimize variations in the process. Value added and non-value added factors are also analyzed. The main purpose of using process mapping is to have an accurate and detailed representation of the whole process system using a standard tool flow chart which shows the operations, decision points, delays, movements, handoffs, rework loops, and control or inspections. Process mapping is mostly used by managers because it serves as a check and balance system for attaining the desired outcome.

3. Process Capability Technique/Tool

Process capability technique/tool emphasizes on fulfilling the customers CTQ and meeting specifications required to carryout the process effectively. It is long-term in nature. Process capability tool is used in the process of six-sigma in the form of pareto chart which is a graphical representation focusing on causes, defects and other aspects of the process.

4. Hypothesis Testing

Hypothesis testing determines the probability value. Hypothesis testing analyzes the problem, statistically tests the data assumptions, selects samples and determines whether or not the probability of defect arises by random chance or by some other factor. It emphasizes on the critical improvement of the process.

5. Failure Mode Effect Analysis (FMEA)

FMEA is a disciplined process which predicts, identifies and avoids the problems. FMEA helps six sigma in identifying those problems which are related to work processes and their improvements and data collection procedures.

6. Control Chart

Control chart helps six sigma in identifying the problem and taking corrective action. The control chart consists of the Lower Control Limit (LCL) and the Upper Control Limit (UCL) which marks the minimum and maximum inherent limits of the process collected from data in the six sigma process.

4.5 Six Sigma Metrics

Q10. Explain Six Sigma Metrics in detail.

Ans : **(Nov.-21, Dec.-20, June-18)**

1. Defects Per Million Opportunities

In six sigma, the DMAIC process begins with the customer. It is of utmost important to define the customer requirements. The customer requirements can be collected with the help of surveys, quality function deployment, focus group interview and so on. The next step soon after defining the customer requirements is to define the process defects, product/service units and opportunities.

Defect

A defect refers to any component of a product or service which is unable to meet the customer (both external and internal) requirements/ specifications or which results in customer dissatisfaction.

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Product/Service Unit

A unit is defined as any thing which is quantifiable by a customer.

Opportunities

Opportunities refer to the number of chances of defects in a unit. Defects Per Million Opportunities (DPMO) can be calculated with the help of the following formula,

$$DPMO = \frac{\text{Total Number of Defects Detected}}{\text{Number of Units Manufactured} \times \text{Opportunities of Defects Per Unit}} \times 10,00,000$$

2. First Pass Yield

The first pass yield refers to the average proportion of units which pass through the process for the first time without any defects. The defective items corrected by rework are not included in first pass yield.

3. Final Yield

Final yield is the proportion of total units which comes out of a process without any defects. The defective items corrected by rework are included in final yield.

4. Cost of Poor Quality

Cost of Poor Quality (COPQ) is a failure cost related with the production of defective products or services and elimination of the wastages. The concept of Cost Of Poor Quality (COPQ) was introduced by Juran. It helps in identifying the traceable as well as untraceable costs of all the defects which are present in the process. It represents the losses incurred if the product or process is not as per the set quality levels.)

4.5.1 Cost of Poor Quality

Q11. Explain in detail about Cost of Poor Quality.

Ans :

Cost of Poor Quality (COPQ) is the cost associated with producing poor quality products or services for the customer. In other words, it is the total financial losses incurred by the company due to errors and subpar work. For example, scrap, rework, repair, and warranty failure all add to the cost of poor quality.

Cost of Quality is a methodology used in the organization to measure the number of resources being used for the cost of good quality. In other words, it is the cost of making quality products or services.

The cost of quality is the combination of the cost of good quality and the cost of poor quality.

$$COQ = \text{Cost of Good Quality (COGQ)} + \text{Cost of Poor Quality (COPQ)}$$

Categories of Cost of Quality

The cost of quality can be divided into four categories: prevention cost, appraisal cost, internal failure cost, and external failure cost.

Cost of Poor Quality (COPQ)

Preventive Cost– Preventive costs are the costs of activities that are specially designed to prevent poor quality of products or services. In other words, these efforts are for making sure that failures never happen in the first place.

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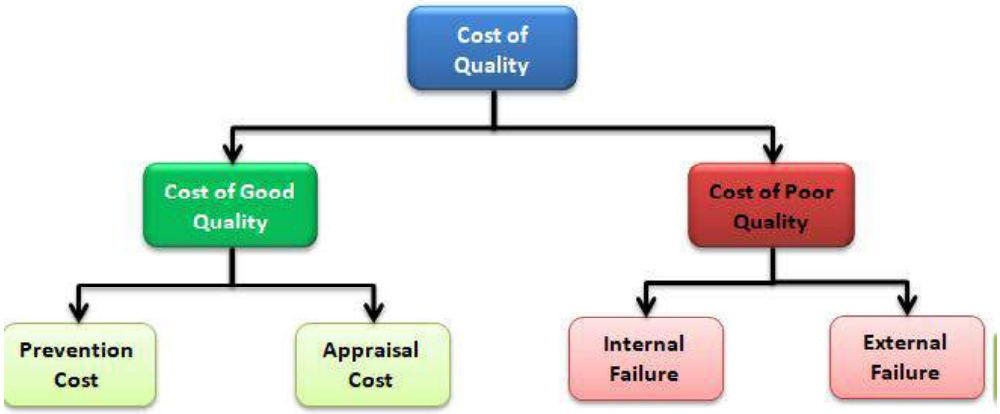

- Quality planning
- Contract review
- Trainings
- Quality audits
- Supplier evaluation
- Market research

Process capability studies

Appraisal costs: Appraisal costs are incurred when the company pays a consultant or expert to find the causes of the poor quality of the product or service. In other words, appraisal costs are related to testing, measuring, and auditing. The appraisal cost focuses on the discovery of defects rather than the prevention of defects.

- Incoming goods inspection
- In-process inspection
- Supplier inspection
- Laboratory testing
- Final goods inspection
- Calibration

Internal failure: Internal failure costs result from the finding of defects prior to delivery of the product or service to the customers. In addition, these are the costs due to the failure of a product to achieve the required quality standards.

- Rework
- Repair
- Internal scrap
- Re-testing

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- Efforts spent on failure analysis
- Raw material rejects
- In-process rejects

External failure: External failure costs arise from the rejection of the product or services by the customers after delivery. In other words, these are the costs when a product or service fails to meet the required quality standards and is detected after it reaches the customer.

- Warranty claims
- Customer visits
- Penalties
- Replacements
- Investigations
- Loss of goodwill

4.5.2 Defects per Million Opportunities

Q12. Explain in detail about Defects per million opportunities.

Ans :

DPMO stands for 'Defects Per Million Opportunities'. 'Opportunity' means the opportunity for a defect, one unit may have many opportunities for a defect.

DPMO is a Six Sigma Metric. Six Sigma process improvement projects aim to achieve 3.4 or fewer Defects Per Million Opportunities. Using DPMO, rather than the proportion of defective items, gives a common standard that can be used to compare the defect rates of simple and complex items.

The Six Sigma approach aims to get the DPMO below 3.4 per million. Using the number of opportunities for a defect, rather than the number of units with a defect, allows the measure to be applied to simple and complex items. The disadvantage is that the definition of 'opportunity' is hard to pin down.

For example it could be (incorrectly, but plausibly) argued that recording an address involves many opportunities for a defect; wrong street number, wrong zip, street name spelled wrong, and so on. The opportunity should be defined in terms the customer cares about.

Defects per Million Opportunities, or DPMO, is an easy method of measuring process performance often used in Six Sigma initiatives. DPMO also serves as a basis for calculating process sigma values, another performance measure. Unlike Defects per Unit (DPU), which provides the number of defective products, DPMO takes into account the reality that multiple defects can exist in a single product. This article provides step by step instructions for calculating the number of Defects per Million Opportunities.

Defects Per Million Opportunities (DPMO)

Defects per Million Opportunities factors in the total opportunities for defect occurrence existing in a process. DPMO is considered long-term measurement of a process and this can be directly converted into a long-term Z-statistic (sigma value).

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Given :

D : # of defects

O : # of opportunities for a defect

U : # of units

TOP : Total number of opportunities

= U * O

Formula :

DPMO = DPO * 1,000,000

B) First Pass Yield / Throughput Yield (TPY)

Six Sigma uses a number of specialized measures (metrics). The most fundamental is the Defects Per Million Opportunities (DOMO) measure. The aim of six sigma is to achieve less than 3.4 DPMO. A process that gives 3.4 DPMO has achieved 'six sigma'

The Rolled Throughput Yield (RTY) is a key tool in achieving this. The individual yields at each process step might look, at first site, quite good, but the First Pass Yield might be significantly lower. Even when the First Pass Yield at each process step looks satisfactory the overall or Rolled throughput Yield may be low.

The sigma metric is an alternative to the traditional process capability and process performance measures used in Statistical Process Control.

The proportion of units that, on average, go through a process first time without defects. It is calculated from :

$FPY = e^{-DPU}$

Throughput Yield (TPY)

Throughput Yield (TPY) is the number of acceptable pieces at the end of the end of a process divided by the number of starting pieces excluding scrap and rework (meaning they are a part of the calculation).

Rework IS a part of the TPY calculation. Use the process map as a guide for evaluating each individual process.

TPY is used to only to measure a single process.

Sometimes only raw material is available at the start so it may be necessary to convert the raw material to expected pieces that it should make, or use a unit of weight at the start and weight out at the end to calculate final yield.

4.5.3 First Pass Yield

Q13. Explain about First pass yield.

Ans :

The first pass yield refers to the average proportion of units which pass through the process for the first time without any defects. The defective items corrected by rework are not included in first pass yield.

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A high first pass yield can be achieved only when the process functions smoothly and flawlessly. If the process is studied in detail, it would be found that the process includes three sub-processes which are used in transforming the product. In each sub-process, few damaged units are manufactured which makes the output less than the input and for each sub processes the six sigma capability is being computed. The key feature of this sub-processes is that the output of every sub-process does not consist the damaged units which are corrected through rework.

4.6 Benefits and Costs of Six Sigma

Q14. What are the Benefits and costs of Six Sigma?

(OR)

Discuss the Benefits and costs of Six Sigma.

(OR)

Explain the Benefits and costs of Six Sigma.

Ans : **(Nov.-20, June-19, Aug.-17, Imp.)**

Benefits

1. Customer Satisfaction or Customer Loyalty

Six Sigma tends to increase customer satisfaction by reducing the potential problems and by eliminating the unwanted specifications from the process. A satisfied customer is a happy customer. Thus six sigma helps to achieve the customer's loyalty and helps to retain the customer.

2. Eradication of Variation and Waste from The Process

Six Sigma is a data-driven approach for reducing the unwanted actors from the process which eradicates the variation and deviation from the process. Thus, Six Sigma helps to identify the improvement areas for the process.

3. Workforce Motivation

Six sigma helps to motivate the employees of the organization by ensuring that the employees are able to use the available technology for their ease of work and their time is saved. Productivity is automatically increased when the employees are motivated and inspired to keep working and challenging their limits.

4. Effective Time Management

Six Sigma focuses on efficient business and increased productivity by helping the employees to manage their time effectively. As time is effectively managed, the work-life balance of employees is improved and hence again their morale is boosted to work smart and work hard.

5. Advancement in Career

Having Six Sigma certification helps you to stand apart from the crowd and provides you additional advanced skillset which is highly demanded by the company. Thus Six Sigma certification helps you to uplift your career and guides you to move one step ahead of the competition.

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6. Inculcates Leadership

Training of Six Sigma guidelines inculcates leadership quality by making you aware of the ways and methods for increasing the process revenue and efficiency. The black belt certified professionals or the master black belt certified professionals are essentially the trainers who train and guide the entry-level quality analyst to grow to make them good leaders. Six Sigma certification and training open various managerial positions for the professionals who wish to make a career in the quality and process improvement sector. Following the six sigma guidelines helps to improve the quality of products and services offered to the customers which generates a happy and satisfied customer.

7. Strategic Planning

The Six Sigma helps to identify the potential problems or pullbacks of the process in advance, thus it helps the project management team to strategize and plan to reduce and eliminate the problems and waste so that the productivity is not affected and the quality of the product and services offered to the customers is not compromised at any point. It helps the project management team to recognize the strengths and weaknesses of the business process resulting in the elimination of the unwanted process.

8. Promotes a Healthy Company Culture

Six Sigma is now an established company culture in top-notch organizations. The six sigma training motivates each and every employee to contribute towards the organization's advancement and thus makes them adaptable to changes to the workplace. Thus Six Sigma is a continuous improvement process and helps to promote a healthy work culture in the organization. Healthy work culture is again important for happy and satisfied employees and also for the organization's growth.

Costs

1. Indirect Payroll

It includes the cost incurred on the activities like, measurement, obtaining the data about the customers and improvement of projects. These costs are mainly associated with the executives, team members, process owners and others.

2. Improvement Implementation Costs

These are expenses involved in introducing the new solutions or process designs which are specifically for IT driven solutions.

3. Training Costs

It involves the costs incurred on training the employees on six sigma skills.

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Short Questions and Answers

1. First Pass Yield

Ans :

Six Sigma uses a number of specialized measures (metrics). The most fundamental is the Defects Per Million Opportunities (DOMO) measure. The aim of six sigma is to achieve less than 3.4 DPMO. A process that gives 3.4 DPMO has achieved 'six sigma'

The Rolled Throughput Yield (RTY) is a key tool in achieving this. The individual yields at each process step might look, at first site, quite good, but the First Pass Yield might be significantly lower. Even when the First Pass Yield at each process step looks satisfactory the overall or Rolled throughput Yield may be low.

The sigma metric is an alternative to the traditional process capability and process performance measures used in Statistical Process Control.

The proportion of units that, on average, go through a process first time without defects. It is calculated from :

$$FPY = e^{-DPU}$$

2. Define six sigma.

Ans :

Meaning

Six sigma is a s tatistical control limit given to the process of completing a job or task either completely or partially with a confidence level of 99.9997%.

In other words, the probability of the product being defective is only 3.4 parts per million. Six sigma is best explained as an improvement approach which aims at minimizing the defects by emphasizing on output which is important to the customer.

Six sigma is an effective strategy, which assures quick growth of an organization and it also acts as an effective technique for lowering the cost and increasing the level of production, rejection, rework etc.

Definition

"Six sigma is simply a TQM process that uses process capability analysis as a way of measuring process".

3. Six Sigma Metrics in detail.

Ans :

1. Defects Per Million Opportunities

In six sigma, the DMAIC process begins with the customer. It is of utmost important to define the customer requirements. The customer requirements can be collected with the help of surveys, quality function deployment, focus group interview and so on. The next step soon after defining the customer requirements is to define the process defects, product/service units and opportunities.

Defect

A defect refers to any component of a product or service which is unable to meet the customer (both external and internal) requirements/specifications or which results in customer dissatisfaction.

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Product/Service Unit

A unit is defined as any thing which is quantifiable by a customer.

Opportunities

Opportunities refer to the number of chances of defects in a unit. Defects Per Million Opportunities (DPMO) can be calculated with the help of the following formula,

$$DPMO = \frac{\text{Total Number of Defects Detected}}{\text{Number of Units Manufactured} \times \text{Opportunities of Defects Per Unit}} \times 10,00,000$$

2. First Pass Yield

The first pass yield refers to the average proportion of units which pass through the process for the first time without any defects. The defective items corrected by rework are not included in first pass yield.

3. Final Yield

Final yield is the proportion of total units which comes out of a process without any defects. The defective items corrected by rework are included in final yield.

---

4. Features of Six Sigma.

Ans :

1. Six sigma aims at continuous improvement by reducing the cost of production and increasing customer satisfaction and return on investment.
2. One of the features of six sigma is to produce the output defectless or error free.
3. It ensures quality products.
4. Six-sigma's philosophy is "Do it right the first time and every time".
5. Six sigma's principles are applied in manufacturing and service industries.
6. Six sigma is a statistical process control technique which is applied to gain complete confidence in the company's product and services and also the management.
7. It is helpful to solve problems in an organized manner.

---

5. Principle of Six Sigma.

Ans :

1. To Decrease Variations

Six sigma aims to assure uniformity in the performance, as it helps the users and customers to build confidence in the quality and reliability in various products and services provided by the firm. The six sigma focuses on minimizing the variations by creating a manufacturing and service set up having a zero variation in the product and process.

2. To Decrease Defects/Rework

The six sigma technique aims to remove or decrease the rejects and defects to zero. This technique controls the process which helps in creating the products without any defects.

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3. To Enhance Yield/Productivity

Saving an individual rejection helps in producing an extra piece of product. The time saved in reworking can be used for producing the products and services effectively which in turn increases the productivity. The six sigma technique aims to enhance the productivity by making the maximum utilization of human resource, material and machinery. It also focuses on the elimination of wastages. With an increase in productivity, the cost of production reduces and the quality and competitiveness in the market increases.

4. To Improve Customer Satisfaction

By offering the right quality of products and services, in right quantity, at the right time, right place and at right cost a firm can attain the customer satisfaction. The products should also be produced in accordance with the needs of the customers. Attaining customer satisfaction is one of the significant objective of six sigma as it is very important for the survival of the firm. The concept of six sigma helps in offering defect free products and services which in turn improves the satisfaction of the customers.

6. DMAIC Model.

Ans :

DMAIC model is one of the six sigma problem solving approach. The five phases in DMAIC model are,

(a) D-Define Phase

The define phase helps in defining the problem clearly as and when they occur. This is the first step in six sigma methodology. Define phase identifies those factors which are to be measured, analyzed, improved and controlled for greater revenue and needs improvement to carry out the project successfully.

(b) M - Measure Phase

Measure phase is used to identify the critical internal processes which directly affects the CTQ (Critical To Quality) measurements. Once the problem is defined, then the measure phase starts wherein it measures or evaluates the problems in the process which affects the CTQ standard.

(c) A - Analyze Phase

Under this phase, the defects which are affecting the Critical-to-Quality (CTQ) are analyzed. Hypothesis and statistical test are used to determine the factors which are critical to the outcome.

(d) I - Improve Phase

Once the factors which effect the variables are measured and analyzed, the improve phase begins in order to rectify the defects. In improve phase, all those factors are improved which affect the Critical-To-Quality (CTQ) outcomes.

(e) C - Control Phase

Control phase is used to maintain continuous improvement and in some cases control phase does not exist because mostly the problem gets eliminated in the first four phases. Control phase ensures quality, productivity and improvement in the processes continuously.

