BALAJI INSTITUTE OF I.T AND MANAGEMENT KADAPA

OPERATIONS MANAGEMENT (21E00206)

ICET CODE: BIMK

1st & 2nd Internal Exam Syllabus

ALSO DOWLOAD AT http://www.bimkadapa.in/materials.html

Name of the Faculty: M.ANANTH KUMAR

Units covered : 1 to 5 Units

E-Mail Id :kumar2ananth@gmail.com

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

MASTER OF BUSINESS ADMINISTRATION
MBA; MBA (General Management); MBA (Business Management)
COMMON COURSE STRUCTURE

Course Code	OPERATIONS MANAGEMENT	L	T	P	C
21E00206		4	0	0	4
	Semester	**II**			

Course Objectives:

- To explain various concepts of Production and Operations Management.
- To explore and impart knowledge on the elements of good control system, the role of control charts and statistical process control methods in helping managers to control variation.
- To develop the strong knowledge about quality control systems
- To facilitate the knowledge over real time inventory control techniques
- To offer learners an introduction to industry 4.0, its applications in the business world.

Course Outcomes (CO): Student will be able to

- Understand the concept of Production and Operations Management.
- Construct and interpret simple control charts for both continuous and discrete data.
- Gain knowledge on the quality philosophies and principles of deming, Juran, six sigma and to become acquainted with the International Organization for Standardization's ISO 9000:2000 requirements.
- Learn different types of inventory that firm's use and their role in value analysis
- Familiarize with inventory concepts to support the development of useful quantitative models for inventory management.
- Understand the drivers and enablers of Industry 4.0

UNIT - I	Lecture Hrs:08

Introduction and Overview of Operations Management: Definition of Operations Management – Nature and Scope of OM – Role & Decision areas of Operations Manager- interface of OM with other functions - Operations Management's future challenges

UNIT - II	Lecture Hrs:12

Operations Control: Managing of Work Environment–Automation—Technology Management-Waste Management-Quality Assurance and Quality Circles–Statistical Quality Control–Control Charts for Variables-Average-Range and Control charts for Attributes. Acceptance Sampling Plans. Purchase functions and Procedure

UNIT - III	Lecture Hrs:12

Managing for Quality: Basic concepts of quality, dimensions of quality, Juran's quality trilogy, Deming's 14 principles, Quality improvement and cost reduction, ISO9000-2000 clauses & coverage. Six Sigma, Productivity–factors affecting productivity - measurement & improvements in productivity-new product development and design-stages.

UNIT - IV	Lecture Hrs:12

Inventory and Inventory Models: Inventory Control-Different Systems of Inventory Control, Costs & Types of Inventory – ABC, VED. Value Analysis – importance in cost reduction – concepts and procedures. Inventory control –Types of Inventory–Safety stock – Inventory Control Systems–JIT, VMI.

UNIT - V	Lecture Hrs:12

Introduction to Industry 4.0 - The Various Industrial Revolutions - Digitalization and the

Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 – Benefits of adopting an Industrial 4.0 model
Textbooks:
1. Heizer, Render, Principles of Operations Management 8th Edition, Prentice Hall, 2011. 2. B. Mahadevan, "Operations Management - Theory and Practice", Pearson, New Delhi, 2013. 3. Operations Management and Control , Banerjee Biswajit, S.Chand
Reference Books:
1. Panner Selvem: "Production and Operations Management", Prentice Hall of India, New Delhi, 2012. 2. S N Chary, "Production and operations management", Tata McGraw Hill, NewDelhi, 2013.
Online Learning Resources:
https://onlinecourses.swayam2.ac.in/imb21_mg47/preview https://onlinecourses.nptel.ac.in/noc21_me18/preview

UNIT – 1

INTRODUCTION

OVERVIEW OF OPERATIONS MANAGEMENT.

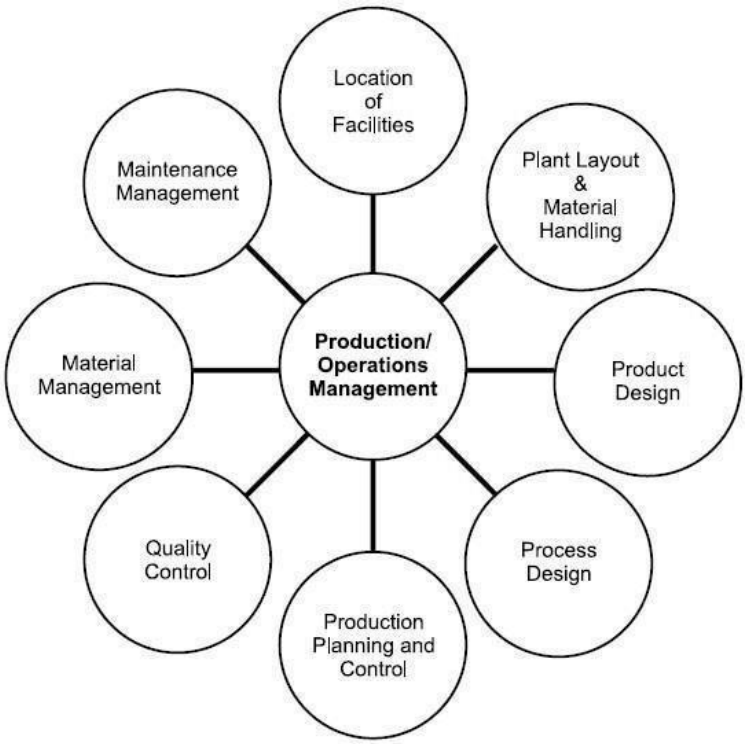
Operations Management involves the planning, scheduling, and control of activities That transform inputs into finished goods and services. For organizations providing specialized health services to children, the success of the Management of the operations impacts directly on the ability of that organization to Deliver services of a certain quality standard in the quantity and timeliness that meets the Needs of the consumers of the services.

DEFINATION:

The administration of business structure, practices, and processes to enhance efficiency and maximize profit.

MEANING:

Operations management is the branch of Operations Management is a field that focuses on the management of resources and processes to create and deliver goods or services. It is a relatively new domain, only emerging as a different discipline in the early 20thcentury. Operations management is concerned with all aspects of an organization.



Scope Of Operations Management:

It is the process of planning, organizing, directing, and controlling the resources needed

to produce goods and services. The scope of operations management includes all the activities necessary to plan, design, and manage the production and distribution process.