7. Cost of Poor Quality.

Ans :

Cost of Poor Quality (COPQ) is the cost associated with producing poor quality products or services for the customer. In other words, it is the total financial losses incurred by the company due to errors and subpar work. For example, scrap, rework, repair, and warranty failure all add to the cost of poor quality.

Cost of Quality is a methodology used in the organization to measure the number of resources being used for the cost of good quality. In other words, it is the cost of making quality products or services.

The cost of quality is the combination of the cost of good quality and the cost of poor quality.

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8. Defects per Million Opportunities.

Ans :

DPMO stands for 'Defects Per Million Opportunities'. 'Opportunity' means the opportunity for a defect, one unit may have many opportunities for a defect.

DPMO is a Six Sigma Metric. Six Sigma process improvement projects aim to achieve 3.4 or fewer Defects Per Million Opportunities. Using DPMO, rather than the proportion of defective items, gives a common standard that can be used to compare the defect rates of simple and complex items.

The Six Sigma approach aims to get the DPMO below 3.4 per million. Using the number of opportunities for a defect, rather than the number of units with a defect, allows the measure to be applied to simple and complex items. The disadvantage is that the definition of 'opportunity' is hard to pin down.

For example it could be (incorrectly, but plausibly) argued that recording an address involves many opportunities for a defect; wrong street number, wrong zip, street name spelled wrong, and so on. The opportunity should be defined in terms the customer cares about.

9. Throughput Yield (TPY)

Ans :

Throughput Yield (TPY) is the number of acceptable pieces at the end of the end of a process divided by the number of starting pieces excluding scrap and rework (meaning they are a part of the calculation).

Rework IS a part of the TPY calculation. Use the process map as a guide for evaluating each individual process.

TPY is used to only to measure a single process.

Sometimes only raw material is available at the start so it may be necessary to convert the raw material to expected pieces that it should make, or use a unit of weight at the start and weight out at the end to calculate final yield.

10. Benefits of Six Sigma.

Ans :

1. Customer Satisfaction or Customer Loyalty

Six Sigma tends to increase customer satisfaction by reducing the potential problems and by eliminating the unwanted specifications from the process. A satisfied customer is a happy customer. Thus six sigma helps to achieve the customer's loyalty and helps to retain the customer.

2. Eradication of Variation and Waste from The Process

Six Sigma is a data-driven approach for reducing the unwanted actors from the process which eradicates the variation and deviation from the process. Thus, Six Sigma helps to identify the improvement areas for the process.

3. Workforce Motivation

Six sigma helps to motivate the employees of the organization by ensuring that the employees are able to use the available technology for their ease of work and their time is saved. Productivity is automatically increased when the employees are motivated and inspired to keep working and challenging their limits.

4. Effective Time Management

Six Sigma focuses on efficient business and increased productivity by helping the employees to manage their time effectively. As time is effectively managed, the work-life balance of employees is improved and hence again their morale is boosted to work smart and work hard.

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Choose the Correct Answer

1. Achieving six sigma quality means the business is [d]
   (a) Producing 50,000 DPMO (b) Producing 10,000 DPMO
   (c) Producing 4.8 DPMO (d) Producing 3.4 DPMO
2. The following are the phases of six sigma DMAIC model except [b]
   (a) Measure (b) Continue
   (c) Define (d) Analyze
3. In design for six sigma, SIPOC stand for [c]
   (a) Start, innovate, practice, overcome, complete
   (b) Simplicity, ingencity, patience, output, control
   (c) Supplier, input, process, output customer
   (d) None of the above.
4. Six sigma is usually started by [a]
   (a) The CEOs (b) It's a bottom up approach
   (c) Middle management (d) The quality director
5. What is a business matrix ? [b]
   (a) A measurement of difference between the current state of a process and future state
   (b) A unit of measurement that provides a way to objectively quantify a process in terms of objectives.
   (c) A means of difference between process and customer
   (d) Any characteristics that is CTQ customer.
6. A baseline is, [b]
   (a) Six sigma synonym
   (b) A standard for comparing, the current performance of a process.
   (c) The lowest limits
   (d) A synonym for gap analysis.
7. Six sigma used in project selection for [d]
   (a) A solution (b) Low-level problem
   (c) Customer satisfaction (d) None of the above.
8. A six sigma project review is also know as [c]
   (a) A six sigma report-out (b) A six sigma phase-gate review
   (c) Both (a) and (b) (d) Neither (a) nor (b).
9. What is y = f(x) [b]
   (a) A quadrilateral equation (b) A six sigma transfer function
   (c) One variation of x = f(y) and y = x(f) (d) An algorithms for controlling DMAK
10. Black belts works [a]
    (a) Fulltime (b) Part time
    (c) Both (a) and (b) (d) Only (b).

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Fill in the blanks

1. Six sigma stands for _____.
2. DPMO Stands for _____.
3. Six sigma uses the concept of _____.
4. STPOC model is one of the most useful techniques used for _____ and _____
5. _____ tool is used for testing and optimizing the performance of a process, product or service or provide solutions.
6. _____ is also one of the tools of statistical process.
7. COPQ is an acronym for _____ .
8. Master black belts assist _____ .
9. _____ studies enable black belts to determine whether data is accurate, repeatable, reproducible and improves the process.
10. _____ is the standard model for six sigma methodology.

ANSWERS

1. Six standard deviations from the mean
2. Defects per million opportunities
3. Critical to Quality (CTQ)
4. Process management and imporovement
5. Design of Experiment (DOE)
6. Control charts
7. Cost of poor quality
8. Black belts
9. Gauge R & R
10. DMAK

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UNIT V

TQM in the Service Sectors:

Implementation of TQM in service organization: Framework for improving service quality, Model to measure service quality programs. TQM in Health-care services, Hotels and financial services – Banks, Investment Company and Mutual Funds.

5.1 Implementation of TQM in Service Organization

Q1. Explain the Implementation of TQM in various Service Organization.

Ans : **(Imp.)**

The Implementation of TQM in various Service Organization is as follows

1. TQM in Hotels

In the hotel industry, the persons who offer personal services have a direct contact with the customers daily, so they have to behave in a formal manner. On the other hand, the individual customer is concerned about the quality of the services, provided to them as well as the employees providing the services to them.

Hotels can enhance their quality of customer service by concentrating on the following aspects,

(a) Arrangement of adequate reservation facilities.

(b) Arrangement of adequate room facilities.

(c) Easy access to food and bar services.

(d) Easy access to other services like parking, transportation, gift shops, telephone services, laundry etc.

(e) Accountability to the customer complaints and taking appropriate actions for solving it.

(f) Understanding and providing service to the customers as per their needs.

2. TQM in financial services

The financial service sector consists of many organizations such as banks, investment agencies, finance corporations, insurance agencies and mutual funds. These organizations have grown very rapidly in India since the initiation of liberalization, and they are used by people to carry out different types of transactions. Finance organizations have made significant contributions to economic growth. In the 1990s, many financial organizations became sensible to the need to adopt TQM methods like their counterparts in manufacturing.

The extensive reforms, market deregulation, partial elimination of governmental barriers and international agreements paved the way for the entry of foreign financial service companies, making business more competitive, and placing enormous pressures on managements for quick changes and improvements in service quality.

3. TQM in Banks

ABC Bank (India), whose corporate office is in Mumbai, is a commercial bank, which has 124 retail branches spread all over the country. Its turnover is approximately Rs 80 billion and it employs 3,200 people. TQM at ABC Bank is a systematic approach with a mission of satisfying customers. It encompasses every facet of the business, every employee, every product, every process. Quality of service is perceived as the distinguishing factor by which the bank differentiates itself from other commercial banks. TQM processes are planned, highly structured and carefully monitored. Specific tasks are documented, responsibilities defined and accountability structures established.

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5.1.1 Framework for Improving Service Quality

Q2. Define service quality. How do you implement TQM in service sector.

(OR)

Bring out the framework for improving service quality in Indian universities.

Ans : **(June-19)**

Meaning

Service quality is a measure of how an organization delivers its services compared to the expectations of its customers. Customers purchase services as a response to specific needs. They either consciously or unconsciously have certain standards and expectations for how a company's delivery of services fulfills those needs. A company with high service quality offers services that match or exceed its customers' expectations.

Steps

The following steps are proposed for TQM implementation in a service system.

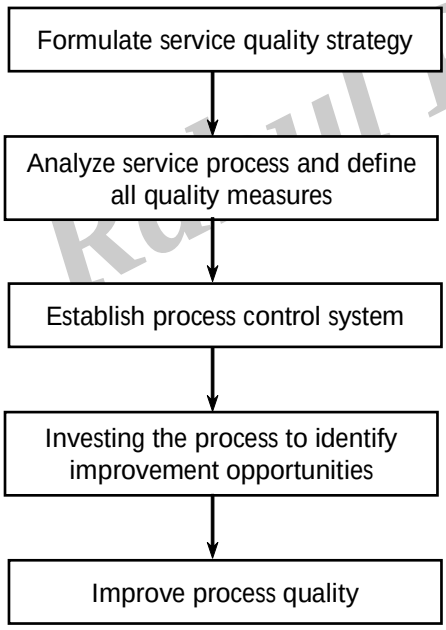

Fig. : Framework for Improving Service Quality

Step 1: Formulate Service Quality Strategy

Attaining the full benefits from a TQM implementation program requires a well-defined purpose, patience and discipline. The initiative to develop, propagate and implement a quality improvement program should start with the top management. The chief executive needs to maintain a direct, highly visible and an all-pervasive involvement in the TQM program. His continual involvement can be expressed through various means such as persuasion, motivation, direction and involvement. In developing strategies for continual improvement, it is necessary to analyze.

- The needs and expectations of the customers;
- Function and project objectives;
- Service process and operations;
- Measurement and control parameters, and
- Feedback system and evaluation.

Based on these analyses, the quality improvement strategy should involve:

- A mission statement demonstrating the company's vision and philosophy, including an orientation towards the needs of the customers.
- Senior management commitment to support customer service initiatives.
- Customer satisfaction feedback program designed to measure customer perception of the service delivery.
- A set of performance standards.

The management also should give thought to how these strategies can be communicated throughout the organization.

Step 2 : Analyze Service Process and Define Quality Measures

The process through which service functions operate must be well identified and its quality dimensions defined for proper implementation and review. This involves

(a) Developing inputs, process activities and outputs through detailed flow charts;

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(b) Defining the process and identifying customer requirements;

(c) Understanding how the process operates at different levels and what is required of it;

(d) Identifying all inputs to the process and documenting quality requirements for these inputs, and

(e) Defining the output of the service function and deter-mining how the output quality is measured.

The quality dimensions in a service system involve

- **Time dimension:** The time required to execute a service determines the quality of service. The time dimension includes arrangement time, waiting time, service and delay time;
- **Cost dimension:** The cost of service to the satisfaction of the customer decides the quality of service;
- **Error dimension:** The number of errors, their nature and the time and cost associated in rectifying them decides the quality of service.
- **Psychological dimension:** The extent to which people are satisfied with the quality of service depends upon the understanding, courtesy and efficiency shown to them.

In establishing quality measures, organizations should review existing measures, documentation and reporting systems and establish new measures, including a customer satisfaction feedback system.

Step 3 : Establish Process Control System

For continuous monitoring of the service process, it is essential to establish process controls. The focus should be on an understanding what needs to be measured and controlled to meet customer requirements. For this, it is required to analyze the existing process to determine important performance areas, collect data and develop a trial control system.

Step 4 : Investigate the Process to Identify Improvement Opportunities

In this step, it is required to identify internal process problems affecting customer satisfaction and costs and exploring process improvement opportunities. This can be done by

(a) Collecting and reviewing data on process operations.

(b) Developing cause-and-effect diagrams to identify causes of waste or poor quality.

(c) Prioritizing causes of waste to determine the areas of greatest opportunity.

(d) Determining chronic problem areas.

(e) Documenting potential problem areas.

(f) Reviewing improvement opportunities and deciding on improvement projects.

Step 5 : Improve Process Quality

The goal of the improvement stage is to achieve and sustain a new level of process performance. This requires

(a) Regular review of quality improvement opportunities and quality management performance with all employees.

(b) Identifying root causes, developing action plans, testing and implementing solutions.

(c) Maintaining top management involvement and participation throughout the organization.

Q3. Explain the dimensions of service quality.

Ans :

The following are the dimensions of service quality.

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1. Reliability

This refers to an organization's ability and consistency in performing a certain service in a way that satisfies its customers' needs. This process involves every step of customer interaction, including the delivery or execution of the good or service, swift and precise problem resolution and competitive pricing. Customers have a certain expectation of reliability in buying a specific product, and a company's success usually depends on its ability to meet those expectations.

2. Tangibility

This is an organization's ability to portray service quality to its customers. There are many factors that give a company highly tangible quality, such as the appearance of its headquarters, its employees' attire and demeanor, its marketing materials and its customer service department.

3. Empathy

Empathy is how an organization delivers its services in a way that makes the company seem empathetic to its customers' desires and demands. A customer who believes a company truly cares about their well-being is likely to be more loyal to that company.

4. Responsiveness

This is a company's dedication and ability to provide customers with prompt services. Responsiveness implies receiving, assessing and swiftly replying to customer requests, feedback, questions and issues. A company with high service quality always responds to customer communication as soon as possible which can often indicate the value a company places on customer satisfaction.

5. Assurance

Assurance is the confidence and trust that customers have in a certain organization. This is especially important with services that a customer might perceive as being above their ability to understand and properly evaluate, meaning that there has to be a certain element of trust in the servicing organization's ability to deliver. Company employees need to be mindful of earning the trust of their customers if they want to retain them.

5.2 Model to Measure Service Quality Programs

Q4. Describe various models to Measure Service Quality Programs.

(OR)

Elucidate the model to Measure Service Quality Programs.

Ans : **(Nov.-21, Aug.-17)**

There is a need for service quality measurement at various levels in the organization. A service quality measurement system can have the following benefits

(a) It creates a basis for assessing the degree of customer satisfaction, so that necessary action can be initiated to improve the process through which the service is offered, and

(b) It provides the right motivation for better performance by suppliers, vendors, departments and organizational units.

The effectiveness of a service quality program depends upon the extent to which an organization is successful in measuring it. A conceptual model to measure the effectiveness of a service quality program is presented here. This model should help organizations to

(a) Evaluate the success of a service quality program against the set objectives;

(b) Identify the areas that need improvement;

(c) Enable effective follow-up with customers;

(d) Provide self-analysis in determining the root causes of problems;

(e) Review the competitive position, and

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Make alterations in policies and procedures and divert and allocate resources accordingly.

Total service quality effectiveness (TSQE) may be defined as the extent to which the implementation of a total service quality program meets the desired objectives. It can be termed as a dependent variable, which may be affected by a set of independent variables, such as top management commitment response, product and process improvement, customer orientation response, human resource excellence and economic advantage. The mathematical representation of such a performance measure may be formulated as

TSQE - f [TMR, PPI, HRE, COR, EA] ... (1)

where; TSQE is total service quality effectiveness, f is the functional form of any appropriate mathematical relationship, TMR is the top management commitment response, PPI is the product and process improvement, COR is the customer orientation response, HRE is human resource excellence and EA is the economic advantage.

Independent Variables for Service Quality Programme

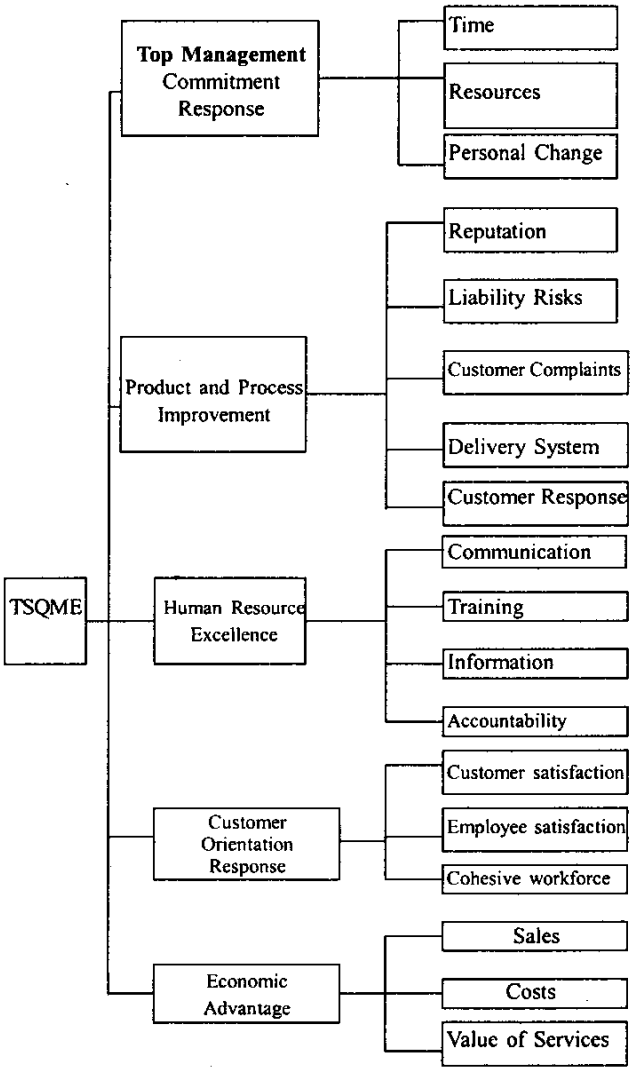

Fig.: Conceptual Model to Measure Service Quality Programs

1. Top Management Commitment Response

Top management commitment response is the extent to which the top management is satisfied with the progress of the quality program and has increased its involvement in it. This is a vital factor because installing a total quality culture in the company's organization requires a vision, a new orientation, and innovative direction from the leader who is driven by the obsession to create change and bring about excellence. Broadly speaking, time devoted, resources allotted and personal changes exhibited are the factors that will decide top management commitment response. This may be denoted analytically as

$$TMR = f [TD, RA, PCR] \quad ... (2)$$

where; TD is the time devoted, RA is the resource allotted and PCR is the personal change response. These can be evaluated by tracking the activities of the top management and by estimating the behavior change through some empirical studies.

2. Product and Process Improvement

Product and process improvement can be perceived from enhanced reputation, reduced liability risks, reduction in customer complaints, smoother delivery of services and better customer response. This can be expressed mathematically as

$$PPI = f [R, LR, CC, D, CR] \quad ... (3)$$

Here, R is the reputation, LR is the reduced liability risks, CC is reduced customer complaints, D is the smoother delivery system, and CR is the enhanced customer response.