The eight scopes of operations management are as follows:

1. Work force planning and management

2. Inventory management

3. Scheduling

4. Quality control

5. Transportation and logistics

6. Maintenance

7. Project management

Role of Operations Management:

Operations managers are responsible for managing activities that are part of the production of goods and services. Their direct responsibilities include managing the operations process, embracing design, planning, control, performance improvement, and operations strategy. Their indirect responsibilities include interacting with those managers in other functional areas within the organization whose roles have an impact on operations. Such areas include e marketing, finance, accounting, personnel and engineering. Operations management is a field concerned with designing, planning, controlling,

DECISIONAL AREAS OF OPERATIONAL MANAGEMENT:

Decision-making in operations management is the decision-making process about efficiently using resources to produce goods or services. Operations management decisions aim to maximize efficiency while meeting customer needs. It will be no surprise that operations managers have to make many decisions. In fact, they may make dozens of decisions each day. Some of these decisions are routine, while others are more complex and require more transparently While it may not always be easy, decision- making is essential to operations management. Goals. Operations managers are responsible for making decisions that will impact the operations of their organization**.**

However, one can analyze the operations function using 5 major decision responsibilities:

1. process,
2. capacity,
3. inventory,
4. work force, and
5. quality

The importance of operations management

The functions of operations management are critical for every business—whether you're in the manufacturing or tech industry. While tech companies may find finance and strategy more important and manufacturing companies may focus more on the supply chain, these seven functions draw a full picture of how to run any internal team.

Companies make many decisions through the production process, and the operations team of ten serves as a voice of reason between departments. Without operations management, departments may have trouble aligning decisions with company goals, avoiding conflict, and keeping operations running smoothly.

In particular, operations management:

Motivates team members:

The operations team motivates team members by keeping the workplace organized and improving workplace conditions. Team members are more excited to work when they have a functioning work environment.

Utilizes resources:

Another part of your job as operations manager is to build a budget that uses the company's resources wisely. Try to reduce costs whenever possible, stretch resources of it project needs, and keep resources from going to waste.

Enhances collaboration:

You can enhance team collaboration within your organization by improving decision making. When you make good decisions, you establish trust among teams, which results in the delivery of top-quality products to customers.

Helps achieve objectives:

You'll help achieve business objectives by serving as a check point for big decisions. When department leaders consider Changes or initiatives, you'll assess whether their ideas align with company goals.

Improves productivity:

Increase **productivity** by making the product's delivery process more efficient. Team members in your organization may complete their work faster when you make improvements to production

INTERFACE OF OM WITH OTHER FUNCTIONAL OPERATIONAL MANAGEMENT.

1. Accountants have to understand the basic inventory management and capacity utilization.

2. Management Accountants must know process cost in and variance analysis.

3. Financial Managers take capital budgeting decision, based on production requirement. Cash flow statements and current asset management has to be examined in the light of Production decisions. Make-or-buy or plant expansion has financial implication.

4. Marketing Managers have to understand production schedules to meet their delivery requirement.
   They should understand how products can be customized.

5. Production has a great role to play in new product development in service industries , Marketing and operation overlap each other.

6. Personal department is interested understanding job analysis, job descriptions, job specification
   and job evaluation . They develop compensation plans and incentive system, keeping production
   requirements in mind.

7. MIS has to install suitable control systems for production which takes inputs from marketing
   Information system and provides output to purchasing information system.

8. Enterpreneurs owe their success to successful production planning supported by working Capital management and inventory management.

FUNCTIONS OF OPERATIONAL MANAGEMENT

There are 7 functions of operational management.

1. **Operational planning**

2. **Finance**
3. **Product design**
4. **Quality control**
5. **Forecasting**
6. **Strategy**
7. **Supply chain management**

FUTURE CHALLENGE OF OPERATIONAL MANAGEMENT.

There are multiple challenges that operations managers face on a daily basis; five major challenges of an operational manager facing in the current situation are:

1.globalization,
2.sustainability,
3.ethicalconduct,
4ineffectivecommunication,
5.systemdesign

Globalization:

Globalization is a process of interaction and integration among the people, companies, and governments of different nations. It is driven by a reduction in trade barriers, advancements in information technology, and transportation technology (Globalization101). Operation managers face competition from the company across the street, as well as, from across the country and

Across the world. Mainly in this pandemic situation operation managers face some barriers in transportation, selling and labor .

Sustainability:

Business operational sustainability is a method of evaluating whether a business can maintain existing practices without putting future resources at risk (Kay Miranda) When discussing the concept of sustainability, The three pillars of sustainability which are social, environmental, and economic. Operations managers must concern themselves with the outcomes of each of the pillars including how their work affects safety, welfare, communities, the environment and economic sustainability.

Ethical Conduct:

Ethics is defined as a subset of business ethics that is "meant to ensure that the production function and/or activities are not damaging to either the consumer or the society." In particular organizations should consider the effects new technologies, defective services, animal testing and business deals have on people, safety, and the environment. If one organization follows ethics the trust of customer and reputation of the company will be severe and operational manager is responsible.

In Effective Communication:

The challenge for the operations manager is to be able to communicate effectively with all internal and external stakeholders. Whether they are talking to someone on the factory floor, or in the board room, they must be able to effectively communicate their message as well as process the messages being directed to them

System Design:

In Key Issues in Operations, a blog detailing the relationship between system design and operational management, the main theme is that organizations must develop systems capable of "producing quality goods and services in demanded quantities in acceptable time frames."Designing the system, planning the system, and managing the system present a wide variety of challenges to even the most savvy operations managers.

IMPORTANT QUESTIONS OF UNIT 1

1. What is the meaning of operations management?
2. What skills are needed for operations management?
3. What improvements can be made to achieve operational management productivity goals?
4. Which operational management processes can be made more efficient? …
5. Which resources are being wasted and why?

UNIT-2

OPERATION CONTROL

MANAGING OF WORK ENVIRONMENT

A work environment is the setting, social features and physical conditions in which you perform your job. These elements can impact feelings of well-being, workplace relationships, collaboration, and efficiency and employee health. Here are the significant aspects of a work environment:

(1) Physical environment

This is made up of the size, layout and location of a work place, whether work is conducted indoors or outdoors, the facilities of freed in a work place and the furnishings used while working.

(2)Company culture

This element refers to the way a company and its employees operate, including what effective communication looks like between different levels of staff, employees' perspective of company leaders, the company's goals and what the organization values.

(3)Working conditions

This element includes the formal terms under which staff members are hired, such as the rate of pay, contract of employment and length of the work day. It can also cover recreational activities and other initiatives to promote a healthy workplace. A work environment is the setting, social features and physical conditions in which you perform your job. These elements can impact feelings of wellbeing, workplace relationships, collaboration, efficiency and employee health. Here are the significant aspects of a work environment.