3. Human Resource Excellence

Developing an organization profile, which can be used to analyze the organization and its processes, can assess human resource excellence. The organization profile system provides management with insights and data to improve and simplify work processes, job duties, staffing, compensation and organizational structure. Broadly speaking, human resource excellence can be assessed by factors such as improvement in communication, training, information and accountability. This can be expressed as:

$$HRE = f [C, T, I, A] \quad ... (4)$$

Here, C, T, I and A represent improvement and change in communication, training, information and accountability, respectively.

4. Customer Orientation Response

Customers are both within and outside the organization. Customer orientation response measures how the organization performs in the external world when compared with competitors as well as approaches to internal customers. Employees can generate total quality output only if they receive total quality as an input. Customer satisfaction and a cohesive workforce are the factors that will decide customer orientation response. This can be represented as

$$COR = f [CS, ES, CWF] \quad ... (5)$$

Here, CS is customer satisfaction, ES is employee satisfaction and CWF is a cohesive workforce.

5. Economic Advantage

The economic advantage indicates the extent to which the service quality program results in increase in sales; reduction in costs and increase in value of services. Market reports and audits indicate increases in sales. Reduction in costs can be perceived from reduced cycle time and better service flow.

This can be analytically expressed as

$$EA = f [CS, C, VS] \quad ... (6)$$

Here, CS is the change in sales; C is the reduction in costs and VS is the increase in value of service.

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5.3 TQM IN HEALTH-CARE SERVICES

Q5. Bring out the framework needed for improving service quality in healthcare industry.

Ans : **(Nov.-20)**

The framework required for improving service quality in healthcare covers the characteristics of service like intangibility, inter-relatedness and diversity. These characteristics help in understanding the problems of service quality. A proper framework is designed around these characteristics for better understanding of services provided in healthcare organizations which will result in improvement of service quality in healthcare industry.

S.No.	Area	Problem	Requirements for Service Quality
1.	**Intangibility**	(a) Consumers find it difficult to understand the service or health care product. They don't understand what they are receiving until they stop receiving it.	The solution to this problem is to remind the customer about the quality of service they are receiving.
		(b) As the service is intangible in nature, customers look for more tangible elements of service to get some indications of quality.	The service provider in the healthcare centre can make the customer or patient understand the quality of service by focussing more on service charges, physical environment and appearance.
2.	**Employee Diversity**	(a) A large number of workforce is used in healthcare industry including physician, nurse, telephone operator, unit clerk, x-ray technologist, patient transporter, admitting clerk etc.	The best solution to this problem is to control the employee diversity, especially for the employees who come in a direct contact with customers.
		(b) The service quality is affected in healthcare industry due to the highly customized and unique nature of service.	This problem can be overcome by setting certain standards and rules to reduce employee discretion such as, (i) Using pre-set standard call response to customer/patient's inquires. (ii) Setting strict protocols. (iii) Maintaining online computer systems with updated information about the patient.
3.	**Inter-Relatedness**	The quality of service cannot be tasted before consumption. In healthcare, services are inter-related. Patient or customer get involve in production and consumption of service.	The best way to resolve these issues is to educate customers regarding how exactly the service works. This will help the patient in understanding the service, makes them participate better in the production and consumption process and helps them perceive the quality of service in a better manner because of their involvement throughout the process.

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Q6. Discuss the significance of TQM in healthcare services. Write about applications of deming's principles to healthcare services.

Ans :

Importance

- **Quality of Administration and Management:** This quality aspect includes operations such as staffing, purchasing, supervision, appointments, admissions, discharges, emergency rooms, record keeping, prescriptions, pharmacy and medicines, laundry related performance, house-keeping, sanitation, operating rooms, and laboratory work.
- **Quality of Doctor's Service :** The quality of a doctor's service is reflected by the effectiveness with which the medical problem is eliminated, or brought under control. A patient must be satisfied that the doctor has done all that could be done. The different aspects of a doctor's services include examination, laboratory tests, accuracy of diagnosis, effectiveness of the medicines prescribed, effectiveness of the surgery performed and side-effects of medicines and treatment.
- **Quality of Hospital Care :** Quality enters into every aspect of a hospital from the time a patient is admitted until he is discharged. It is a potent tool to upgrade a hospital's image in society, but one that is overlooked most of the time. It includes the emergency room, ambulance service, admissions, patient control, patient room, patient's surroundings, food, medicines, monitoring and factors such as personal attention, cleanliness, security, central telephone control, visitor control, delivery control, mail control, discharge control, insurance and billing, operating room control, nursing performance, doctor's care and house keeping.

Application of Deming's Principles to Healthcare Systems

- The constant purpose should be providing acceptable quality health service to patients at an affordable price. This means adequate attention and care for every patient, despite the wide variations in physical and mental health. This purpose must include patient safety security, and satisfaction.
- **Avoid mistakes, which may prove fatal and costly such as**

  Using a cylinder of carbon dioxide, instead of a cylinder of oxygen. Connecting a source of argon to an oxygen line. Serving inadequate meals in a nursing home, resulting in patient malnutrition. Stealing patients' belongings in nursing homes.
- **Insist on zero defects, eliminate inspections through proper quality control on vendors**

  Test all equipment daily to see that it operates properly and safely. Maintain a continuous error prevention program. Keep daily time, error and performance records of all personnel who are directly connected with the quality of the services rendered to the patient.
- **Select vendors based on quality performance as well as price**

  The health facility wants acceptable quality at affordable prices from its vendors.

  Patients can select health vendors of different kinds from among all the doctors and hospitals that are available around them, but hospitals seldom have much choice, unless they are located in big cities. The complete absence of knowledge makes it impossible to select a health facility on the basis of quality performance.

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- **Constantly improve the system**

  By constantly searching for problems and trouble spots, and eliminating them. By running a continuous error prevention program and adequate time-use program.

- **Supervision**

  Maintain and use daily error, time and performance records on all individuals. Shift those who are not flexible enough to handle the wide variety of individuals encountered in a health facility adequately. Hold individual workers accountable for high quality work and let them know it.

- The fears to drive out are those that the patient may have developed as a resident of the medical facility, such as an insane roommate, thieving employee, an aggressive patient, etc.

- Enlist the close cooperation of all units, viz. the front desk, admissions, housekeeping, food sendees, nurses, doctors, surgery, radiology, laboratory, pharmacy, discharge, volunteers and visitors. This cooperation is aimed at rendering adequate service to the patient, not for making it easier for others, unless justified.

- **Eliminate numerical goals, work standards and slogans**

  Time, error and performance records are used daily to eliminate errors and reduce delays. When one error can be fatal, you do not construct a time chart or control chart and wait for the error to occur. Control must be continuous.

- **Remove barriers that hinder the worker throughout the day**

  Remove barriers to job efficiency and job satisfaction, and restore dignity to work. Be sure that each person's job is described in writing, in detail, so that each worker knows the major tasks expected of him, including attitudes, knowledge and skills.

- **Education and training programs, including retraining**

  Enhance present knowledge and skills and learn new methods, techniques, skills, abilities and arrangements as the need arises. Continuous training programs are needed to prevent errors, delays and to optimize service time. Training should be based on findings from daily time, error and performance records. Training should also be based on complaints from patients, their relatives or other sources.

- **Top management support for implementing the above**

  There are a number of advantages associated with a system of total quality management. These include significant increases in employee motivation and in quality without sacrificing productivity Certainly, in the manufacturing sector, TQM has led to increased productivity and decreased costs.

5.4 TQM IN HOTELS

Q7. Elucidate the applications of TQM in hospitality sector.

(OR)

Give a critical a note on TQM in hotel industry.

Ans : **(Nov.-21, Dec.-20, Imp.)**

In the hotel industry, the persons who offer personal services have a direct contact with the customers daily, so they have to behave in a formal manner. On the other hand, the individual customer is concerned about the quality of the services, provided to them as well as the employees providing the services to them.

Hotels can enhance their quality of customer service by concentrating on the following aspects,

a) Arrangement of adequate reservation facilities.

b) Arrangement of adequate room facilities.

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c) Easy access to food and bar services.

d) Easy access to other services like parking, transportation, gift shops, telephone services, laundry etc.

e) Accountability to the customer complaints and taking appropriate actions for solving it.

f) Understanding and providing service to the customers as per their needs.

Assessing the Quality Standards of Hotels

The quality standards of the hotels are assessed by providing the star or diamond ratings.

Star Ratings

The quality standard of the hotel can be evaluated with the help of star ratings from one to five.

1. -One Star Level

At this level of star rating, the staff are attentive and well mannered. The service provided by the hotel is friendly, simple, efficient and most of the rooms of the hotel are next to each other. The eating area of the hotel will have a fair and sensible choice of food and wine.

2. ««-Two Star Level

The staff of such hotels are well dressed, well groomed and provides good and satisfactory service. All the rooms are next to each other and have a facility of television. There is one restaurant I or dining room available with significant choice of food and wines.

3. ««««-Three Star Level

The staff of such hotels are very talented and effectively responds to the requirements of the guests. The receptionist of the hotel is committed towards the job. All the rooms are next to each) other and have the facilities of remote-controlled TV and direct dial telephone. The restaurant and bar are opened for the residents and their guests.

4. «««««-Four Star Level

The service offered by such hotels is professional and sophisticated. The staff predicts and responds as per the needs of the guests. The reception is available at 24 hours a day and the facility of baggage handler will be provided on request. The bedrooms will have a high quality of comfort and the bedrooms having attached bathrooms will have superior quality toiletries. The hotels at this level also provides other services like 24 hour room service, laundry and dry clean facilities and a restaurant providing excellent cuisines.

5. «««««-Five Star Level

A perfect and professional guest service is offered at this level as the staff of such hotels is very attentive. The rooms of the hotels are very wide, elegant and lavish along with magnificent interior design and perfect furnishings. The dishes offered at the restaurant of the hotel are prepared with high level of technical skill, and are provided along with the superior wines. The en-suited rooms of the hotel have an exceptional quality and offers other facilities like bath sheets, bath robes and an evening turndown service.

Diamond Ratings

Diamonds are given based on the overall impact on guest instead of an individual criteria. The professional judgment is the most important factor which helps in ascertaining the diamond rating for a property. The following are the diamond rating quality standards,

1. One Diamond

The establishments at this level offers basic requirements such as comfort, cleanliness and hospitality. All these requirements, basically attracts the budget-minded traveler, as it fulfills the essential requirements.

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2. Two Diamond

The establishments at this level offers physical attributes, design elements and other amenities at a reasonable price. These kind of establishments mainly attracts the travelers who are looking for more than the basic accommodations.

3. Three Diamond

The establishments at this level attracts the traveler who has a wide range of needs. These establishments have a unique style and improved quality of physical attributes, all amenities and comfort level.

4. Four Diamond

The establishments at this level are very expensive and are of high quality. The accommodations offered by these establishments are sophisticated and stylish. The physical attributes of the property signifies an improved quality. The distinctive attributes of the establishments at this level are amenities integrated with a high level of hospitality, service and attention.

5. Five Diamond

The establishments at this level are magnificent and extravagant. These establishments offers first class accommodations and have physical attributes which are outstanding in every aspect. The establishments at this level provides perfect service, satisfy all the requirements and expectations of the guests and maintain a flawless standard of excellence.

5.5 TQM IN FINANCIAL SERVICES – BANKS, INVESTMENT COMPANY AND MUTUAL FUNDS

Q8. Explain the role of TQM in financial services.

Ans :

Introduction

The financial service sector consists of many organizations such as banks, investment agencies, finance corporations, insurance agencies and mutual funds. These organizations have grown very rapidly in India since the initiation of liberalization, and they are used by people to carry out different types of transactions. Finance organizations have made significant contributions to economic growth. In the 1990s, many financial organizations became sensible to the need to adopt TQM methods like their counterparts in manufacturing.

The extensive reforms, market deregulation, partial elimination of governmental barriers and international agreements paved the way for the entry of foreign financial service companies, making business more competitive, and placing enormous pressures on managements for quick changes and improvements in service quality.

It tries to analyze such questions as how do customers perceive quality in financial services, how can financial services achieve and sustain quality, how can these achievements be measured, how will the market environment (internal and external) perceive and react to these changes?

Quality Processes in Financial Services

In a financial company, internal operations are carried out somewhat differently from those in a manufacturing company Managers and staff are more closely related. Job descriptions are often developed with the real possibility of the staff member becoming a manager as a natural evolution of his career in the company. Thus, in a financial service, the staff perceives itself as much closer to the management team than in the manufacturing sector.

Furthermore, in a manufacturing process, the raw materials and final products are accountable for and controlled. This enables total quality control before the customer gains access to the goods. In a financial service, the degree of intangibility of the service delivered, and intense face-to-face contact between employee and customer during the process

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itself, render the organization unable to control the quality performance of the service delivered before it is offered to the customer.

Thus, it can be said that the primary raw material in a financial service is the customer and the primary resource is the employee. Another area of difference is the use of statistical techniques on individual products/services. Manufacturing goods can have a statistical tolerance level imposed. However, in a banking service, a money transaction must be absolute. This means that customers will tolerate no mistake-All transactions must be 100 per cent accurate.

Finally, in a financial service, the customer is normally both the supplier and the buyer of services. One obvious example of this is a financial transaction in which a customer pays in cheques and credits at one end of the system and these are processed through to ensure that the customer accounts are appropriately credited at the other end.

According to Shashikant, Gururajan and Sethu (1996), quality initiatives in the financial services sector differ from those in the manufacturing sector due to the following reasons

(a) Monetary benefits have to be accurately delivered-tolerance for errors is zero (Ansell, 1993);

(b) The product is intangible and, therefore, perceptions matter a great deal;

(c) Financial products are information sensitive and valued and priced on a continuous basis;

(d) Certain levels of service are regulated to protect investor interest, and

(e) The service centers on a series of processes in which investor participation is direct.

Q9. Explain the metrics used to measure the service quality of financial services firms.

Ans : **(Nov.-20, Imp.)**

There are number of metrics or techniques used to measure the service quality of financial serve firms. Some of the important metrics are discussed as under,

1. SERVQUAL
2. Mystery Shopping
3. Post-Service Rating and Follow-up Surveys
4. Social Media Monitoring.

1. SERQUAL

'SERVQUAL' is a multidimensional scale which is used to understand and capture the custom perceptions and expectations about the service quality. This scale consists of 21 perception items which distributed across five service quality dimensions.

2. Mystery Shopping

Another metric that can be used by any service firm including a financial firm is "mystery shopping". In this technique, a financial firm like bank hires an undercover customer and gives him a responsibility of testing the quality of service being provided by bank This agent would evaluate the bank service quality based.

3. Post-Service Rating and Follow-up Surveys

Post-service rating is a metric which is also being adopted by many service firms to measure service quality. In this practice, customers are asked to rate the service after its delivery.

Follow-up surveys are similar to post-service rating method but they are comparatively more efficient. Service firms encourage their customers to rate the service quality through an e-mail survey.

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4. Social Media Monitoring

Most of the companies are turning towards social media to get feedback from customers. Many financial institutions like banks are also using facebook and twitter to get unfiltered feedback from customers.

Q10. Give a critical a note of TQM in banks.

Ans : **(June-18)**

ABC Bank (India), whose corporate office is in Mumbai, is a commercial bank, which has 124 retail branches spread all over the country. Its turnover is approximately Rs 80 billion and it employs 3,200 people. TQM at ABC Bank is a systematic approach with a mission of satisfying customers. It encompasses every facet of the business, every employee, every product, every process. Quality of service is perceived as the distinguishing factor by which the bank differentiates itself from other commercial banks. TQM processes are planned, highly structured and carefully monitored. Specific tasks are documented, responsibilities defined and accountability structures established.

ABC Bank initiated its quality of service improvement process with an awareness campaign to spread the messages of quality. Boards bearing the message, "DIRF-Do It Right First", were displayed at employee canteens, restaurants and even on internal note pads. DDRF reinforced the precept that doing everything right the first time results in improved customer service at reduced costs. In addition, employees participated in a slogan contest for the quality effort. More than 2,000 slogan entries were received. Parties were held for employees with the theme, "It's just a beginning", and it soon became apparent to all that the concept of quality was taking hold and the process was gaining momentum.

The quality improvement program was launched by the chairman of ABC Bank, who remained highly visible and brought his quality campaign to the staff by appearing in the company's quarterly news magazine and monthly bulletin. He addressed the internal staff, managers and external customers on the need for quality and closely monitored the quality improvement processes by holding quarterly meetings to discuss the status of annual quality plans.

The chairman also set up a quality improvement steering committee, consisting of seven executives and senior vice- presidents from retail banking, commercial lending, technology and processing, financial management, marketing, human resources and quality improvement. The steering committee's first task was to formulate the basic strategies and policies for TQM. The committee proposed a formal organizational structure to undertake TQM plans. A quality council constituting of managers from each functional area of the banking operation was formed to coordinate inter-divisional quality improvement projects and to further facilitate the efforts all over the bank. Quality improvement teams, comprising managers at all levels, were formed in each division with the responsibility of identifying problems and improvement opportunities and developing "quality action teams" to analyze the details and implement the required changes. A quality improvement taskforce, consisting of knowledgeable people in the organization, were engaged to train the bank staff, develop and present proposals to the steering committee, facilitate implementation of the approved strategies and help keep the process on track.

Q11. Examine the pros and cons of TQM in banking organization.

Ans : **(Imp.)**

Benefits

1. Bank collected data about the customer feedback through surveys, feedback forms placing at the branch counters, conducting interviews with the selected customers and used the information to train and mould its customer relations executive to effectively

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handle the customer complaints and address their grievances.

2. By implementing the reengineering process to the loan's section, bank was successful in reducing the loan processing and sanction time from six working days to just two days.

3. In order to improve the service quality, the bank opened a series of ATM centres all over India. This helped in reducing the long queues and increased the customer satisfaction levels.

Problems

1. It is very difficult to use statistical tools in banks as they possess a level of error tolerance. However, banking operations need to be 100% error free every time.

2. In the banking sector, quality is not owned by a single individual employee. It is quite complex to involve all the employees towards following the TQM practices.

3. Other problems towards implementing TQM in the banking sector includes,
   (a) Conservative attitude of employees
   (b) Lack of proper training
   (c) Lack of management support.

Q12. Explain the role of TQM in investment company with an example.

Ans : **(Imp.)**

TQM plays an important role in investment company which can be clearly understood with the help of following example.

Investment Company Background

XYZ Investment, a Bangalore based private limited investment company, was established in 1992 to deal with various financial transactions such as insurance, loans, etc. First and foremost, the company had to face the formidable task of organizing itself to meet its mission to gain a footing in the new regulatory environment. XYZ Investment began to settle into its market by the end of 1993, and simultaneously able to focus on ways to grow and become more competitive. It recognized self-assessment as a process that would

(a) Provide answers as to whether the firm was prepared to grow as rapidly as necessary, and

(b) Identify areas that would need to be improved to support the growth.