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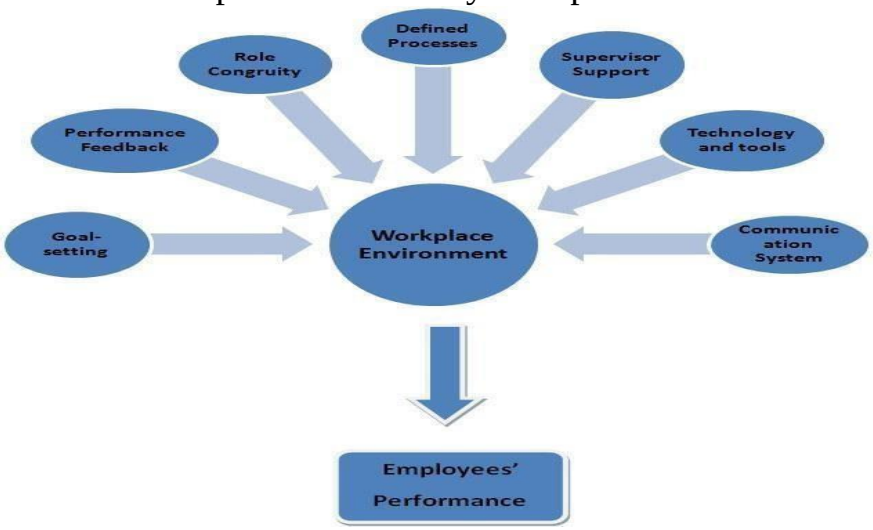


Elements of a work environment

Physical environment the physical conditions you work under will play a crucial role in enabling you to reach your full potential. Some critical aspects of your physical environment to consider include:

Size:
The size of your working area can have an impact on whether you have everything at hand to accomplish your job, while at the same time significantly influencing how you feel at work. To evaluate the size of your work space, consider the amount of space you have to move freely, whether you have all the equipment you need nearby and if the area is large enough to accommodate all staff members.

Layout
Some indoor work places have an open floor plan, while others use cubicles or other dividers to separate spaces. The design of a work place may depend on the type of work. For example, a more collaborative environment may benefit from an open layout, while a job that requires discretion would better operate with separate offices or cubicles to ensure privacy. Furnishings Desks, chairs, conference tables and other

Work places furniture can also impact employees on the job. Access to comfortable and adequate seating, clean work places and functional desks can ensure indoor workplaces remain efficient. Outdoor work places may include comfortable furniture for break times.

Equipment
Some roles require special equipment to do their job, and depending on the company, the employer may or may not provide it. Some roles, such as a mechanic, may be required to bring their own set of tools. Indoor office spaces are more likely to provide the necessary equipment,

such as computers, printers and other essential technology used on the job.

Facilities
Other facilities can influence how you feel physically and mentally during your working life. Being able to take a break or go to the bathroom are essential parts of any productive daily routine, so the location of these facilities can also impact the work environment. Additional facilities such as relaxing spaces and on-site gyms can also have a positive influence on employees.

AUTOMATION TECHNOLOGY MANAGEMENT:

MEANING:

The application technology, programs, robotics or processes to achieve outcomes with minimal human input.
Automation is the use of technology to perform tasks with where human input is minimized. This includes

OVERVIEW:
Enterprise applications such as business process automation (BPA), IT automation, network automation, automating integration between systems, industrial automation such as robotics, and consumer applications such as home automation and more.

Types of automation

1. **Basic automation.**
2. **Process automation**
3. **Intelligent automation**

IMPACT OF AUTOMATION AUTOMATION TECHNOLOGY IN MANAGEMENT

1. The Impact of Automation Technology on Businesses has many positive benefits. It allows organizations of all sizes to cherry-pick specific processes to automate. This way, business leaders and devote more time to higher-value roles and reduce the human resource required. Additionally, organizations can improve team collaboration by integrating their business applications. Despite the potential downsides of automation, it can help businesses save money and time. Here are four ways automation can improve your business.

2. Increasing productivity and output:

Many businesses have already begun incorporating automation technology into their operations. This has numerous benefits for business owners and employees. It can cut down on human resources, resulting in higher productivity and output. It can also reduce production costs and factory lead times. Companies can use automation to save money, as it can be done by automating repetitive tasks. Although automation is a good thing for businesses, it can be expensive.

3. Savings:

   One of the significant disadvantages of automation is worker displacement. This can lead toemotional and physical stress for displaced workers. Some businesses are already implementing retraining programs to help displaced workers find alternative jobs. However, the retraining process can be time-consuming and expensive. And if the retraining is not successful, the displaced workers may be forced to move to find a new job.

4. Increased efficiency:

   Automation has the potential to increase productivity. In addition to increasing output, it can improve quality and safety. It can also reduce factory lead times. While automation does not eliminate human workers, it does make their jobs easier. By automating specific processes, businesses can increase their productivity and efficiency. This means that employees are freed up to focus on other things. That makes it a win-win situation for business owners.

5. Job creation:

   In the case of automation, companies can automate repetitive tasks. In this way, they can lower the cost of production and increase the efficiency of processes. The result is increased profitability. And because it is cheaper, it can lead to safer working environments.

6. Data-driven businesses can be more efficient.

   The data they collect is more accessible and valuable than ever before. By automating repetitive processes, companies can increase the efficiency of their teams. They can avoid hiring more workers, reduce overhead and increase employee productivity. A business can also cut its costs by automating its backend systems.

<u>Waste management in Production and Operations Management</u>

Waste management places an important role in managing operations. Wastes can be categorized into obsolete, surplus and scrap items.

Obsolete items:

These are those materials and equipments which are not damaged and which have economic worth but which are no longer useful for the Company's operation owing to many reason such as, changes in product line, process, materials, and so on.

Surplus items:

These are those materials and equipments which have no immediate use but have accumulated due to faulty planning, forecasting and purchasing. However, they have a usage value in future.

Scrap:

It is defined as process wastage, such as, turnings, borings, sprues and flashes. They may have an end-use within the plant having commercial values. Hence, should be disposed of periodically

VERSATILE BENEFITS OF AUTOMATION

AUTOMATION <u>TECHNOLOGY IN MANAGEMENT.</u>

When it comes to automation, there are some obvious benefits. In addition to increasing productivity, it can improve efficiency and accuracy. With the help of robotics and artificial intelligence, companies can create new products at a fraction of the cost of human labor. It will improve their competitive edge and streamline their operations. With more automated processes, they can increase profits by removing manual staff. It can also reduce the time it takes to produce the same products. Automation improves the safety of businesses. Using robots, for example, can protect workers from harmful chemicals. These machines can also save a business's profits and increase sales. This is a significant benefit of the automation of work. This will lead to increased productivity. The impact of automation on businesses in manufacturing is un avoidable. It can result in a better bottom line and a lower level of debt.