The TQM-based, self-assessment process is becoming widely accepted as the best roadmap to guide organizations towards quality improvement. It is based on the seven criteria of TQM- leadership, information and analysis, strategic planning, human resource development and management, process management, business results and customer focus and satisfaction. Recommendations for improvement can be tailored to suit the needs of the areas that require improvement.

This helps to prioritize the implementation of quality improvement efforts based on the extent of the deficiencies and the criticality of the affected areas. Employee inputs, as a source of data, is considered the best for TQM-based self-assessments, as the people closest to all the key processes and procedures of an organization are the best qualified to assess them.

Assessment through TQM

In 1996, XYZ Investment conducted an employee focused self- assessment, XYZ's quality steering committee, which consists of the president and all its business unit heads, came to the conclusion that the self-assessment would require four key components to be successful

(a) It must be based on the TQM criteria;
(b) It must be an employee-focused effort;
(c) It must be designed with the help of a consulting firm, and
(d) It must receive external validation from an external examiner.

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The decision to use a TQM-based model for the self-assessment was made by the steering committee. The seven TQM criteria were developed by quality experts with the understanding that achieving excellence in each category would provide a solid foundation for long-term success. Another requirement of the quality steering committee was that the effort be based on employee inputs.

The employee based focus of the self-assessment was two-fold. First was the formation of a cross- functional, eight member, employee run project team, which was given ownership of the process. The eight member project team had representation from every business unit, including systems, financial and operations people. "We really wanted high-caliber people on this team because they were going to be providing feedback critical to the outcome of the assessment.

The fact that senior management, during such a busy time for the company, pulled these key people off the line to work on this project when they could have been putting their time into something else, says a lot about their commitment," said the managing director of XYZ Investment.

Q13. Explain the framework for improving the service quality of mutual funds.

(OR)

Bring out the framework for improving the service quality in mutual funds industry.

Ans : **(Aug.-21, Dec.-20, Imp.)**

Service Quality Management in Mutual Funds

The mutual fund industry is an important provider of financial M I vices worldwide. In India, during the last decade, a number mutual fund companies have come into being. Fund mobilization has grown from Rs 20 billion in 1987 to more than Us 200 billion today. Unit holding accounts have grown to Rs 105 million.

Mutual funds have been focusing on financial features (risk, return and liquidity) to gain a foothold in the industry. (generally, mutual fund products have been positioned as savings and investment instruments for small and medium investors. These arc sold by emphasizing the

a) Benefits of diversification of risk;

b) Professional management of funds;

c) Matching the risk-return characteristics of the products to that of the investor, and

d) Expected returns.

Some recent developments such as the down trend in the stock markets causing a significant fall in the net asset values of mutual funds and the entry of many international players known for efficient investor service have necessitated the improving and using of after sales service as an effective strategy to differentiate in lie offering and maintaining market share. These developments are resulting in

a) Widespread recognition of the investor as the customer;

b) Specification and implementation of service standards;

c) Quantitative measurement and monitoring of service delivery, and

d) Concerted efforts towards the achievement of better quality.

In developed countries, institutional investors such as pension funds and provident funds are able to demand and obtain higher quality of services from the mutual funds in which they invest. In India, most mutual funds have targeted retail investors. In the past, these investors tolerated inadequate services mainly on account of their ignorance of the investment process and the inability to collectively challenge the might of the funds.

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However, of late, retail investors have been able to take their grievances to consumer forums (quasi-judicial bodies) and bring the service providers to book. Transactions in securities are still largely paper based. Delays, risk of loss/damage in transit and manual handling make service quality negatively elastic with respect to volumes. Investor services in the mutual fund industry are dependent on heterogeneous agents such as banks, vendors, agents and postal and courier services. The lack of electronic fund transfer mechanisms results in warrants being physically dispatched, increasing risks of loss, theft and fraudulent encashment.

Process of Mutual Fund Agency

The following processes are undertaken in a mutual fund agency

- Designing of application forms;
- Distributing of forms through agents, branches and investor service centers;
- Collecting of completed forms and money;
- Depositing of cheques, drafts and other fund transfer documents with banks;
- Reconciling of amounts paid with units applied for;
- Tracking of cheques returned unpaid;

Different mutual funds manage investor services differently. The following variants have been noticed.

- **External Agency Operations**

90 percent of mutual funds schemes are serviced through the appointment of external registrars and transfer agents (RTAs). RTAs are transaction processing agents, who merely create, maintain and update investor records. RTAs provide the full line of services to the customers.

- **Internal Agency Operations**

No external agent is appointed as RTA; the work is done by either a subsidiary or an internal department.

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Short Questions and Answers

1. TQM in Hotels.

Ans :

In the hotel industry, the persons who offer personal services have a direct contact with the customers daily, so they have to behave in a formal manner. On the other hand, the individual customer is concerned about the quality of the services, provided to them as well as the employees providing the services to them.

Hotels can enhance their quality of customer service by concentrating on the following aspects,

(a) Arrangement of adequate reservation facilities.

(b) Arrangement of adequate room facilities.

(c) Easy access to food and bar services.

(d) Easy access to other services like parking, transportation, gift shops, telephone services, laundry etc.

(e) Accountability to the customer complaints and taking appropriate actions for solving it.

(f) Understanding and providing service to the customers as per their needs.

2. TQM in financial services.

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4. Investment company.

Ans :

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The TQM-based, self-assessment process is becoming widely accepted as the best roadmap to guide organizations towards quality improvement. It is based on the seven criteria of TQM- leadership, information and analysis, strategic planning, human resource development and management, process management, business results and customer focus and satisfaction. Recommendations for improvement can be tailored to suit the needs of the areas that require improvement.

5. Service quality

Ans :

Meaning

Service quality is a measure of how an organization delivers its services compared to the expectations of its customers. Customers purchase services as a response to specific needs. They either consciously or unconsciously have certain standards and expectations for how a company's delivery of services fulfills those needs. A company with high service quality offers services that match or exceed its customers' expectations.

6. Dimensions of service quality.

Ans :

1. Reliability

This refers to an organization's ability and consistency in performing a certain service in a way that satisfies its customers' needs. This process involves every step of customer interaction, including the delivery or execution of the good or service, swift and precise problem resolution and competitive pricing. Customers have a certain expectation of reliability in buying a specific product, and a company's success usually depends on its ability to meet those expectations.

2. Tangibility

This is an organization's ability to portray service quality to its customers. There are many factors that give a company highly tangible quality, such as the appearance of its headquarters, its employees' attire and demeanor, its marketing materials and its customer service department.

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3. Empathy

Empathy is how an organization delivers its services in a way that makes the company seem empathetic to its customers' desires and demands. A customer who believes a company truly cares about their well-being is likely to be more loyal to that company.

7. Quality Standards of Hotels.

Ans :

The quality standard of the hotel can be evaluated with the help of star ratings from one to five.

1. One Star Level

At this level of star rating, the staff are attentive and well mannered. The service provided by the hotel is friendly, simple, efficient and most of the rooms of the hotel are next to each other. The eating area of the hotel will have a fair and sensible choice of food and wine.

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8. SERQUAL

Ans :

'SERVQUAL' is a multidimensional scale which is used to understand and capture the custom perceptions and expectations about the service quality. This scale consists of 21 perception items which distributed across five service quality dimensions.

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Ans :

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(a) Benefits of diversification of risk;

(b) Professional management of funds;

(c) Matching the risk-return characteristics of the products to that of the investor, and

(d) Expected returns.

10. Quality Dimensions of a Hotel.

Ans :

The Following are the Quality Dimensions of a Hotel

1) Reliability

2) Durability

3) Features

4) performance

5) Quality

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Choose the Correct Answer

1. The dimensions of quality defined by Garvin are [d]
   (a) Reliability (b) Durability
   (c) Performance (d) All the above
2. This approach recognizes the holistic process of service delivery which is controlled by taking into consideration the expectations and attitudes of service clients [b]
   (a) Product attribute approach (b) Consumer oriented approach
   (c) Both (a) and (b) (d) None
3. Five stars of service quality includes [d]
   (a) Responsiveness (b) Empathy
   (c) Assurance (d) All the above
4. Inspiring trust and confidence is function of [a]
   (a) Assurance (b) Empathy
   (c) Reliability (d) Tangibles
5. Gaps between service quality specifications and service delivery refers to [c]
   (a) Lack of development (b) Lack of understanding
   (c) Poor delivery (d) Unrealistic expectations
6. A service quality system has the following components [d]
   (a) Employees (b) Information Technology
   (c) Customer expectations (d) All the above
7. The implementation of TQM in health care systems is influenced by [c]
   (a) Organizational factors (b) Economic factors
   (c) Both (a) and (b) (d) Technological factors
8. The quality standards used for assessing the performance of hotels are [a]
   (a) Star rating (b) Grades
   (c) Pearl rating (d) Ranks
9. Financial service sector comprises different organizations like [d]
   (a) Banks (b) Mutual funds
   (c) Investment agencies (d) All the above
10. A group of chartered accountants who provides diversified financial services is [b]
    (a) XYZ services (b) PQR services
    (c) ABC services (d) A to Z services.

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Fill in the blanks

1. Service consists of _____ and _____ components.
2. In _____, ownership of a product changes hands at a specific point in time.
3. Services which are provided by businesses that produce tangible goods is known as _____.
4. _____ are defined as the level of service which the customer hopes to receive the "wished for" level of performance.
5. Service encounters are also referred as _____.
6. _____ is defined as the delivery of excellence or superior service related to customer expectations.
7. The "missing service quality concept" is explained by _____.
8. TSQE stands _____.
9. _____ are transaction processing agents, who create, maintain and update investor records.
10. _____ focuses on providing customer service rather than merely processing transactions.

ANSWERS

1. Tangible and intangible
2. Manufacturing sector
3. Facilitating services
4. Desired services
5. Moment of truth
6. Service quality
7. Gronroos model
8. Total service quality effectiveness
9. RTAs
10. PQR services

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UNIT - I AND V - ADDING PART

UNIT - I

1.10 Golden Peacock National Quality Award (GPNQA)

Q1. Explain briefly about Golden Peacock National Quality Awards.

Ans :

Meaning

The Golden Peacock National Quality Award, named after India's national bird the "Peacock", is awarded annually. The award winners may use the Golden Peacock National Quality Award logo on their printed and promotional material for the next 3 years. Selected organizations may be given a commendation card.

The Golden Peacock National Quality Award will be given separately for manufacturing and service organizations in different sectors under the following categories :

Categories

- Large Enterprises (Annual Turnover 300 crores & above)
- Medium and Small Enterprises (Annual Turnover less than 300 crore)

Special Categories

- Education, Training, Research and Development, Testing & Inspection
- Service Sector covering Tourism, Transport, Couriers, Hotels & Hospitality, Healthcare
- Telecommunication, Professional Consultancies, Financial Institutions.
- Government Organizations, Undertakings & Services.

Eligibility

Manufacturing or Service organizations or parts of organizations (self accounting profit centres) operating in India may participate in the Golden Peacock National Quality Award. The decisive factor for eligibility is that the operations of the applicant must reasonably correspond to the award criteria and which can be verified at the time of evaluation.

The operations of the applicant must be carried out independently, meaning that responsibilities, authorities, results, etc. are clearly defined. This must be documented, for example, in the annual report, organization plan or equivalent.

Rules & Regulations

- GPAS reserves the right to alter the award scheme.
- GPAS reserves the right to award more than one trophy each year and also to withhold awards if the required standard is not met.
- GPAS accepts no liability for any loss resulting from the disclosure of information concerning an entry, though all reasonable precautions will be taken to maintain secrecy.
- GPAS cannot undertake to return documents or supplementary material submitted with an entry.
- Few selected award winners may also be invited to make a brief presentation in the ensuing "World Congress on Total Quality" to share their experiences.
- The decision of the Chairman of the Jury, on the recommendations of the Panel of Judges is final and no appeal or correspondence will be entertained.

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Q2. Explain the core values of Golden Peacock National Quality Awards.

Ans :

The Golden Peacock National Quality Award is based on 13 core values and concepts that are characteristic of successful organizations.

The evaluation of organization is based on how and to what extent the core values and concepts permeate your operations and provide the foundation for integrating key business requirements within a results-oriented framework.

1. Customer-Driven Quality

The objective of all organizations is to satisfy their customers' stated or implied needs. All employees must consider it their task to satisfy the needs of both their external and internal customers. Customer is the final arbiter who takes into account the issues that influence royalty.

2. Committed Leadership

In order to create a system that focuses on the customer, personal, active and visible commitment is required from every manager. The leadership must set the direction and define and follow up the goals by creating opportunities for the employees to achieve the same. Leaders develop the organizations culture, and drive the organization towards excellence.

3. Participation by Everyone

A prerequisite for a successful organization is that every employee feels that he/she is trusted by the organization to perform and develop his or her tasks. Consequently, everyone must be aware of the goals, have the means to attain them and be aware of the results achieved.

4. Competence Development

Skilled employees are a prerequisite for the success and competitiveness of an organi-zation. Therefore every employee should have the opportunity for improvement and further development in a way that benefits both the individual and the organization.

5. Long-Range Perspective

The organization must focus on long-term development and competitiveness. A sustainable process of improvement leads to improved productivity and effectiveness, a better environment, increased customer satisfaction and long-range profitability.

6. Social Responsibility

Every organizaticn has a public responsibility that extends beyond laws and regulations. The organization and the employees must see their processes, products and services as part of a much broader totality and actively contribute to improving society and the environment.

7. Process Orientation

The activities of the organization should be seen as processes that create value for the customers. Process orientation stimulates an analysis and improvement in the work flow and working of the organization and lays the foundation for customer-oriented operational development. Decisions must be based on reliable facts and figures.

8. Prevention

It pays to prevent faults from occurring and eliminate risks in processes, goods and services. It is also vital to involve customers and suppliers in this process.

9. Continuous Improvement

Competitiveness requires continuous improve-ments and renewal of all aspects of the business. The basis of this is a methodical process of improvement that permeates all level of the organization and an organizational culture that stimulates creative suggestions and new ideas.

10. Learning From Others

The organization must acquire knowledge in all areas about what can be achieved. This requires comparisons to be made with those that can be considered to be the best in a certain process, regardless of the trade or sector they happen to belong to.

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11. Faster Response

In all businesses, shorter response times and more rapid reactions to the needs of the customers are decisive. This applies to development, production and delivery of goods and services, as well as to administrative processes.

12. Partnership

Partnership development is the key to success in today's business. It is essential that, through co-operation, different skill areas are combined among staff and among customers, suppliers, partners, owners and principals.

13. Results Focus

The organizations performance measurements need to focus on key results balancing and satisfying the interests of all stake-holders.

UNIT - V

5.6 IMPLEMENTATION OF TQM IN MANUFACTURING SECTOR

Q3. Explain the Implementation of TQM in manufacturing sector.

Ans : **(Imp.)**

The pillars of TQM in manufacturing sector is as follows :

1. Creation of quality management environment

This includes the assurance of a quality arrangement, making and executing quality arranging and confirmation, and quality control and quality improvement. Quality administration not just spotlights on the nature of items and administrations yet in addition on how they can be achieved. So every employee from top to bottom should know quality.

2. Introduction of workers to total quality management And Training Employees

To implement Total Quality Management (TQM), all of the workers should have the basic knowledge about it.

For this, there must be a grooming session or training so that they can use the TQM tools and techniques appropriately. As a starter, it can be done by organizing some workshops and seminars, then formal training sessions.

3. Development of teamwork and promote cooperation

The main priority of any industry is to satisfy the customer and meet their needs. So they need to work together to achieve the goal. If all the employees in department work as a whole, they can easily detect a problem and provide a creative solution.

On the other hand, they need to cooperate by helping them understand what their roles are. For achieving this, there should be communication between the employee, and there must be a sharing of information.

4. Use of quality control tools and techniques

To improve the quality first, the representative needs to distinguish the right quality issues they have to utilize suitable devices and methods. In such manner, SPC (Statistical Process Control) is the best specialized apparatus that assumes a noteworthy job.

It incorporates seven essential apparatuses in particular Pareto graph, Process stream outline, Cause-and-impact outline, Check sheets, Histogram, Control graphs, and Scattered chart which will help to identify visually if their process is "in control" or "out of control" and when to take corrective action.

5. Front-line employee involvement in decision-making

Quality is the responsibility of everyone. It can be beneficial for industry and employees to involve and empower employees in decision-making, as quality employees are the backbone of a smoothly run organization.

Asking them for their opinions can give different perspectives to make better decisions. It can be done in three ways suggestion box, leadership team, and employee survey.

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6. Sharing information with everyone

Poor communication, vague instructions, and anticipations, poor attending skills, inaccurate data, lack of cooperation among team members of the various department can be very costly.

This can lead the industry in making a decision which is based on a false assumption and unreliable data. So an Industry should be designed in a manner that obtaining reliable and fast feedback gets smooth.

7. Focus on customer satisfaction

The primary and basic goal of an organization is to appease the customer. So the customer should be the priority of any industry. Quality is not only defined by durability, packaging, timely delivery, reliability, and so on but also a customer's total experience with the organization.

The industry needs to understand their target customer well. On the other hand, customer feedback should be monitored carefully.

8. Benchmarking

Benchmarking is a methodical, continuous technique by which an industry can com-pare its performance with another industry, which is considered to be standard. Simply benchmarking is learning from others.

Companies use benchmarking to analyze the performance and identifying the strengths and weaknesses of the company and what needs to make Improvement.

9. Continuous Improvement of the process and the goal

TQM is a never-ending approach. It aims to ensure that all of the employees of the industry feel consistently empowered to improve efforts, results. Most writers favor a zero defect' and a do it right the first time stance towards the quality system, which requires a zero-defect mindset of the workers.

5.7 IMPLEMENTATION OF TQM IN AUTOMOBILE SECTOR

Q4. Explain the TQM Implementation in the Automobile Manufacturing Sector?

Ans :

(a) Leadership Commitment:

Top management should show unwavering commitment to TQM by setting the vision, mission, and quality goals of the organization. They should lead by example and actively participate in TQM initiatives.

(b) Customer Focus:

Understand customer needs and preferences. Incorporate customer feedback into product design, manufacturing processes, and after-sales service to continuously enhance customer satisfaction.

(c) Continuous Improvement

Implement continuous improvement practices like Kaizen and Six Sigma to identify and eliminate defects, waste, and inefficiencies in manufacturing processes. Encourage employees to suggest improvements and provide a platform for their ideas.

(d) Employee Empowerment

Empower employees to take ownership of quality. Train them in problem-solving techniques, quality tools, and statistical analysis methods. Foster a culture where employees are comfortable reporting quality issues without fear of reprisal.

(e) Supplier Partnerships

Develop strong relationships with suppliers based on mutual trust and collaboration. Ensure that suppliers adhere to high-quality standards and provide consistent, high-quality materials.

(f) Process Management

Map out and document all processes involved in automobile manufacturing. Use process flowcharts to identify bottlenecks, redundancies, and areas for improvement.

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(g) Data-Driven Decision Making

Collect and analyze data to monitor key performance indicators (KPIs) related to quality, efficiency, and customer satisfaction. Use data to make informed decisions and prioritize improvement efforts.

5.8 Implementation of TQM in Pharmaceuticals Sector

Q5. Explain the TQM Implementation in the Pharmaceuticals Manufacturing Sector.

Ans :

(a) Regulatory Compliance

Due to the highly regulated nature of the pharmaceutical industry, ensure that TQM practices are aligned with regulatory requirements and guidelines.

(b) Risk Management

Identify potential risks to product quality and patient safety. Implement risk management strategies to prevent quality deviations and ensure consistent product quality.

(c) Document Control

Maintain accurate and up-to-date documentation for manufacturing processes, quality standards, and standard operating procedures (SOPs).

(d) Batch Tracking and Traceability

Implement systems for tracking and tracing individual batches of pharmaceutical products throughout the supply chain. This helps in quickly identifying and addressing quality issues if they arise.

(e) Cross-Functional Teams

Form cross-functional teams involving professionals from various departments (research, development, manufacturing, quality control, etc.) to collaborate on quality improvement initiatives.

(f) Validation and Qualification

Implement validation and qualification processes for equipment, processes, and systems to ensure they consistently meet quality standards.

(g) Change Control

Establish a robust change control process to manage any modifications to processes, equipment, or systems. This helps prevent unintended quality deviations.

(h) Training and Skill Development

Provide regular training to employees to enhance their understanding of quality standards, regulations, and the importance of their role in maintaining product quality.

5.9 Role of TQM in IT Sector

Q6. Explain the Role of TQM in IT Sector?

Ans :

Total Quality Management (TQM) plays a crucial role in the Information Technology (IT) sector by providing a framework for continuous improvement, quality assurance, and customer satisfaction.

1. Quality Assurance

- TQM emphasizes the importance of quality at every stage of the software development life cycle (SDLC). It ensures that each phase, from requirements gathering to implementation and maintenance, adheres to strict quality standards.
- By implementing robust quality assurance processes, IT organizations can detect and address defects early in the development process, reducing the likelihood of costly errors in the final product.

2. Customer Satisfaction

- TQM places a strong focus on customer needs and expectations. In the IT sector, understanding and meeting customer requirements are paramount for success.
- Through techniques like customer feedback, surveys, and continuous communication, TQM helps IT companies align their products and services with customer expectations. This results in higher customer satisfaction, increased loyalty, and positive word-of-mouth.

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3. Continuous Improvement

- A core principle of TQM is continuous improvement. In the IT sector, this involves regularly assessing and enhancing processes, methodologies, and technologies to stay competitive and adapt to changing market demands.
- Through methods like Six Sigma and Kaizen, IT organizations can identify areas for improvement, streamline processes, and optimize workflows, leading to increased efficiency and effectiveness.

4. Employee Involvement and Training

- TQM emphasizes the involvement of all employees in the quality improvement process. In the IT sector, this means fostering a culture of collaboration and shared responsibility for quality.
- Regular training programs ensure that IT professionals stay up-to-date with the latest technologies and best practices. This not only enhances individual skills but also contributes to the overall quality of IT products and services.

5. Data-Driven Decision Making

- TQM promotes the use of data and metrics for decision-making. In the IT sector, this involves gathering and analyzing data related to development processes, system performance, and customer feedback.
- Data-driven insights enable IT organizations to make informed decisions, identify trends, and proactively address issues, leading to better overall quality and performance.

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Case Studies

UNIT - I

Case Study 1 : Establishment of Quality Strategy for Brix & Co

Brix & Co is a proprietorship firm located in Dhaka. It is a TV Spare parts manufacturing company. It is in existence for more than 55 years. There are recent plans in the company to export its products abroad. Twenty young professionals who are highly talented were also recruited recently. The proprietor, Mr. Shah Alam is a strict disciplinarian who is 70 years old.

He is known for his autocratic style of management. Mr. Shah Alam attended seminar organized for executives on quality management. Attracted by the principles taught in the seminar, he wanted to make his company a quality company.

The same day he sat alone till 2 am and formulated a vision statement for his company. The next day morning at 8 am he called for an urgent meeting of all the 60 employees he had and announce proudly his intentions of making the company a quality company. He also announced the vision statement for the company. By 10 am about 100 placards with the vision statement were made ready and fixed in all important locations. All the employees were surprised to see the placard everywhere and wondered what it is all about. Mr. Shah Alam enforced that the vision of the company has to be adhere to by everyone. He was confident that company will soon become a quality company.

One month later. Mr. shah Azad approached his brother Mr. Shah Alam to help him in starting a joint venture company. Mr. Shah Azad was new to business. Mr. Shah Alam being very much attached to his family, readily agreed to his brother's proposal to start a new company. For the next six months, Mr. Shah Alam spent more than 80% of his time in the establishment of the new company.

In the meantime. Brix & Co in Dhaka, had a setback. Even though Brix & Co has set targets to exports, the situation was so bad, they could not even penetrate the local market. Percentage rejection increased and the balance sheet showed heavy loss.

Discuss

1. What according to you is the reason for the setback in Brix & Co?

Ans :

Reason for the Setback in Brix & Co

The primary reason for the setback in Brix & Co appears to be the lack of a comprehensive and inclusive quality strategy. Mr. Shah Alam's autocratic management style and unilateral decision-making process did not involve the employees in the quality improvement initiative. The vision statement was imposed without proper communication, training, or a clear action plan. Additionally, Mr. Shah Alam's focus shifted to the new joint venture, leading to a lack of leadership and oversight at Brix & Co, which contributed to operational inefficiencies and increased rejection rates.

2. What would be your advice to Mr. Shah Alam to revamp the situation?

Ans :

Advice to Mr. Shah Alam to Revamp the Situation

- **Engage Employees:** Involve employees at all levels in the quality improvement process. Encourage feedback and suggestions to foster a sense of ownership and commitment.
- **Training and Development:** Provide training on quality management principles and practices to ensure everyone understands their role in achieving quality objectives.

- **Continuous Improvement:** Implement a continuous improvement process, such as Total Quality Management (TQM) or Six Sigma, to systematically address quality issues.
- **Leadership Focus:** Reallocate time and resources to focus on Brix & Co, ensuring that leadership is present and actively involved in the company's operations.

3. What would have been the right strategy for Mr. Shah Alum in the beginning?

Ans :

Right Strategy for Mr. Shah Alam in the Beginning

- **Collaborative Vision Development:** Develop the vision statement collaboratively with input from key stakeholders, including employees, to ensure alignment and buy-in.
- **Comprehensive Quality Plan:** Create a detailed quality strategy with clear goals, timelines, and responsibilities. This should include metrics for measuring progress and success.
- **Communication and Culture:** Foster a culture of quality by clearly communicating the vision and strategy, and by recognizing and rewarding quality improvements.

4. Do you feel that Mr. Shah .Alam should not have started the second company? If he still wanted to start what he should have done?

Ans :

Should Mr. Shah Alam Have Started the Second Company?

- **Considerations Before Starting:** Mr. Shah Alam should have ensured that Brix & Co was stable and on a clear path to achieving its quality objectives before diverting attention to a new venture.
- **Delegation and Management:** If he still wanted to start the second company, he should have delegated responsibilities at Brix & Co to capable leaders who could maintain focus on the quality strategy. This would involve empowering a management team to oversee operations and ensure continuity in leadership and quality initiatives.

Case Study 2 :

Statistical quality control at generic electric (GE)

General Electric (GE) has long been committed to quality management across its diverse range of products and services. Statistical Quality Control (SQC) has played a crucial role in this commitment, helping GE maintain high standards and improve operational efficiency.

Objectives of SQC at GE

1. Enhance Product Quality: Minimize defects and ensure reliability.
2. Improve Operational Efficiency: Streamline processes to reduce waste and costs.
3. Data-Driven Decision Making: Foster a culture that utilizes data for continuous improvement.

Implementation of SQC Techniques

1. Control Charts:

- Used to monitor process performance over time.
- Example: In manufacturing jet engines, control charts track critical parameters like pressure and temperature.

2. Process Capability Analysis:

- Evaluates how well processes meet specifications using indices such as Cp and Cpk.
  - Example: In appliance manufacturing, this analysis helps ensure components meet tight tolerances.

3. Design of Experiments (DOE):

- A systematic approach to testing various factors to identify optimal conditions.
- Example: Testing different materials for LED lighting to optimize energy efficiency and durability.

4. Six Sigma Methodology:

- A structured approach aimed at reducing defects to fewer than 3.4 per million opportunities.
- Results in substantial cost savings and quality improvements across various divisions.

Challenges Faced

1. Cultural Resistance: Employees were initially hesitant to adopt a data-centric approach.

2. Training Needs: Significant investment in training was necessary to develop staff expertise in SQC tools.

3. Integration: Aligning new statistical methods with existing processes proved challenging.

Results Achieved

1. Defect Reduction: Achieved a 30% reduction in defects within the first year of SQC implementation.

2. Cost Savings: Approximately $12 billion saved over five years due to Six Sigma initiatives.

3. Customer Satisfaction: Enhanced product quality led to improved customer satisfaction ratings.

Questions and Answers :

1. What were the main objectives of implementing SQC at GE?

Ans :

The main objectives were to enhance product quality, improve operational efficiency, and promote a data-driven culture for continuous improvement.

2. What statistical tools did GE use in its SQC processes?

Ans :

GE used control charts, process capability analysis, design of experiments (DOE), and the Six Sigma methodology to monitor and improve quality.

3. How do control charts assist in GE's manufacturing processes?

Ans :

Control charts assist by allowing GE to monitor critical process parameters over time, helping to identify trends or anomalies that may indicate quality issues, thereby enabling timely corrective actions.

4. What challenges did GE encounter during the implementation of SQC?

Ans :

Challenges included cultural resistance from employees, significant training requirements, and difficulties in integrating new statistical methods with existing processes.

5. What measurable results did GE achieve from its SQC initiatives?

Ans :

GE achieved a 30% reduction in defects, approximately $12 billion in cost savings, and improved customer satisfaction ratings due to enhanced product quality.

6. How does the Six Sigma methodology complement SQC at GE?

Ans :

Six Sigma complements SQC by providing a structured framework focused on reducing process variation and defects through data analysis and systematic problem-solving, leading to quality and efficiency improvements.

7. What recommendations can be made for further improving SQC at GE?

Ans :

Recommendations include ongoing training for employees, exploring advanced analytics for predictive quality control, and fostering cross-divisional collaboration to share best practices.

UNIT - II

Case Study 1 :

A TV company branded 'SS' established in 80's was selling its brand based on 'price' differentiation. With several MNC entering the market, SS started facing stiff competition. The owner Mr. Nattan felt if he focuses his company's image as a quality company then he can beat the competition. Hence he shifted the company's focus from 'price' differentiation to 'service'. He started concentrating in finding what the customer wants. Prior to quality introduction, the performance measures were in terms of number of new clients, total billing etc. While meeting the customer, the sales talk was on 'high service delivery' without any regard to customer's needed level of service or on the satisfaction as in the minds of the customer. There was hence a possibility of not meeting their own stated level of service delivery which led to disappointment among customers. Quality goals were now established which were felt to be the indicators of quality - assuring the company in terms of tangible success.

Satisfaction of customer is indicated through

- Bills paid on time
- Retaining customer return at 70%
- Accounts receivable days outstanding is improved by 30% within the next 6 months
- Customer satisfaction survey will indicate customer satisfaction to be above 90%

Satisfaction of employee is indicated by

- Turnover rate brought down by 3% in 6 months time
- Absenteeism is lowered by 10%
- Employee satisfaction survey indicating a level above 95%

Growth of the organization is indicated by

- Obtaining ISO certification
- Increase in share price by 30%
- Increase in number of customers

Discuss

1. Do you agree with the methodology adopted by the company for becoming 'quality organization'?

Ans :

The methodology adopted by the company to shift its focus from price differentiation to service-oriented differentiation is a positive move. However, the approach seems to lack a deep understanding of what quality means for the customers and how to effectively measure it. Shifting the focus from price to service is a step in the right direction, but quality should encompass more than just service delivery.

2. Evaluate the firm's 'indicators of quality' which is expected to measure quality.

Ans :

The indicators proposed by the company seem focused on specific metrics related to customer satisfaction, employee satisfaction, and organizational growth. They do provide measurable targets, which is a good start, but they also have some limitations:

Customer Satisfaction

- **Bills paid on time:** While this indicates some level of satisfaction, it doesn't directly measure customer perception of service quality.
- **Retaining customer return at 70%:** This is a good metric for customer loyalty but may not capture the reasons behind customer returns (whether it's due to service quality or other factors).
- **Accounts receivable days outstanding improved by 30%:** This could indirectly reflect better service or efficiency but might not solely indicate customer satisfaction.
- **Customer satisfaction survey above 90%:** This is a good direct measure but might lack granularity in understanding specific aspects of satisfaction.

Employee Satisfaction

- **Turnover rate reduction:** Lowering turnover is positive, but it might not solely indicate improved job satisfaction or quality of the work environment.
- **Reduced absenteeism:** Again, this could be a result of improved employee satisfaction, but it might not directly measure the quality of the work environment.
- **Employee satisfaction survey above 95%:** Similar to the customer survey, this is a good direct measure but might lack depth in understanding specific areas of dissatisfaction.

Organizational Growth

- **ISO certification:** Obtaining ISO certification is a good indicator of quality management practices.
- **Increased share price and customer base:** While these are indicators of growth, they might not solely reflect quality; external factors can influence these metrics.

Customer-Centric Indicators

- **Net Promoter Score (NPS):** Measures customer loyalty and satisfaction.
- **Customer Effort Score (CES):** Gauges the ease of customers' interactions with the company.
- **Service Level Agreements (SLAs) adherence:** Ensures that promised service levels are met.

Employee-Centric Indicators

- **Employee Net Promoter Score (eNPS):** Measures employee loyalty and satisfaction.
- **Training hours per employee:** Ensures continuous learning and development.
- **Employee empowerment index:** Reflects the degree to which employees feel empowered in decision-making.

3. Identify a few quality indicators to measure quality effectiveness for a company gearing towards TQM

Ans :

Process and Quality Improvement Indicators

- **Defect Rate:** Tracks the number of defects or errors in products or services.
- **Process Cycle Time:** Measures the time taken to complete a process, reflecting efficiency.
- **Continuous Improvement Projects:** Tracks the number and success rate of improvement initiatives.

Case Study 2 :

Fishbone analysis for an Educational Institution

Mr. Suresh is a student of an engineering college doing 1st year BE. He stays in the college hostel. In the first semester, he was a regular student but could not score good mark. In the second semester, the college introduced 'shift' system for classes, with the good intention of providing about 4 to 5 hours of time at a stretch for studies and other useful purpose. It was expected that he would improve his studies and score good marks. On the contrary, he has failed in a couple of subjects

Discuss

1. Analyze this problem and draw a fish bone diagram.

Ans :

To understand the issues Mr. Suresh is facing in achieving good marks despite being regular in class, we can use a Fishbone Diagram (Ishikawa Diagram). This diagram helps identify various root causes under categories that may contribute to the main problem.

Analyzing the Problem

The main problem here is that Mr. Suresh is not scoring well in his exams despite being regular in class. Various potential factors might be influencing this outcome, which can be categorized into:

- Methods (Study techniques, teaching methods)
- Environment (Hostel or college atmosphere, study space)
- Materials (Availability of study resources, quality of materials)
- Manpower (Guidance from teachers, peers, or mentors)
- Personal Factors (Mr. Suresh's habits, time management, health)

2. Suggest methodologies for solving the problem.

Ans :

Suggested Methodologies for Solving the Problem

Here are a few targeted solutions based on the factors identified:

- **Methods:** Mr. Suresh could benefit from study skills training or sessions on effective study techniques and time management to optimize his study time during the new shift system. This can include learning how to focus on key topics, taking structured notes, and practicing problem-solving.
- **Environment:** It's essential to create a conducive study environment in the hostel or college library. Setting up a quiet study zone or designated time for study in the hostel could minimize distractions.
- **Materials:** Ensure Mr. Suresh has access to necessary study materials and resources. This may involve setting up a collaborative study group with peers or consulting with professors for recommended study materials and additional resources.
- **Manpower:** Teachers and counselors should provide mentorship and guidance. Teachers could offer additional tutoring sessions, while peer groups could work together in study sessions to encourage better understanding of subjects.
- **Personal Factors:** Suresh might benefit from sessions on goal setting and self-motivation. Implementing a study schedule, with adequate breaks and exercise, could help improve his focus and productivity.

UNIT - III

Case Study 1 :

Toyota, a global leader in the automotive industry, implemented Total Quality Management (TQM) in the 1950s. The company integrated Lean Manufacturing principles into its TQM system, focusing on continuous improvement (Kaizen), employee involvement, and waste reduction. Key elements of Toyota's TQM approach include Just-in-Time (JIT), Kaizen, and Jidoka.

Challenges: In the 1980s, Toyota faced growing competition from other car manufacturers and needed to maintain its quality while reducing costs. The company sought to continuously improve its processes to remain competitive without compromising product quality.

TQM Practices

- **Kaizen:** Toyota encouraged all employees to contribute small but consistent improvements to their daily work. These incremental changes helped in optimizing processes.
- **Just-in-Time (JIT):** Toyota produced cars only when there was demand, reducing inventory and storage costs.
- **Jidoka:** Machines were designed to automatically stop if an issue was detected, allowing quick intervention to maintain product quality.

Results

- Toyota became known for its high-quality vehicles and lean production processes.
- The company reduced costs and improved efficiency, contributing to its global success.
- The focus on employee involvement increased engagement and innovation.

Questions & Answers:

1. What role did employee involvement play in Toyota's TQM system?

Ans :

Employee involvement, especially through the Kaizen philosophy, was crucial to Toyota's success. Every employee was encouraged to suggest small improvements, creating a culture of continuous improvement across all levels of the company.