Conclusion:

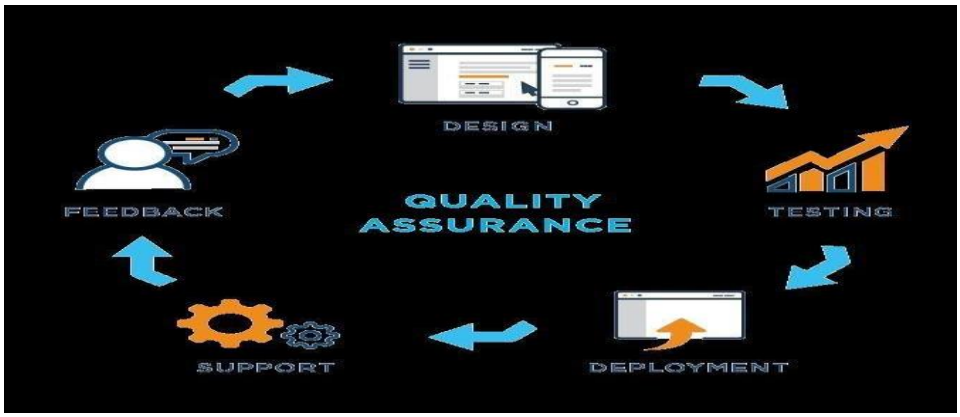
In the future, automation will eliminate and also generate many jobs. This is good news for businesses as it allows IT teams and business users to collaborate more effectively. ONPASSIVE is an AI ITorganization that focuses on building businesses with AI

empowerment that will enable high and productive output by employees and agencies. By reducing the amount of manual labor, companies can spend more money on other activities. Moreover, automated processes can help reduce operational risks. This will also lead to increased productivity. In addition to creating new jobs, automation helps increase the productivity of businesses. This technology can transform a business and create a better work place when used correctly.

QUALITYASSURANCE:

Quality assurance (QA) is any systematic process of determining whether a product or service meets specified requirements.

QA establishes and maintains set requirements for developing or manufacturing reliable products. A quality assurance system is meant to increase customer confidence and a company's credibility, while also improving work processes and efficiency, and it enables a company to better compete with others.



Importance of quality assurance:

Quality assurance helps a company create products and services that meet the needs, expectations and requirements of customers. It yields high-quality product offerings that build trust and loyalty with customers. The standards and procedures defined by a quality assurance program help prevent product defects before they arise.

QUALITY ASSURANCE METHODS:

Quality assurance utilizes one of three methods:

Failure testing:

Which continually tests a product to determine if it breaks or fails. For physical products that need to with stand stress, this could involve testing the product under heat, pressure or vibration. For software products, failure testing might involve placing the software under high usage or load conditions.

Statistical process control (SPC),: a methodology based on objective data and analysis and

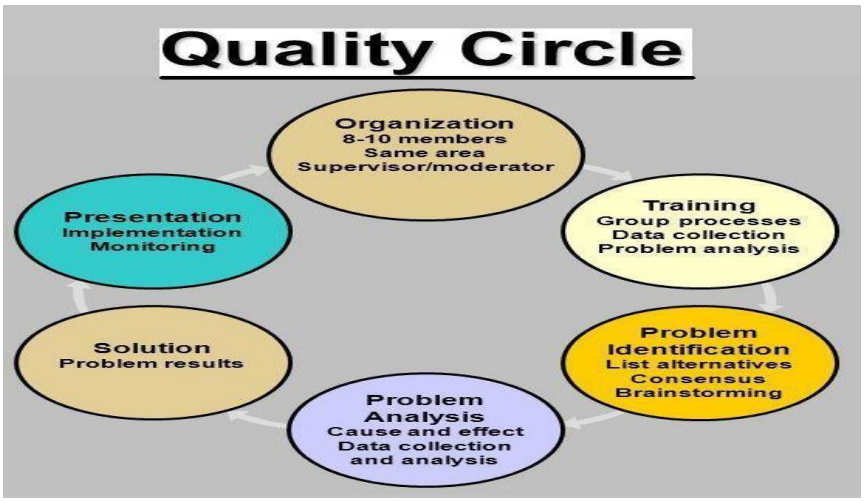
developed by Walter Shewhart at Western Electric Company and Bell Telephone Laboratories in the1920's and1930's. This methodology uses statistical methods to manage and control the production of products.

Total quality management (TQM): which applies quantitative methods as the basis for continuous improvement. TQM relies on facts, data and analysis to support product planning and performance reviews.

QUALITY CIRCLES:

A quality circle or quality control circle is a group of workers who do the same or similar work, who meet regularly to identify, analyze and solve work-related problems. It consists of minimum three and maximum twelve members in number

Normally small in size, the group is usually led by a supervisor or manager and presents its solutions to management; where possible, workers implement the solutions themselves in order to improve the performance of the organization and motivate employees.



Definition of Quality Circle

According to Joel E. Ross and William C. Rossm:

"Quality circle is defined as a small group of employees doing similar or related work who meet regularly to identify, analyse, and solve product quality and production problems and to improve general operations. The circle is a relatively autonomous unit (ideally about ten workers), usually led by a supervisor or a senior worker and organized as a work unit".

What is "QualityCircle"?

Quality Circle is a voluntary association of a group of persons working in same or similar type of job at the same work area who meet regularly one hour a week during their normal working time to discuss about their work-related problems and arrive at a solution which can be implemented by them without additional cost or at a marginal cost. This group will ideally consists of 8 to 10 members but it should never be less than 5 or more than 15 in number because with less number of sufficient ideas may not come up and more number in depth discussion will not be possible. There is a strict discipline in both formation and working of the

group.

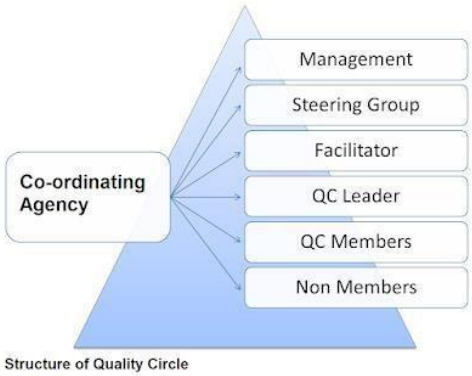
Structure of Quality Circle:

The success of QC lies in its suitable organizational structure, which varies from business-to-business and from firm-to-firm. But a primary structure of QC is utilitarian.

Following are the constituents of this basic structure or quality circle steps:

1) Top Management: It is quite essential for the top management to provide the requisite support needed to ensure smooth functioning of QC. They should also attend the presentations and other key activities. By doing so, they can make sure that the participants feel their support.

2) Steering Committee: The steering committee refers to a counselling committee, in which head of the firm acts as Chairman and head of different divisions play the role of members. This is the top most body of the department, which keeps an eye on the working of quality circle of a particular department and plays the role of counseling authority. The Departmental Head is the leader of the committee and the meeting of the committee is held the minimum of one time in every two or three months by the Chief Executive of



Structure of Quality Circle

that department. The head and facilitator of other departments are the special guests in such meetings.