2. How did the Just-in-Time system contribute to Toyota's competitive advantage?

Ans :

JIT helped Toyota reduce inventory costs and production waste by only manufacturing vehicles based on customer demand. This improved efficiency and allowed the company to respond quickly to market changes.

3. What is the significance of Jidoka in Toyota's TQM?

Ans :

Jidoka ensures that machines automatically stop when a problem is detected. This prevents defective products from continuing through the production line, maintaining high-quality standards and reducing rework costs.

Case Study 2 :

Implementation of Lean Manufacturing at Toyota

Toyota Motor Corporation is renowned for its innovative production system, known as the Toyota Production System (TPS), which emphasizes lean manufacturing principles. This system focuses on efficiency, quality, and continuous improvement, making Toyota one of the most successful automobile manufacturers in the world.

Objectives of TPS Implementation

1. Reduce Waste: Eliminate non-value-added activities to optimize resource use.
2. Enhance Quality: Foster a culture of quality throughout the production process.
3. Improve Flexibility: Adapt quickly to changing customer demands.
4. Encourage Continuous Improvement: Empower employees to identify and solve problems.

Key Elements of TPS

1. Just-in-Time (JIT):

- Producing only what is needed when it is needed, minimizing inventory costs.
- Example: Components are delivered to the assembly line precisely when needed, reducing excess stock.

2. Jidoka (Automation with a Human Touch):

- Machines are designed to stop automatically when a defect occurs, allowing for immediate problem-solving.
- Example: Production lines stop automatically if a quality issue is detected, preventing defective products from progressing.

3. Kaizen (Continuous Improvement):

- Encourages all employees to contribute to improving processes and reducing waste.
- Example: Regular team meetings to discuss potential improvements in workflow.

4. Value Stream Mapping:

- A tool used to visualize the flow of materials and information in the production process to identify areas for improvement.
- Example: Mapping the production process helps highlight inefficiencies and streamline operations.

Challenges Faced

1. **Cultural Shift:** Transitioning from traditional manufacturing practices to lean principles required a significant cultural change.
2. **Employee Resistance:** Some employees were hesitant to adopt new processes and methodologies.
3. **Supply Chain Coordination:** Aligning suppliers with JIT principles required careful planning and collaboration.

Results Achieved

1. **Increased Efficiency:** Significant reductions in production lead times and costs.
2. **Higher Quality:** Consistent improvement in product quality, leading to reduced defect rates.
3. **Employee Engagement:** Greater employee involvement in problem-solving and process improvements.
4. **Market Leadership:** Enhanced competitiveness and market share in the automotive industry.

Questions and Answers :

1. What were the primary objectives of implementing the Toyota Production System?

Ans :

The primary objectives were to reduce waste, enhance quality, improve flexibility, and encourage continuous improvement throughout the production process.

2. What is Just-in-Time (JIT), and how does it benefit Toyota?

Ans :

Just-in-Time (JIT) is a manufacturing philosophy that aims to produce only what is needed when it is needed. It benefits Toyota by minimizing inventory costs, reducing waste, and improving cash flow.

3. How does Jidoka contribute to quality assurance at Toyota?

Ans :

Jidoka ensures that machines stop automatically when a defect occurs, allowing workers to address problems immediately. This prevents defective products from continuing down the production line, thus maintaining high-quality standards.

4. What role does Kaizen play in Toyota's manufacturing process?

Ans :

Kaizen encourages all employees to identify and suggest improvements in their work processes. This culture of continuous improvement helps Toyota optimize operations and reduce waste.

5. What challenges did Toyota face during the implementation of TPS?

Ans :

Challenges included a significant cultural shift required for lean principles, employee resistance to change, and the need for careful coordination with suppliers to align with JIT principles.

6. What measurable results did Toyota achieve from the implementation of TPS?

Ans :

Toyota achieved increased efficiency, higher product quality, greater employee engagement, and improved competitiveness in the automotive market.

7. How does value stream mapping assist Toyota in improving its production processes?

Ans :

Value stream mapping helps Toyota visualize the flow of materials and information, allowing the identification of inefficiencies and areas for improvement in the production process.

UNIT - IV

Case Study 1 :

Motorola, a telecommunications and electronics company, adopted Total Quality Management in the 1980s. To enhance its TQM efforts, Motorola developed the Six Sigma methodology, a data-driven approach focused on reducing defects and improving quality.

Challenges

In the early 1980s, Motorola faced increasing customer complaints about the quality of its products. The company needed to improve its processes to stay competitive and meet customer expectations.

TQM Practices

- **Six Sigma:** A structured methodology to reduce variability and defects in processes. Motorola set a target of reducing defects to fewer than 3.4 per million opportunities.
- **Employee Training:** Motorola invested heavily in training employees in Six Sigma methodologies to ensure that everyone was equipped to contribute to process improvement.
- **Customer Focus:** The company prioritized customer satisfaction by using data to identify areas of improvement and systematically address them.

Results

- Motorola reduced defects by 90% within a few years.
- The company saved billions of dollars in costs by improving efficiency and reducing waste.
- Motorola became a global leader in quality, setting the benchmark for other companies to follow.

Questions & Answers:

1. What is Six Sigma, and how did it fit into Motorola's TQM framework?

Ans :

Six Sigma is a data-driven methodology aimed at reducing defects and variability in processes. Motorola integrated Six Sigma into its TQM framework to systematically improve product quality, reduce defects, and optimize processes, leading to significant performance gains.

2. How did customer focus drive Motorola's TQM strategy?

Ans :

Motorola's TQM strategy was highly customer-centric. By using data to identify customer concerns and areas of improvement, the company was able to tailor its processes to meet customer expectations, which ultimately increased satisfaction and loyalty.

3. What impact did employee training have on Motorola's TQM success?

Ans :

Employee training was critical to the success of Motorola's TQM and Six Sigma initiatives. By investing in education, the company empowered its workforce to apply Six Sigma techniques, leading to widespread improvements in quality and efficiency across all departments.

Case Study 2 :

General Electric (GE) is one of the most famous examples of a company that successfully implemented Six Sigma. Under the leadership of CEO Jack Welch in the 1990s, GE adopted Six Sigma as a central component of its strategy to improve operational efficiency and drive growth. GE's focus was on reducing defects, improving quality, and enhancing customer satisfaction across various business units, including manufacturing, finance, and healthcare.

Challenges

GE faced significant quality issues, inefficiencies, and high operational costs across its diverse business portfolio. The company sought a method to standardize processes, reduce variability, and ensure high-quality outputs.

Six Sigma Practices

- **DMAIC Process:** GE followed the DMAIC (Define, Measure, Analyze, Improve, Control) process to identify inefficiencies, reduce defects, and enhance operational performance.
- **Define:** Identified key areas where quality and performance could be improved.
- **Measure:** Collected data on current performance to quantify problems and set benchmarks.
- **Analyze:** Investigated the root causes of inefficiencies and defects.
- **Improve:** Implemented process changes and solutions based on data analysis.
- **Control:** Ensured long-term sustainability of improvements through control mechanisms.
- **Training:** GE invested heavily in Six Sigma training programs for employees. Employees were trained and certified as Green Belts, Black Belts, and Master Black Belts to lead Six Sigma projects.
- **Customer-Centric Approach:** GE's Six Sigma focused on meeting customer needs by reducing defects and improving product and service quality.

Results:

- GE saved approximately $10 billion over five years due to improvements in operational efficiency and reduced defects.
- Productivity increased across all departments, leading to higher customer satisfaction.
- The successful implementation of Six Sigma helped GE achieve a sustainable competitive advantage, improving processes across various industries such as manufacturing, finance, and healthcare.

Questions and Answers:

1. What is the DMAIC process, and how did GE apply it to improve performance?

Ans :

DMAIC is a structured problem-solving process used in Six Sigma to improve processes. GE applied DMAIC to identify key areas of inefficiency, collect data to measure performance, analyze root causes of problems, implement improvements, and control the processes to ensure sustainability of gains.

2. How did Six Sigma training contribute to GE's success?

Ans :

Six Sigma training played a critical role in GE's success by equipping employees with the skills to lead process improvement initiatives. Employees trained as Green Belts, Black Belts, and Master Black Belts were responsible for driving Six Sigma projects, which led to significant operational improvements and cost savings.

3. How did GE's focus on customer needs influence its Six Sigma strategy?

Ans :

GE's Six Sigma strategy prioritized meeting customer needs by reducing defects and improving the quality of products and services. This customer-centric approach ensured that the changes implemented through Six Sigma projects had a direct positive impact on customer satisfaction.

UNIT - V

Case Study 1 :

Ritz-Carlton, a global luxury hotel chain, is well-known for its high standards of customer service and operational excellence. In the hospitality industry, where customer satisfaction is paramount, Ritz-Carlton adopted Total Quality Management (TQM) to ensure exceptional service quality and operational efficiency.

Challenges

In a highly competitive market, maintaining consistently high customer service across multiple locations while meeting individual customer needs posed significant challenges. The company needed a system to ensure every guest received a flawless experience.

TQM Practices

- **Customer-Focused Service:** Ritz-Carlton places its customers at the center of its TQM strategy. Every employee is empowered to take actions to improve the customer experience, even spending up to $2,000 per guest to resolve issues.
- **Employee Training and Empowerment:** Employees go through rigorous training and are empowered to make decisions without management's approval to enhance customer satisfaction.
- **Continuous Improvement:** Ritz-Carlton uses customer feedback to continuously improve service. The company collects data from customer interactions and adjusts operations accordingly.
- **Benchmarking:** The hotel continuously benchmarks its services against industry leaders to identify areas for improvement.

Results

- Ritz-Carlton consistently ranks at the top in customer satisfaction surveys.
- The company won the prestigious Malcolm Baldrige National Quality Award twice, in recognition of its TQM practices.
- Employee morale and engagement increased due to empowerment and involvement in decision-making.

Questions and Answers:

1. How does Ritz-Carlton empower its employees under TQM?

Ans :

Ritz-Carlton empowers employees by allowing them to spend up to $2,000 per guest to resolve issues on the spot, without needing approval from management. This empowerment allows employees to take immediate action to satisfy customers and improve their experience.

2. How does Ritz-Carlton use customer feedback in its TQM practices?

Ans :

Ritz-Carlton gathers data from customer interactions and feedback to identify areas for improvement. This continuous improvement process ensures that the company adapts its services to meet evolving customer needs and maintain high service standards.

3. Why is benchmarking important for Ritz-Carlton's TQM strategy?

Ans :

Benchmarking allows Ritz-Carlton to compare its services with those of industry leaders. This helps the company identify gaps in its operations and implement best practices to maintain its competitive advantage in delivering exceptional customer service.

Case Study 2 :

Southwest Airlines, a U.S.-based low-cost carrier, implemented Total Quality Management (TQM) to improve operational efficiency, employee satisfaction, and customer service. In an industry known for tight margins, delays, and customer dissatisfaction, Southwest adopted TQM to maintain its competitive edge.

Challenges

Southwest faced challenges related to on-time performance, operational efficiency, and maintaining a customer-centric approach. The airline also needed to balance cost-effectiveness with high-quality service.

TQM Practices

- **Employee Engagement:** Southwest fosters a culture of teamwork and employee involvement. Employees are encouraged to share ideas and take ownership of their roles in delivering quality service.
- **Process Improvement:** The company focuses on optimizing its operations, such as turnaround times for planes, to ensure flights depart and arrive on schedule.
- **Customer Satisfaction:** Southwest is known for its customer-centric policies, such as no hidden fees for baggage and flexible cancellation policies, which are integral to its TQM strategy.
- **Lean Operations:** To maintain low costs and improve efficiency, Southwest focuses on streamlining processes and eliminating waste.

Results

- Southwest consistently ranks high in customer satisfaction and employee engagement surveys.
- The airline achieved one of the lowest cost-per-mile ratios in the industry while maintaining high service quality.
- Southwest has been profitable for over four decades, a rare feat in the airline industry.

Questions and Answers:

1. How does employee engagement contribute to TQM success at Southwest Airlines?

Ans :

Employee engagement plays a critical role in Southwest's TQM success. By fostering a culture of teamwork and empowering employees to take ownership of their roles, Southwest ensures that employees are motivated to provide high-quality service, which directly impacts customer satisfaction.

2. How does Southwest Airlines balance cost-effectiveness with service quality under TQM?

Ans :

Southwest Airlines balances cost-effectiveness with service quality by streamlining processes and eliminating waste through Lean operations. By maintaining a low-cost structure and focusing on customer-centric policies, the airline is able to offer high-quality service while staying profitable.

3. What role does process improvement play in Southwest Airlines' TQM strategy?

Ans :

Process improvement is vital to Southwest's TQM strategy. The company constantly works to improve operational efficiency, such as reducing plane turnaround times, to ensure on-time performance. These improvements help enhance customer satisfaction and operational reliability.

Internal Assessments

Internal Assessment - I **(10 Marks)**

I) MULTIPLE CHOICE QUESTIONS (10 × ½ = 5)

1. Quality usually satisfies three F's _____. [a]

   (a) Fit, Form and Function (b) First, Function and Form

   (c) Fit, Form and Final, and (d) Firm, Function and Fit.

2. _____ is one of the prerequisites for success of TQM [b]

   (a) Commitment at the bottom (b) Customer orientation

   (c) Profit oriented (d) Customer-supplier relationship.

3. The purpose of the _____ reporting system is to provide management with a tool for identifying the improvement areas. [c]

   (a) TQM (b) TPM

   (c) Cost of quality (d) Cost of maintenance.

4. _____ is nothing but TQC conducted in a systematic manner. [d]

   (a) SQC (b) TQC

   (c) COQ (d) QA

5. One of the basic concepts of the TQM philosophy is, [a]

   (a) Continuous process improvement (b) Quality improvement only

   (c) Customer satisfaction (d) Earning profits.

6. A measure of process capability is given by the capability index (C_p) = [a]

   (a) $\frac{USL - LSL}{6\sigma}$ (b) $\frac{LSL - LSL}{6\sigma}$

   (c) $\frac{6\sigma}{USL - LSL}$ (d) None

7. _____ is a systematic technique which is used for analyzing the problems both in manufacturing and service operations. [c]

   (a) RU/CS analysis (b) SWOT analysis

   (c) Five why's (d) PESTLE analysis.

8. The cause and effect diagram is broadly classified into. [d]

   (a) Root cause analysis (b) Process analysis

   (c) Interrelationship diagram (d) All the above

9. The Japanese term 'Seiton' represents. [b]
   (a) Organization (b) Neatness
   (c) Cleaning (d) Discipline.

10. _____ is a polar graph with appearance of a spider diagram. [a]
   (a) Radar chart (b) Control chart
   (c) Pareto chart (d) None

II) FILL IN THE BLANKS (10 × ½ = 5)

1. _____ is defined as the ability of a product or service to meet the customer's needs. **(Quality)**

2. _____ is an organized scientific approach towards continuous improvement of quality involving everyone in the organization, covering every function aimed at achieving total customer satisfaction.

   (Total quality management)

3. _____ refers to delivery of excellent service according to the customer's expectations. **(Service quality)**

4. The Probability of Survival (PS), which provides a measure of reliability, R is expressed as _____.

   ($P = R = e^{-lt} = e^{-lt/m}$)

5. ISO stands for _____. **(International organization for standardization)**

6. A graphical representation of the recorded values in a data set according to the frequency of its occurrence is called a _____. **(Histogram)**

7. The check sheets are very easily used for recording the _____ data and events. **(Non-conforming)**

8. _____ is an index of measuring the delivered performance of a plant or an equipment on the basis of good output. **(Overall Equipment Effectiveness (OEE))**

9. A Gantt chart is also known as _____. **(Bar chart)**

10. The purpose of _____ is to assess the achievement or slippage of the progress.

    (Milestone tracker diagram)

Internal Assessment - II **(10 Marks)**

I) ASSERTION & REASON (5 × 1 = 5)

1. **Assertion (A):** The term 'Quality control' is not used in educational institutions.

   Reason (R): Since 'Quality control' is associated with manufactured products, where as in educational institutions, the human resources are assured for quality. In the light of the above statements, Choose the correct answer from the options given below:

   (a) Both (A) and (R) are true and (R) is the correct explanation (A)

   (b) Both (A) and (R) are true and (R) is NOT the correct explanation of (A)

   (c) (A) is true but (R) is false

   (d) (A) is false but (R) is true

Ans : (a)

2. **Assertion (A):** TQM promotes the way in which a library is organised and perform its ICT functions.

Reason (R): TQM is seen as a hindrance to library and information services.

(a) (A) is true, but (R) is false

(b) (A) is false, but (R) is true

(c) Both (A) and (R) are true

(d) Both (A) and (R) are false

Ans : (a)

3 **Assertion (A):** Consumers must always be conscious of quality certification marks.

Reason (R): Quality certification marks act as a proof of purchase while filing a case in the Consumer Court.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true and (R) is false.

(d) Both (A) and (R) are false.

Ans : (c)

4 **Assertion (A):** ISO 9000 is a set of international quality and assurance standards to maintain quality systems.

Reason (R): ISO 9000 are not industry-specific and can be applied in any industry.

(a) Both (A) and (R) are correct, and (R) is the correct explanation of (A).

(b) Both (A) and (R) are correct, but (R) is not the correct explanation of (A).

(c) (A) is correct, but (R) is not correct.

(d) (A) is wrong, and (R) is correct.

Ans : (b)

5. **Assertion (A):** Implementation of TQM in Libraries is quite challenging.

Reason (R): Some of the key essentials, like open and cooperative culture and employees responsiveness for customers satisfaction, required for successful implementation of TQM, are very much noticed in a library.

(a) (A) is true, but (R) is false.

(b) (A) is false, but (R) is true.

(c) Both (A) and (R) are true.

(d) Both (A) and (R) are false

Ans : (a)

II) MATCH THE FOLLOWING (10 × ½ = 5)

5. Match the Following

a.	Dr. Deming believes	[ ]	1.	Histogram
b.	Ishikawa development	[ ]	2.	Common causes
c.	Type of variation is due to	[ ]	3.	Cause & effect diagram
d.	Crosby's objective of quality	[ ]	4.	International organization for standard
e.	ISO	[ ]	5.	To prevent defect

Answers

a - 5

b - 3

c - 2

d - 1

e - 4

	LIST I		**LIST II**
A)	Quality approach	[ ]	I) Productivity quality - cost -Delivery
B)	Pillar of TQM	[ ]	II) Continual improvement management
C)	Need for TQM is due	[ ]	III) Manufacturing organization
D)	TQM focuses on	[ ]	IV) Cut throat competition
E)	MBQA is eligible for	[ ]	V) Employee

Answers

Answers

A - II

B - I

C - IV

D - V

E - III

Internal Assessment - III **(10 Marks)**

I) SYLLOGISM (10 × ½ = 5)

1. All manufacturing sectors are production units.

No service sector comes under production units.

Conclusions :

I. Some manufacturing sectors are service sectors.

II. No service sector comes under manufacturing sectors.

Options :

(a) Only conclusion I follows

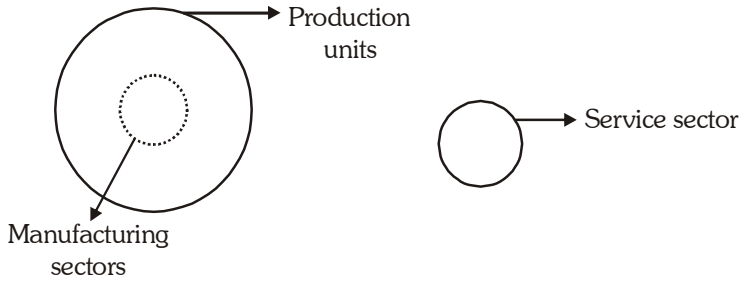
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is,



Only conclusion II follows.

∴ Option (b)

---

2. DMAIC comes under DSSS.

DSSS comes under TQM.

Conclusions :

I. NO DSSS comes under TQM.

II. DMAIC comes under TQM.

Options :

(a) Only conclusion I follows

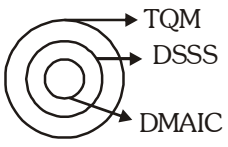
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is,



Only conclusion II follows.

∴ Option (b)

3. Some automobile industries are pharma industries.

All pharma industries are health-care sectors.

Conclusions :

I. Some health-care sectors are automobile industries.

II. Some health-care sectors are pharma industries.

Options :

(a) Only conclusion I follows

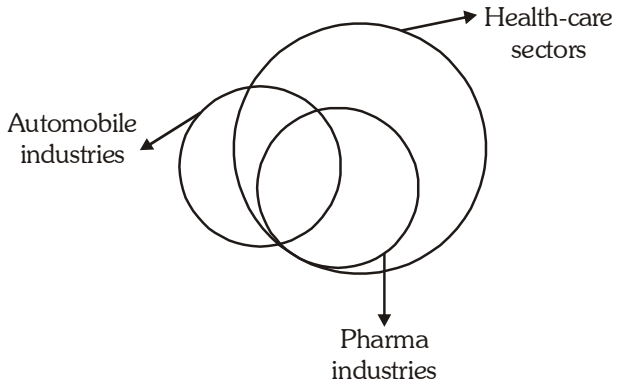
(b) Only conclusion II follows

(c) Either I or II follows

(d) Both I and II follows

Sol :

The basic diagram for the given statements is,



Both I and II follows.

∴ Option (d)

---

4. All six sigma mothodologlos Involve the DMAIC process.

DMAIC is a systematic Improvement process.

Conclusions :

I. All six sigma methodologies are systematic improvement process.

II. Some six sigma methodologies are systematic improvement process.

Options :

(a) Only conclusion I follows

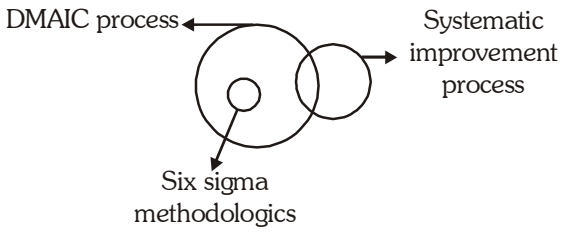
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is,



Neither I nor II follows,

∴ Option (d)

---

5. Some one-star hotels are two-star hotels. Some two-star hotels are three-star hotels.

Conclusions :

I. Some one-star hotels are three-star hotels.

II. No one-star hotel is two-star hotel.

Options:

(a) Only conclusion I follows

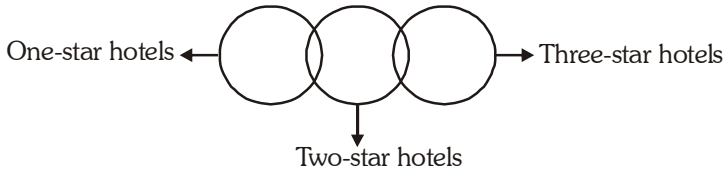
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is,



Neither I nor II follows.

∴ Option (d)

---

6. All control chart come under six sigmas tools.

All hypothesis testing testing come under six sigma tools.

Conclusions :

I. All hypothesis testing come under control charts.

II. All control charts come under hypothesis testing.

Options :

(a) Only conclusion I follows

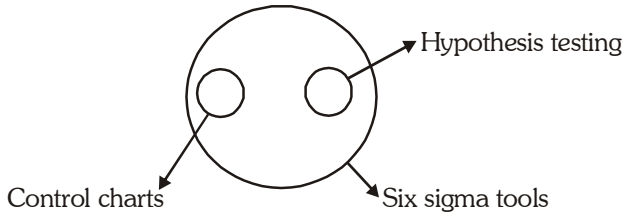
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is



Neither I nor II follows.

∴ Option (d)

---

7. Some red belts are black bolts.

All green belts are champions.

Conclusions :

I. Some black belts are red belts.

II. All red belts are champions.

Options :

(a) Only conclusion I follows

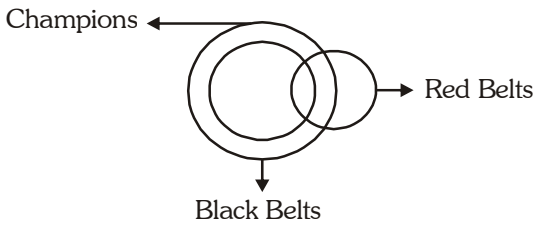
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statement is,



Only conclusion 1 follows.

∴ Option (a)

---

8. Some team members are sponsorers.

Some sponsorers are Master black belts.

Conclusions :

I. Some team members are master black belts.

II. All sponsorers are master black belts.

Options :

(a) Only conclusion I follows

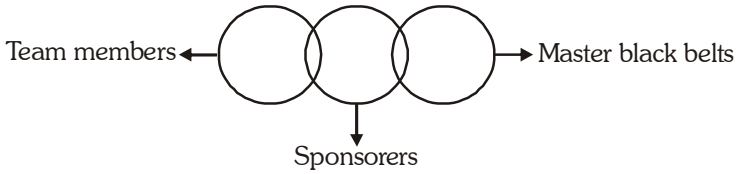
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is,



∴ Option (d)

9. All middle-level managers are top-level managers.

Some customers are top-level managers.

Conclusions :

I. All customers are top-level managers.

II. Some middle-level managers are customers.

Options:

(a) Only conclusion I follows

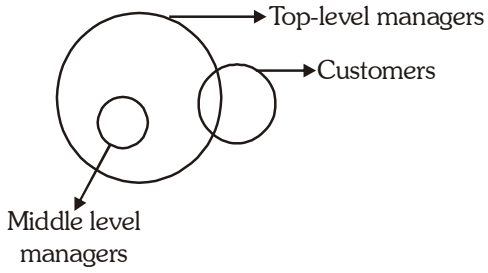
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is,



Neither I nor II follows.

∴ Option (d)

10. All six sigma principles emphasize continuous improvement.

All continuous improvements lead to customer satisfaction.

Conclusions :

I. All customer satisfaction is continuous improvement

II. All six sigma principles leads to customer satisfaction.

Options :

(a) Only conclusion I follows

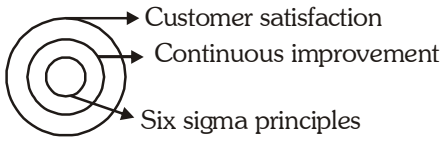
(b) Only conclusion II follows

(c) Either I or II follows

(d) Neither I nor II follows

Sol :

The basic diagram for the given statements is,



Only conclusion II follows.

∴ Option (b)

II) MANAGEMENT QUIZ QUESTIONS (10 × ½ = 5)

1. What is Deming Cycle?

Ans :

P-D-S-A (Plan-Do-Study-Act) cycle of continuous improvement

---

2. Mention the names of some major contributors to the quality movement

Ans :

Edwards Deming, Joseph M. Juran, Philip Crosby, Feigenbaum, Ishikawa, Taguchi, Shingo, Walter Shewhart, etc.

---

3. What are the four categories of quality costs?

Ans :

1. Prevention costs, 2. Appraisal costs, 3. Internal failure costs, and 4. External failure costs.

---

4. What are the major dimensions of service quality?

Ans :

Service duration, timeliness, completeness, consistency, convenience, accuracy, courtesy, etc

5. What does Seiri mean?

Ans :

Separate out all unnecessary things and remove them, retaining only necessary things.

6. What does Seiton mean?

Ans :

Put required things in proper order so that they can be easily accessed for use and quickly put away in their proper locations after use.

7. What does Seiso mean?

Ans :

Keep machinery and work environment clean.

8. What is check sheet?

Ans :

Check sheet or tally sheet is a form for systematic data gathering and registering to get a clear view of the facts.

9. What is histogram?

Ans :

Histogram is a bar chart / diagram showing a distribution of variable quantities or characteristics. It is graphical display of the frequency distribution of numerical data.

10. What is scatter diagram?

Ans :

The scatter diagram is a simple graphical device to depict the relationship between two variables.

FACULTY OF MANAGEMENT

MBA (CBCS) III - Semester Examination

Model Paper - I

TOTAL QUALITY MANAGEMENT

Time : $2^1/_2$ Hours] **[Max. Marks : 60**

PART-A (5 × 2 = 10 Marks)
[Short Answer Type]

Note : Answer all the questions

ANSWERS

1. Define Quality. **(Unit-I, SQA-4)**
2. Define Histogram. **(Unit-II, SQA-2)**
3. Signal-to-Noise Ratio. **(Unit-III, SQA-12)**
4. Six Sigma Metrics in detail. **(Unit-IV, SQA-3)**
5. Dimensions of service quality. **(Unit-V, SQA-6)**

PART - B (5 × 8 = 40 Marks)
[Essay Answer type]

Note : Answer all the questions using the internal choice

6. (a) Discuss the Quality Dimensions for Services. **(Unit-I, Q.No.3)**

OR

(b) Explain the MBNQA and its require-ments. **(Unit-I, Q.No.14)**

7. (a) Explain various tools used for measuring TQM. **(Unit-II, Q.No.1)**

OR

(b) What is meant by Overall Equipment Effectiveness? Discuss the various factors involved in Overall Equipment Effectiveness. **(Unit-II, Q.No.18)**

8. (a) Examine Failure Mode Effect Analysis (FMEA) in detail. **(Unit-III, Q.No.2)**

OR

(b) Describe the steps involved in Bench Marking. **(Unit-III, Q.No.18)**

9. (a) Define six sigma. State the features of six sigma. **(Unit-IV, Q.No.1)**

OR

(b) Explain Six Sigma Metrics in detail. **(Unit-IV, Q.No.10)**

10. (a) Define service quality. How do you implement TQM in service sector. **(Unit-V, Q.No.2)**

OR

(b) Explain the framework for improving the service quality of mutual funds. **(Unit-V, Q.No.13)**

PART - C

Case Study - 10 Marks

Statistical quality control at generic electric (GE)

General Electric (GE) has long been committed to quality management across its diverse range of products and services. Statistical Quality Control (SQC) has played a crucial role in this commitment, helping GE maintain high standards and improve operational efficiency.

Objectives of SQC at GE

1. Enhance Product Quality: Minimize defects and ensure reliability.
2. Improve Operational Efficiency: Streamline processes to reduce waste and costs.
3. Data-Driven Decision Making: Foster a culture that utilizes data for continuous improvement.

Implementation of SQC Techniques

1. Control Charts:

- Used to monitor process performance over time.
- Example: In manufacturing jet engines, control charts track critical parameters like pressure and temperature.

2. Process Capability Analysis:

- Evaluates how well processes meet specifications using indices such as Cp and Cpk.
- o Example: In appliance manufacturing, this analysis helps ensure components meet tight tolerances.

3. Design of Experiments (DOE):

- A systematic approach to testing various factors to identify optimal conditions.
- Example: Testing different materials for LED lighting to optimize energy efficiency and durability.

4. Six Sigma Methodology:

- A structured approach aimed at reducing defects to fewer than 3.4 per million opportunities.
- Results in substantial cost savings and quality improvements across various divisions.

Challenges Faced

1. Cultural Resistance: Employees were initially hesitant to adopt a data-centric approach.

2. Training Needs: Significant investment in training was necessary to develop staff expertise in SQC tools.

3. Integration: Aligning new statistical methods with existing processes proved challenging.

Results Achieved

1. Defect Reduction: Achieved a 30% reduction in defects within the first year of SQC implementation.

2. Cost Savings: Approximately $12 billion saved over five years due to Six Sigma initiatives.

3. Customer Satisfaction: Enhanced product quality led to improved customer satisfaction ratings.

Questions :

1. What were the main objectives of implementing SQC at GE?
2. What statistical tools did GE use in its SQC processes?
3. How do control charts assist in GE's manufacturing processes?
4. What challenges did GE encounter during the implementation of SQC?
5. What measurable results did GE achieve from its SQC initiatives?
6. How does the Six Sigma methodology complement SQC at GE?
7. What recommendations can be made for further improving SQC at GE?

(Unit-I, Case Study-2)

FACULTY OF MANAGEMENT

MBA (CBCS) III - Semester Examination

Model Paper - II

TOTAL QUALITY MANAGEMENT

Time : $2^1/_2$ Hours] [Max. Marks : 60

PART - A (5 × 2 = 10 Marks)

[Short Answer Type]

Note : Answer all the questions

ANSWERS

1. Total Quality Management. **(Unit-I, SQA-6)**
2. Check Sheets. **(Unit-II, SQA-1)**
3. Balanced scorecard. **(Unit-III, SQA-7)**
4. First Pass Yield. **(Unit-IV, SQA-1)**
5. TQM in financial services. **(Unit-V, SQA-2)**

PART - B (5 × 8 = 40 Marks)

[Essay Answer type]

Note : Answer all the questions using the internal choice

6. (a) Evaluate the historical perspective of TQM. **(Unit-I, Q.No.6)**

OR

(b) Define Quality management System (QMS). Explain the various steps involved in Quality management System. **(Unit-I, Q.No.17)**

7. (a) Narrate various Tools and Techniques used for improving TQM. **(Unit-II, Q.No.19)**

OR

(b) What do you understand by Cause and Effect diagram? **(Unit-II, Q.No.9)**

8. (a) Describe Quality Function Deployment (QFD) as a tool of TQM. **(Unit-III, Q.No.7)**

OR

(b) Examine the Taguchi Methods of TQM. **(Unit-III, Q.No.27)**

9. (a) How can six sigma be helpful in achieving quality objectives of a firm. **(Unit-IV, Q.No.5)**

OR

(b) Explain the Six Sigma Problem Solving Approach. **(Unit-IV, Q.No.8)**

10. (a) Bring out the framework needed for improving service quality in healthcare industry. **(Unit-V, Q.No.5)**

OR

(b) Give a critical a note of TQM in banks. **(Unit-V, Q.No.10)**

PART - C

Case Study - 10 Marks

Implementation of Lean Manufacturing at Toyota

Toyota Motor Corporation is renowned for its innovative production system, known as the Toyota Production System (TPS), which emphasizes lean manufacturing principles. This system focuses on efficiency, quality, and continuous improvement, making Toyota one of the most successful automobile manufacturers in the world.

Objectives of TPS Implementation

1. Reduce Waste: Eliminate non-value-added activities to optimize resource use.
2. Enhance Quality: Foster a culture of quality throughout the production process.
3. Improve Flexibility: Adapt quickly to changing customer demands.
4. Encourage Continuous Improvement: Empower employees to identify and solve problems.

Key Elements of TPS

1. Just-in-Time (JIT):

- Producing only what is needed when it is needed, minimizing inventory costs.
- Example: Components are delivered to the assembly line precisely when needed, reducing excess stock.

2. Jidoka (Automation with a Human Touch):

- Machines are designed to stop automatically when a defect occurs, allowing for immediate problem-solving.
- Example: Production lines stop automatically if a quality issue is detected, preventing defective products from progressing.

3. Kaizen (Continuous Improvement):

- Encourages all employees to contribute to improving processes and reducing waste.
- Example: Regular team meetings to discuss potential improvements in workflow.

4. Value Stream Mapping:

- A tool used to visualize the flow of materials and information in the production process to identify areas for improvement.
- Example: Mapping the production process helps highlight inefficiencies and streamline operations.

Challenges Faced

1. **Cultural Shift:** Transitioning from traditional manufacturing practices to lean principles required a significant cultural change.
2. **Employee Resistance:** Some employees were hesitant to adopt new processes and methodologies.
3. **Supply Chain Coordination:** Aligning suppliers with JIT principles required careful planning and collaboration.

Results Achieved

1. **Increased Efficiency:** Significant reductions in production lead times and costs.
2. **Higher Quality:** Consistent improvement in product quality, leading to reduced defect rates.
3. **Employee Engagement:** Greater employee involvement in problem-solving and process improvements.
4. **Market Leadership:** Enhanced competitiveness and market share in the automotive industry.

Questions :

1. What were the primary objectives of implementing the Toyota Production System?
2. What is Just-in-Time (JIT), and how does it benefit Toyota?
3. How does Jidoka contribute to quality assurance at Toyota?
4. What role does Kaizen play in Toyota's manufacturing process?
5. What challenges did Toyota face during the implementation of TPS?
6. What measurable results did Toyota achieve from the implementation of TPS?
7. How does value stream mapping assist Toyota in improving its production processes?