3)Facilitator :Management has the right to nominate the facilitator. Major chances are that the facilitatoris generally a senior officer of the department. The responsibility of establishing and giving directions for the working of quality circle in the organization lies with him.

Leader:

The members of the quality circle. Choose a leader from the group, who can either be a supervisor or a foreman. The leader can be changed after the completion of a project so that every member would get the opportunity to act as a leader. The leader plays a primary role and is accountable for the performance of his quality circle.

Members:

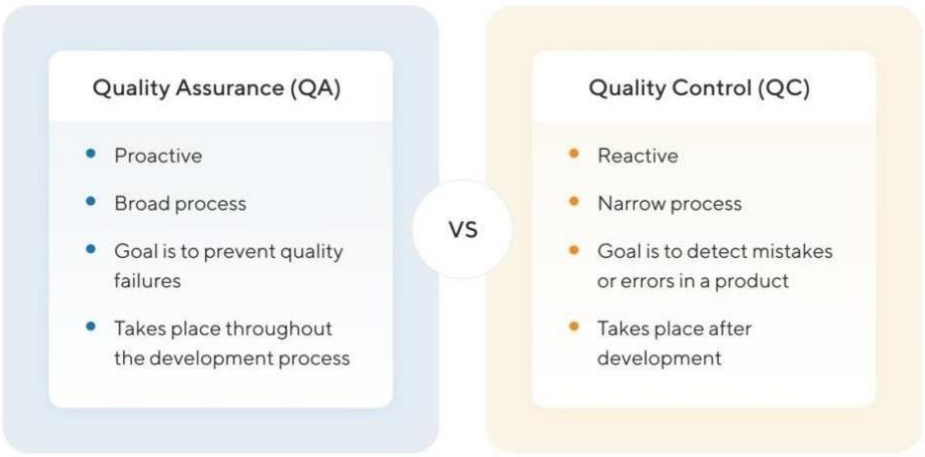
The members of the QC are 5 to 8 workers, who are either from a similar work place or who do the identical task. They establish the quality circle at their own will. They act as enduring members of the group and the relationship terminates only if they do not continue in the same working area. The endeavor of the members is to ensure efficiency in the working of the quality circle and their objective is to ensure constant improvement in the working of quality circle in every possible ways.

Non-Members:
Non-member employees are those employees who actually execute the suggestions coming from the circle for bringing about improvement. Hence, they are important component of the circle.
Coordinating Agency: All the actions of quality circles in an organization are coordinated by the agencies known as coordinating agency at the preliminary stage when there are only few circles, only one person can play this role but with the growth in the number of QC and growth in their activities, a separate body has to be established for this purpose.

Advantages of Quality Circles**:**

The benefits of QC are as follows:

Work Group: QC is useful for the work group in the following ways: An optimistic atmosphere, which foster steam spirit, is established
Management: The QC is useful for the management in the following ways: Quality circle brings relief to the management by solving the problem before it becomes worse. Better quality and enhanced output are secured by the managers.
Organization: The QC is useful for the organization in the following ways: The work performance of entire organization is enhanced, which advances the process of achieving organizational goals. It leads to better working abilities of the managers as well as their juniors.



2) Members start feeling as a part of the company, which gives way to better job satisfaction.
At the preliminary stage when there are only few circles, general purpose machines.
Higher utilization of production facilities.
A high degree of flexibility with regards to work distribution to machineries and workers.
The diversity of tasks and variety of job makes the job challenging and interesting.
Supervisors will become highly knowledgeable about the functions under their department.

STATISTICAL QUALITY CONTROL:

Statistical quality control, the use of statistical methods in the monitoring and maintaining of the qualityof products and services. One method, referred to as acceptance sampling, can be used when a decision must be made to accept or reject a group of parts or it based on the quality found in a sample. A second method, referred to as statistical process control, uses graphical displays known as control charts to determine whether a process should be continued or should be adjusted to achieve the desired quality.

when a decision must be made to accept or reject a group of parts or items based on the quality found in a sample. A second method, referred to as statistical process control, uses graphical displays known as control charts to determine whether a process should be continued or should be adjusted to achieve the desired quality.

“”SQC is defined as the technique of applying statistical methods based on the theory of probability and sampling to establish quality standard and to maintain it in the most economical manner. It is an economic and effective system of maintaining and improving the quality of outputs throughout the whole operating process of specification, production, and inspection based on continuous testing with random samples.””

Advantages of Statistical Quality Control

One of the excellent scientific tools, SQC has the following advantages;

Cost reduction: In this method, only a fragmentary output is inspected to ensure the quality of product, there for probe cost would be reduced greatly.

Huge efficiency: Inspection of a fractional portion requires lesser time and tedium in comparison to holistic investigation leading to huge escalation inefficiency and production.

Easier to use: Pitching SQC not only reduces process variability but also makes the process of production-in-control. Even, it is much to apply by an individual without having such extensive specialized guidance.

Authentic anticipation: SQC is the most preeminent approach that can accurately predict future production. To ensure the degree of perfection and product performance, SQC provides a great predictability.

CONTROL CHARTS FOR VARIABLE

Variables control charts plot continuous measurement process data, such as length or pressure, in a time ordered sequence. In contrast, attribute control charts plot count data, such as the number of defects or defective units. Variables control charts, like all control charts, help you identify causes of variation to investigate, so that you can adjust your process without over-controlling it.

*There are two main types of variables control charts:

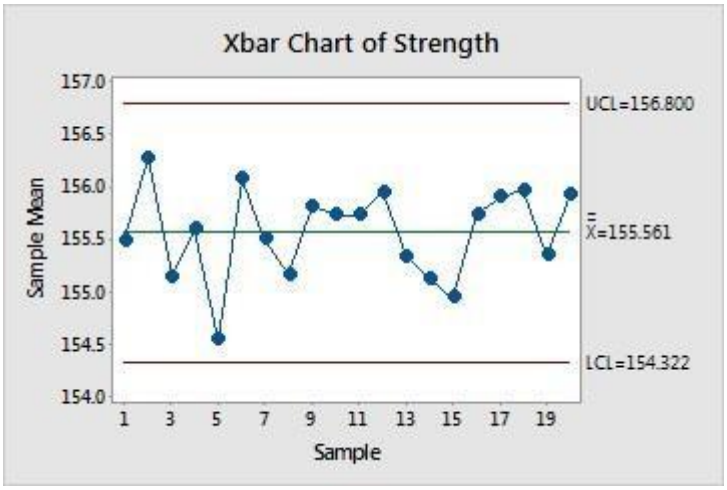
Charts for data collected in subgroups and

Charts for individual measurements.

Variables control charts for subgroup data

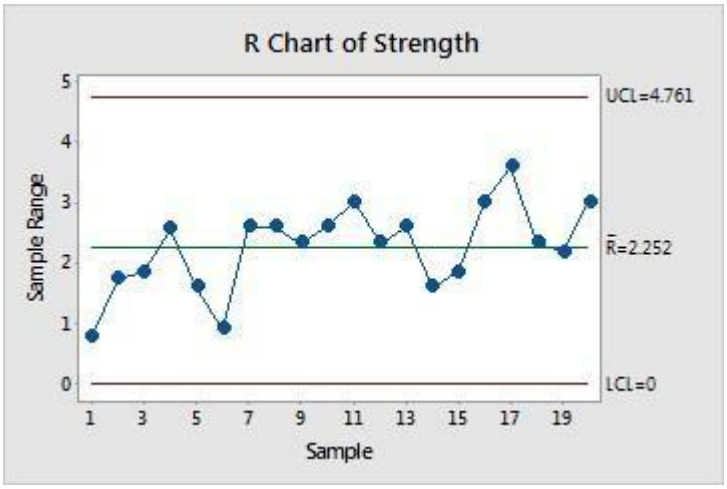
Each point on the graph represents a sub group; that is, a group of units produced under the same set of conditions. For example, you want to chart a particular measurement from your process. If you collect and measure five parts every hour, your subgroup size would be 5.

Variables control charts for subgroups include X bar, R, S, and Zone.



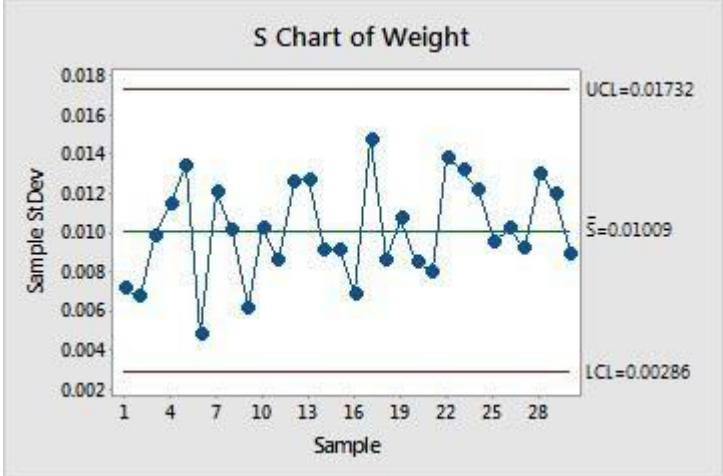
X bar chart

Plots the process mean over time. Use to track the process level and detect the presence of special causes affecting the mean.



R chart

Plots the process range over time. Use to track process variation and detect



unexpected variation.

S chart

Plots the process standard deviation overtime. Use to track the process variation and detect unexpected variation.

Zone chart

Plots the cumulative scores based on"zones"at 1, 2, and 3 standard deviations from the centerline. Use to detect unexpected variation.

CONTROL CHATS FOR ATTRIBUTES:

Attribute data on a control chart is simply the count of products or characteristics of a product that do not conform to some established criteria. The chart becomes a line graph showing the variation in the quality of the process over a period of time.

Types of Attribute Control Charts and Data

Attribute data is a count of non conforming units (defective parts), or the number of on conformities on a unit (number of defects per part). Attribute data does not require actual measurements such as length, width, or torque. It is only necessary to count the number of defects or defective units. Many characteristics of quality can only be measured in this way, such as the presence or absence of a required screw, or the number of bad solder connections on a printed circuit board. Other attribute data may be the result of data that is measurable but recorded as pass or fail, such as that from a GO/NO-GO gauge.

Control charts for attribute data have a number of advantages:

Attribute data is easier to collect and, as a result, less costly to acquire.
Attribute data can be collected from any type of process.
Several types of defects can be grouped on one chart.
Attribute data is easy to understand by all personnel.
Attribute control charts provide an overall picture of the quality of a process and provide useful quality history.

There are also some disadvantages:

An attribute chart does not always provide detailed data for the analysis of individual characteristics. For attribute charts, a part is defective if it has one defective characteristic or many defective characteristics.
Attribute data does not indicated if ferent degrees of defectiveness. A non conforming it may be very defective or slightly defective.
Because of the above disadvantages of attribute data, control charts for attribute data are less sensitive in indicating changes in the process.

How Control Chart Types are Defined

Control chart types are defined by the type of data being charted. There are four types of control charts for attributes. See Table 3.3.1. Control charts that are for the count of non conforming units are called p-charts and np-charts. A unit is nonconforming if it has one or more defects. If the data is in subgroups of varying sizes then the p-chart is used. If the data is collected in subgroups of constant size, then the chart used is an np-chart.
Control charts that count individual
nonconformities or defects on a product are c-charts and u-charts. The c-chart involves subgroups of constant size, and au-chart has subgroups that are not of constant size.

TYPE	WHAT IS COUNTED	SAMPLE SIZE
p-chart	defective items	varies
np-chart	defective items	constant
c-chart	defects on an item	constant
u-chart	defects on an item	varies

Table 3.3.1 Summary of types of attribute control charts.

Elements of a Control Chart for Attributes

Elements of a Control Chart for Attributes A control chart is a two-dimensional line graph (Figure3.3.1). The plotted points represent the given measure of the quality of the process from the data collected at pre determined periods of time. The horizontal axis is divided into rational groups(also called subgroups) — hour to hour, day to day, a lot to lot, etc. The **vertical scale represents** the quantity or percentage of defects per unit or defective units. Three control lines are also drawn horizontally on the control chart — a centerline, upper control limit line, and lower control limit line. The centerline is the average of the number of defects or defective units in the process for the total period of the process being charted. The data used to calculate control limits is also used to calculate the center line.

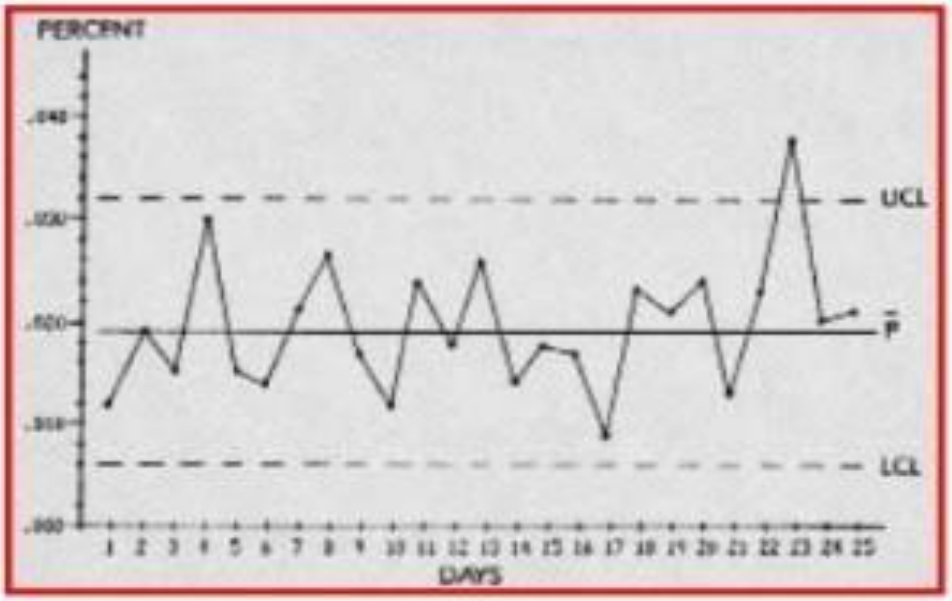


Fig. 3.3.1 Attribute control chart, with cen-terline and control limits.