(Unit-III, Case Study-2)

FACULTY OF MANAGEMENT

MBA (CBCS) III - Semester Examination

Model Paper - III

TOTAL QUALITY MANAGEMENT

Time : $2^1/_2$ Hours] [Max. Marks : 60

PART-A (5 × 2 = 10 Marks)

[Short Answer Type]

Note : Answer all the questions

ANSWERS

1. Quality management System. **(Unit-I, SQA-9)**
2. Resource Utilization and Customer Service Analysis. **(Unit-II, SQA-7)**
3. Quality Function Deployment. **(Unit-III, SQA-3)**
4. Throughput Yield (TPY). **(Unit-IV, SQA-9)**
5. Quality Standards of Hotels. **(Unit-V, SQA-7)**

PART - B (5 × 8 = 40 Marks)

[Essay Answer type]

Note : Answer all the questions using the internal choice

6. (a) Bring out cost and benefits of TQM. **(Unit-I, Q.No.11)**

OR

(b) Explain the European Foundation for Quality Management (EFQM). **(Unit-I, Q.No.16)**

7. (a) Explain various Analytical Tools for TQM. **(Unit-II, Q.No.12)**

OR

(b) State PDCA cycle as a tool for assuring continuous process improvement. **(Unit-II, Q.No.35)**

8. (a) Discuss the essential elements in smaller the best and target the best. **(Unit-III, Q.No.30)**

OR

(b) Examine the design of and Monte Carlo Technique of TQM. **(Unit-III, Q.No.13)**

9. (a) Describe the Roles and Responsibilities Six Sigma Organization. **(Unit-IV, Q.No.7)**

OR

(b) What are the Benefits and costs of Six Sigma? **(Unit-IV, Q.No.14)**

10. (a) Explain the Implementation of TQM in various Service Organization. **(Unit-V, Q.No.1)**

OR

(b) Explain the role of TQM in investment company with an example. **(Unit-V, Q.No.12)**

PART - C

Case Study - 10 Marks

Motorola, a telecommunications and electronics company, adopted Total Quality Management in the 1980s. To enhance its TQM efforts, Motorola developed the Six Sigma methodology, a data-driven approach focused on reducing defects and improving quality.

Challenges

In the early 1980s, Motorola faced increasing customer complaints about the quality of its products. The company needed to improve its processes to stay competitive and meet customer expectations.

TQM Practices

- **Six Sigma:** A structured methodology to reduce variability and defects in processes. Motorola set a target of reducing defects to fewer than 3.4 per million opportunities.
- **Employee Training:** Motorola invested heavily in training employees in Six Sigma methodologies to ensure that everyone was equipped to contribute to process improvement.
- **Customer Focus:** The company prioritized customer satisfaction by using data to identify areas of improvement and systematically address them.

Results

- Motorola reduced defects by 90% within a few years.
- The company saved billions of dollars in costs by improving efficiency and reducing waste.
- Motorola became a global leader in quality, setting the benchmark for other companies to follow.

Questions :

1. What is Six Sigma, and how did it fit into Motorola's TQM framework?
2. How did customer focus drive Motorola's TQM strategy?
3. What impact did employee training have on Motorola's TQM success?

(Unit-IV, Case Study-1)

FACULTY OF MANAGEMENT

M.B.A. II-Semester (CBCS) Examination

May / June - 2018

TOTAL QUALITY MANAGEMENT

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **All** the Questions form Part-A and Part-B

Each question carries **4** marks in **Part-A** and **12** marks in **Part-B**

PART - A (5 × 4 = 20 Marks)

(Short Answer Type)

ANSWERS

1. QA **(Unit-I, SQA. 1)**
2. Quality Circles **(Unit-II, SQA.11)**
3. Signal-to-noise Ratio **(Unit-III, SQA.12)**
4. Six Sigma Metrics **(Unit-IV, SQA.3)**
5. Quality Dimensions of a Hotel **(Unit-V, SQA.10)**

PART - B (5 × 12 = 60 Marks)

(Essay Answer Type)

6. (a) Bring out the historical perspective of TQM. **(Unit-I, Q.No. 6)**

OR

(b) Explain the role of EFQM. **(Unit-I, Q.No.16)**

7. (a) Explain process mapping and regression analysis in TQM. **(Unit-II, Q.No.13, 15)**

OR

(b) Narrate of Radar chart and PDCA cycle of TQM. **(Unit-II, Q.No. 34,35)**

8. (a) Examine role of activity based costing. **(Unit-III, Q.No. 25)**

OR

(b) Explain the techniques of nominal -the-best and target-the-best methods of TQM. **(Unit-III, Q.No. 30)**

9. (b) Describe the problem solving approach of six sigma. **(Unit-IV, Q.No.8)**

OR

(b) Explain six sigma metrics in detail. **(Unit-IV, Q.No. 10)**

10. (a) El.ucidate the model to measure service quality programs. **(Unit-V, Q.No. 4)**

OR

(b) Give a critical note of TQM in banks. **(Unit-V, Q.No. 10)**

FACULTY OF MANAGEMENT

M.B.A. II-Semester (CBCS) Examination

May / June - 2019

TOTAL QUALITY MANAGEMENT

Time : 2 Hours] [Max. Marks : 80

PART - A (4 × 5 = 20 Marks)

ANSWERS

Note : Answer any Four questions.

1. Benefits of ISO Registration **(Unit-I, SQA.3)**
2. Gantt Charts **(Unit-II, SQA.13)**
3. Monte Carlo Technique **(Unit-III, SQA. 11)**
4. Six Sigma **(Unit-IV, SQA.2)**
5. TQM in any Service Sector. **(Unit-V, SQA.4)**

PART - B (4 × 15 = 60 Marks)

Note : Answer any Four questions.

6. (a) Briefly explain the different quality awards for TQM. **(Unit-I, Q.No.12)**

OR

(b) Explain the MBNQA and its requirements. **(Unit-I, Q.No. 13)**

7. (a) Briefly describe the 7 QC tools for process improvement. **(Unit-II, Q.No. 1)**

OR

(b) Explain the Kaizen and JIT tools of TQM. **(Unit-II, Q.No.20,23)**

8. (a) Describe the steps involved in benchmarking. **(Unit-III, Q.No. 18)**

OR

(b) Examine any two methods of TQM. **(Unit-III, Q.No.30)**

9. (b) How can 'six-sigma' be helpful in achieving quality objective of a firm? **(Unit-IV, Q.No. 5)**

OR

(b) What are the benefits and costs of Six-Sigma? Explain. **(Unit-IV, Q.No. 14)**

10. (a) Bring out the framework for improving service quality in Indian Universities. **(Unit-V, Q.No. 2)**

OR

(b) How TQM can be achieved in health care services? Give your suggestions. **(Unit-V, Q.No. 5)**

FACULTY OF MANAGEMENT

M.B.A. II-Semester (CBCS) Examination

December - 2020

TOTAL QUALITY MANAGEMENT

Time : 2 Hours] **[Max. Marks : 80**

PART - A (4 × 5 = 20 Marks)

ANSWERS

Note : Answer any Four questions.

1. MBNQA **(Unit-I, SQA.2)**
2. Gant Chart **(Unit-II, SQA.13)**
3. The Balanced Score Card **(Unit-III, SQA.7)**
4. First Pass Yield **(Unit-IV, SQA.1)**
5. Functions of Investment Company. **(Unit-V, SQA.4)**

PART - B (4 × 15 = 60 Marks)

Note : Answer any Four questions.

6. Distinguish between Conventional Quality Management and TQM. **(Unit-I, Q.No.8)**
7. Explain the European Foundations for Quality Management (EFQM) **(Unit-I, Q.No.16)**
8. Explain various tools used for measuring TQM **(Unit-II, Q.No.1)**
9. Narrate various tools and techniques used for improving TQM **(Unit-II, Q.No.19)**
10. Examine FMEA and SPC in detail. **(Unit-III, Q.No. 2,5)**
11. Examine the Taguchi methods of TQM **(Unit-III, Q.No.27)**
12. Draw and explain the framework of Six Sigma Program. **(Unit-IV, Q.No.6)**
13. Write a detailed note on Six Sigma Metrics. **(Unit-IV, Q.No.10)**
14. Bring out the frame work for improving the service quality in mutual funds industry. **(Unit-V, Q.No.13)**
15. Elucidate the application of TQM in hospitality sector. **(Unit-V, Q.No.7)**

FACULTY OF MANAGEMENT

M.B.A. II-Semester (CBCS) Examination

August - 2021

TOTAL QUALITY MANAGEMENT

Time : 2 Hours] **[Max. Marks : 80**

PART - A (4 × 5 = 20 Marks)

ANSWERS

Note : Answer any Four questions.

1. What is Quality Assurance? **(Unit-I, SQA.1)**
2. What is Check Sheet? **(Unit-II, SQA.1)**
3. Quality dimensions of a hotel **(Unit-V, SQA.10)**
4. Explain QFD **(Unit-III, SQA.3)**
5. What are the uses of quality indices? **(Unit-I, SQA.11)**

PART - B (4 × 15 = 60 Marks)

Note : Answer any Four questions.

6. Evaluate the historical perspective of TQM **(Unit-I, Q.No.6)**
7. Explain the Customer and Supplier focus in TQM **(Unit-I, Q.No.10)**
8. Discuss about the Tools Histograms, Run charts, Scatter Diagram and their application in TQM. **(Unit-II, Q.No. 3,4,5,6,7,8)**
9. What is JIT in services ? Explain how it is implemented in services. **(Unit-II, Q.No. 25)**
10. Describe the steps involved in the Design of experiments and state its merits. **(Unit-III, Q.No.11)**
11. Discuss the applicability of Genichi Taguci's Quality loss function with respect to Indian Industry. **(Unit-III, Q.No.28)**
12. What is six sigma and explain theoretical frame work of six sigma approach? **(Unit-IV, Q.No. 1,6)**
13. Discuss the model of DMAIC in detail. **(Unit-IV, Q.No.8)**
14. Explain the Implementation of TQM in various Service Organization. **(Unit-V, Q.No.1)**
15. Explain the frame - work for improving the service quality in Mutual Funds. **(Unit-V, Q.No.13)**

FACULTY OF MANAGEMENT

M.B.A. II-Semester (CBCS) Examination

October / November - 2021

TOTAL QUALITY MANAGEMENT

Time : 2 Hours] **[Max. Marks : 80**

PART - A (4 × 5 = 20 Marks)

ANSWERS

Note : Answer any Four questions.

1. What is MBNQA ? **(Unit-I, SQA.2)**
2. Explain Quality circles. **(Unit-II, SQA.11)**
3. What is Kaizen philosophy? **(Unit-II, SQA.9)**
4. SPC **(Unit-III, SQA.2)**
5. Explain Balanced Score Card. **(Unit-III, SQA.7)**

PART - B (4 × 15 = 60 Marks)

Note : Answer any Four questions.

6. Define the term 'quality' and discuss it determinants. **(Unit-I, Q.No. 1, 2)**
7. Explain the role of EFQM. **(Unit-I, Q.No.16)**
8. Explain process mapping and regression analysis in TQM. **(Unit-II, Q.No.13,15)**
9. Explain the basic principles of Quality Function Deployment (QFD). What are its benefits? **(Unit-III, Q.No.7,10)**
10. Examine the role of activity based costing. **(Unit-III, Q.No. 26)**
11. Explain the Salient features of Kanban and Activity Based Costing. **(Unit-III, Q.No.24,25)**
12. Explain the various Quantitative Techniques of Six Sigma in TQM **(Unit-IV, Q.No.9)**
13. Explain six sigma metries in detail. **(Unit-IV, Q.No. 10)**
14. Elucidate the model to measure service quality programs. **(Unit-V, Q.No.4)**
15. Give a critical note of TQM in Hotel Industry. **(Unit-V, Q.No.7)**

FACULTY OF MANAGEMENT

M.B.A. III-Semester (CBCS) Examination

March / April - 2023

TOTAL QUALITY MANAGEMENT

Time : 3 Hours] **[Max. Marks : 80**

PART - A (5 × 4 = 20 Marks)

Note : Answer all the questions.

Answers

1. ISO **(Unit-I, Q.No. 18)**
2. Pareto's chart **(Unit-II, Q.No. 10)**
3. Balance Score Card **(Unit-III, SQA-7)**
4. Six sigma metrics **(Unit-IV, SQA-3)**
5. Service quality **(Unit-V, SQA-5)**

PART - B (5 × 12 = 60 Marks)

Note : Answer all the questions.

6. (a) Briefly discuss the international quality award programs? **(Unit-I, Q.No. 13, 14)**

(OR)

(b) Explain the benefits and costs of TQM? **(Unit-I, Q.No. 11)**

7. (a) Explain the various measurement tools of TQM? **(Unit-II, Q.No. 1)**

(OR)

(b) Explain the objectives and benefits of the quality circles? **(Unit-II, Q.No. 26, 27)**

8. (a) What is Taguchi's Quality loss function with an illustration? **(Unit-III, Q.No. 28)**

(OR)

(b) Write the objectives, benefits and types of Failure Mode Effective Analysis? **(Unit-III, Q.No. 2, 3, 4)**

9. (a) Write the DMAIC process for six sigma implementation? **(Unit-IV, Q.No. 8)**

(OR)

(b) Explain the concept of objectives of six sigma? **(Unit-IV, Q.No. 1, 2)**

10. (a) Write the methods and techniques used to improve the service quality? **(Unit-V, Q.No. 4)**

(OR)

(b) Write the issues and solutions in managing the total quality at Hotel industry? **(Unit-V, Q.No.7)**

FACULTY OF MANAGEMENT

MBA (CBCS) III-Semester Examination

February - 2024

TOTAL QUALITY MANAGEMENT

Time : 3 Hours] **[Max. Marks : 70**

PART-A (5 × 4 = 20 Marks)

(Short Answer Type)

Note : Answer all the questions.

Answers

1. Connotations of Quality **(Unit-I, Q.No. 1)**
2. Pareto's Chart **(Unit-II, Q.No. 10)**
3. Quality Function Deployment **(Unit-III, SQA-3)**
4. Costs of Six Sigma **(Unit-IV, Q.No. 14)**
5. Role of TQM in Hotels **(Unit-V, SQA-1)**

PART-B (5 × 10 = 50 Marks)

(Essay Answer Type)

Note : Answer all the questions.

6. (a) Explain the benefits and costs of TQM. **(Unit-I, Q.No. 11)**

(OR)

(b) Discuss the historical perspectives of TQM? Write a brief note on MBNQA. **(Unit-I, Q.No. 6, 14)**

7. (a) What are the measurement tools of TQM? Discuss. **(Unit-II, Q.No. 1)**

(OR)

(b) Write a note on Quality circles in detail? Discuss the applications of it with real time examples? **(Unit-II, Q.No. 26)**

Ans :

Quality circles are small groups of employees who meet regularly to identify, analyze, and solve work-related problems. They focus on improving quality, productivity, and workplace culture. Here are some applications of quality circles with real-time examples:

1. Manufacturing Industry

Example: Toyota

Application: Toyota employs quality circles to enhance production efficiency. Workers identify issues in the assembly line, propose solutions, and implement changes, leading to reduced waste and improved quality of vehicles.

2. Healthcare

Example: Virginia Mason Medical Center

Application: Quality circles at Virginia Mason focus on improving patient care processes. Staff members collaborate to streamline procedures, reduce wait times, and enhance patient safety. This approach has led to significant improvements in care quality and efficiency.

3. Service Industry

Example: McDonald's

Application: McDonald's uses quality circles to enhance customer service. Employees discuss ways to improve order accuracy and speed. Implemented changes have resulted in better customer satisfaction and increased efficiency in service delivery.

4. Education Sector

Example: A Local School District

Application: Teachers form quality circles to address student engagement. They share best practices and develop strategies to improve teaching methods, leading to enhanced student performance and a more interactive classroom environment.

5. Retail Industry

Example: Walmart

Application: Walmart encourages employees to form quality circles to address inventory management issues. By collaborating, staff identify problems in stock levels and propose solutions, which helps reduce excess inventory and improve product availability.

6. Construction Industry

Example: Turner Construction

Application: Quality circles at Turner Construction focus on safety improvements on job sites. Workers share insights on hazards and best practices, leading to a safer work environment and reduced accident rates.

7. Information Technology

Example: IBM

Application: IBM implements quality circles in software development teams to improve code quality and collaboration. Team members discuss challenges and propose improvements, resulting in more efficient development cycles and higher-quality software.

8. Hospitality

Example: Marriott International

Application: Marriott uses quality circles to improve guest experiences. Employees discuss service delivery, identify areas for improvement, and implement changes that enhance customer satisfaction and loyalty.

9. Automotive Industry

Example: Ford Motor Company

Application: Ford uses quality circles to address production issues and improve product.

8. (a) What are the quantitative techniques of TAM? Explain FMEA. **(Unit-III, Q.No. 1, 2)**

(OR)

(b) What are the qualitative techniques of TQM? Discuss in brief about activity based costing (ABC). **(Unit-III, Q.No. 14, 25)**

9. (a) What is six sigma? Explain the frame work of six sigma? **(Unit-IV, Q.No. 1, 6)**

(OR)

(b) Discuss the problem solving approach of six sigma. **(Unit-IV, Q.No. 8)**

10. (a) Discuss the implementation of TQM in pharmaceutical sector. **(Unit-V, Q.No. 5)**

(OR)

(b) Elaborate the role of TQM in IT Sector. **(Unit-V, Q.No. 6)**

FACULTY OF MANAGEMENT

MBA (CBCS) III-Semester Examination

June / July - 2024

TOTAL QUALITY MANAGEMENT

Time : 3 Hours] **[Max. Marks : 70**

PART-A (5 × 4 = 20 Marks)

(Short Answer Type)

Note : Answer all the questions.

Answers

1. Dimensions of Quality. **(Unit-I, Q.No. 3)**
2. PDCA Cycle. **(Unit-II, Q.No. 35)**
3. Benchmarking. **(Unit-III, SQA-6)**
4. Benefits of Six Sigma. **(Unit-IV, Q.No. 14)**
5. TQM Role in IT Sector. **(Unit-V, Q.No. 6)**

PART-B (5 × 10 = 50 Marks)

(Essay Answer Type)

Note : Answer all the questions.

6. (a) Explain the concept and evolution of TQM. **(Unit-I, Q.No. 6)**

(OR)

(b) Discuss the Quality System awards and guidelines. **(Unit-I, Q.No. 12)**

7. (a) What are the analytical tools of TQM? Explain. **(Unit-II, Q.No. 12)**

(OR)

(b) Explain in brief the force field analysis and Five S's. **(Unit-II, Q.No. 28, 30)**

8. (a) What are the quantitative techniques of TQM? Explain SPC. **(Unit-III, Q.No. 1, 5)**

(OR)

(b) What are the qualitative techniques of TQM Discuss in brief about sales and operations planning. **(Unit-III, Q.No. 14, 23)**

9. (a) Discuss the roles and responsibilities of six sigma organization. **(Unit-IV, Q.No. 7)**

(OR)

(b) Explain the benefits and costs of six sigma? State the challenges in implementing it? **(Unit-IV, Q.No. 14)**

10. (a) Discuss the implementation of TQM in Automobile sector. **(Unit-V, Q.No. 7)**

(OR)

(b) Write a note on TQM in health-care services. **(Unit-V, Q.No. 5)**