ACCEPTANCE SAMPLING PLANS

Acceptance sampling is a statistical measure used in quality control. It allows a company to determine the quality of a batch of products by selecting a specified number for testing. The quality of this designated sample will be viewed as the quality level for the entire group of

products.

A company cannot test every one of Its products at all times. There may be too many to inspect at a reasonable cost or within a reasonable timeframe. Also, comprehensive testing might damage theproduct or make it unfit for sale in some way. Testing a small sample would be indicative without ruining the bulk of the product run.

Understanding Acceptance Sampling

Acceptance sampling tests a representative sample of the product for defects.The process involvesfirst, determining the size of a product lot to be tested, then the number of products to be sampled, and finally the number of defects acceptable within the sample batch.

Types Of Acceptance Sampling

There are three main types of the acceptance sampling plan, which are discussed below:

1.SingleSamplingPlan

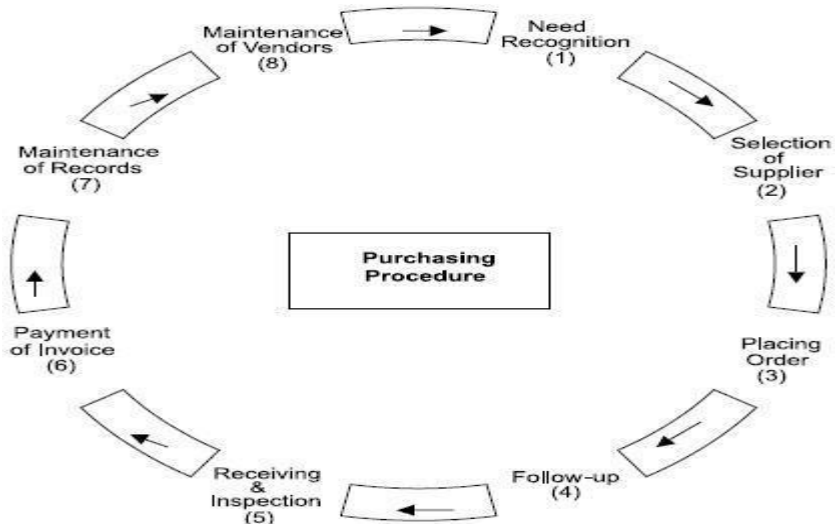
2.DoubleSamplingPlan3

Multiple or Sequential Sampling Plan

- **ADVANTAGES:**

  Significant advantages of acceptance sampling are the following:

- First, it is an affordable method of inspection since the number of items that are tested is quite low in number.
- Less handling of the products indicates that the scope for the damage is low**.**



In most manufacturing industries buyers will have to interact closely with the production department to ascertain their precise requirements.

(c)Though inventory control may or may not be The direct responsibility of the purchasing officer, He is primarily responsible for ensuring that Sufficient supplies of materials or components Are available to maintain continuity of production Or sales.

IMPORTANT QUESTIONS OF UNIT-2

1. **What is automation testing?**
2. **What are the types of automation testing?**
3. **What is the lifecycle of a Quality Assurance Process? Differentiate between Quality Assurance and Testing.**

UNIT-III

Managing for Quality: Basic concepts of quality, dimensions of quality, Juran's quality trilogy, Deming's 14 principles, Quality improvement and cost reduction, ISO9000-2000 clauses & coverage. Six Sigma, Productivity-factors affecting productivity - measurement & improvements in productivity-new product development and design-stages.

BASIC CONCEPTS OF QUALITY:

1 - Quality Assurance

Quality assurance is a way of ensuring that the operational quality standards and requirements, already established, are used in all future development processes, whether of a product or service.

2 - Quality Control

This concept is aimed at fulfilling the quality requirement, and is mainly carried out through inspections. Quality inspection is a procedure that analyzes and assesses whether the attributes of a product or service conform to specified requirements to determine whether a nonconformity has occurred.

3 - Quality Management

Quality management is the coordination of activities in production processes and services so that they are performed with quality. This management aims to achieve excellence in the execution of all tasks and procedures, keeping in mind that the dimensions of quality can be understood as performance, reliability, perception, durability, characteristics, conformity, and service.

In another post, we mentioned the implementation of a Quality Management System (QMS) as one of the steps in Quality Management. But in order for a QMS to guarantee excellent results for your business, it is critical that the team practice and follow the 7 principles of quality:

4 - Focus on customers

Customers are stakeholders in your business, and developing products and services designed for them is a vital strategy for the growth of any company. A good practice for this quality principle is quite simple: agree on the customer's needs in the negotiation, treat them as fundamental requirements to be met, and perform quality inspections with the help of Specifications (standards established in the negotiation).

5. Leadership

Leadership is the ability to lead a team in a tactical and targeted manner, so that the team can perform its tasks with quality. Good leadership allows employee engagement and commitment, and ensures that the entire team is aligned with the company's purposes.

6. People's commitment

The participation and commitment of everyone, including top management members, contributes to an effective Quality Management System. Trained employees understand the importance of quality in their activities, and are thus qualified and prepared to achieve the established goals. Therefore, the culture of quality needs to be part of the company's routine.

7. Approach through processes

This principle is directly related to knowledge, the way a company manages its processes and how it achieves the results planned beforehand. This method is fundamental for the smooth running and excellence of a QMS, because a product or service's level of perfection will depend on the quality of the process management.

8. Continuous improvement

The continuous improvement of services and products can, and should, be employed in the organizational culture. The purpose of continuous improvement is to enhance stakeholder satisfaction, because the more the company strives to improve the quality of its processes, products, and services, the more value it will deliver to its customers.

9. Relationship management

Establishing a good relationship with stakeholders, such as suppliers, is very important to identify needs and avoid risks that impact business strategies. Building relationships with stakeholders fosters a sense of responsibility when it comes to organizational growth.

10. Fact-based decision-making

Decision making based on information, allows the security and efficiency of the actions taken, because with the help of performance indicators, it is possible to analyze which factors are contributing to good results and which ones require more attention and improvement points.Quality concepts are critical and must be viewed as a business strategy. There's no point

in having certifications and not applying these concepts in the company's day-to-day operations. Linked to the business objectives, the quality concepts create advantages, such as increased competitiveness, organization, and excellence in production processes, resulting in the boosting of results

DIMENSIONS OF QUALITY:

1. Performance:

A performance characteristic describes a product's essential function. For a car, performance would include characteristics like millage per gallon, acceleration, handling, cruising speed etc. For a Smartphone, performance would include characteristics like clear phone reception, data speed etc.

2. Features:

Features are a secondary aspect of performance. They're "the bells and whistles" of products and services. They're the ones who add extra functionality to their essential functions. For a car, features would include the built-in GPS, seat warmer, smartphone integration etc. For a smartphone, features could include a high-resolution camera, retina or fingerprint sensor. Sometimes it might be challenging to say which is a performance dimension and which is a feature dimension.

3. Reliability

Reliability is the ability of a product or service to perform as expected over time. For example, if you buy a new car, you do not expect the vehicle to break down frequently. The most commonly used reliability measurements are the Mean Time to Failure (MTTF) and Mean Time Between Failures (MTBF).

4. Conformance

Conformance is the degree to which a product conforms to its specification. For example, when we talk about conformance in software development, we mean that the code complies with the requirements defined by the customer. Quality Guru Philip Crosby defines quality as conformance to requirements.

5. Durability

Durability is the measurement of product life. This defines the amount of use the customer could get from the product before it deteriorates. For example, how long will your car last? Reliability is the probability of failure over a specified period. Durability is measured by the number of cycles or the time a component will function properly as a part of the product life.

6. Serviceability

Serviceability is the ease at which a user can repair a faulty product or get it fixed. It could be measured in terms of how much time and effort it takes to get a faulty product repaired and returned to regular use.

7. Aesthetics

Aesthetics refers to the appearance of a product or service. It includes all aspects related to the physical appearance of a product, for example, the weight, colour, size, texture, packaging design etc.

8. Perceived Quality

Perceived quality is the overall opinion of the customers towards the product. It's the combined effects of factors such as brand name, price, salesperson, marketing strategy etc.
Example: When was the last time you had a positive experience with a bank?

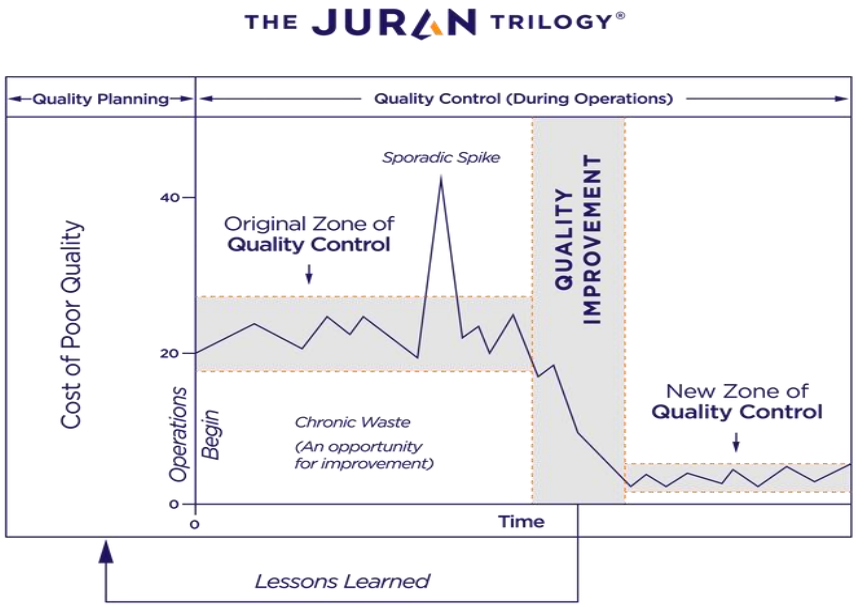
JURAN'S QUALITY TRILOGY:

The Juran Trilogy, also called Quality Trilogy, was presented by Dr. Joseph M. Juran in 1986 as a means to manage for quality. The traditional approach to quality at that time was based on quality control, but today, the Trilogy has become the basis for most quality management best practices around the world.

In essence, the Juran Trilogy is a universal way of thinking about quality—it fits all functions, all levels, and all product and service lines. The underlying concept is that managing for quality consists of three universal processes:

1. Quality Planning (Quality by Design)
2. Quality Control (Process Control & Regulatory)
3. Quality Improvement (Lean Six Sigma)

The Juran Trilogy diagram is often presented as a graph, with time on the horizontal axis and cost of poor quality on the vertical axis.



The initial activity is quality planning, or as we refer to it today, 'quality by design' – the creation of something new. This could be a new product, service, process, etc. As operations proceed, it soon becomes evident that delivery of our products is not 100 percent defect free. Why? Because there are hidden failures or periodic failures (variation) that require rework and redoing.In the diagram, more than 20 percent of the work must be redone due to failures. This waste is considered chronic—it goes on and on until the organization decides to find its root causes and remove it. We call it the Cost of Poor Quality. The design and development process could not account for all unforeseen obstacles in the design process.Under conventional responsibility patterns, the operating forces are unable to get rid of the defects or waste. What they can do is to carry out control—to prevent things from getting worse, as shown. The figure shows a sudden sporadic spike that has raised the failure level to more than 40 percent. This spike resulted from some unplanned event such as a power failure, process breakdown, or human error.As a part of the control process, the operating forces converge on the scene and take action to restore the status quo. This is often called corrective action, troubleshooting, firefighting, and so on. The end result is to restore the error level back to the planned chronic level of about 20 percent.The chart also shows that in due course the chronic waste was driven down to a level far below the original level. This gain came from the third process in Juran's Trilogy—improvement. In effect, it was seen that the chronic waste was an opportunity for improvement, and steps were taken to make that improvement.

Quality Planning (Quality by Design)

The design process enables innovation to happen by designing products (goods, services, or information) together with the processes—including controls—to produce the final outputs. Today many call this Quality By Design or Design for Six Sigma (DFSS)The Juran Quality by Design model is a structured method used to create innovative design features that respond to customers' needs and the process features to be used to make those new designs. Quality by Design refers to the product or service development processes in organizations.

Quality Improvement (Lean Six Sigma)

Improvement happens every day, in every organization—even among the poor performers. That is how businesses survive—in the short term. Improvement is an activity in which every organization carries out tasks to make incremental improvements, day after day. Daily improvement is different from breakthrough improvement. Breakthrough requires special methods and leadership support to attain significant changes and results. It also differs from planning and control as it requires taking a "step back" to discover what may be preventing the current level of performance from meeting the needs of its customers. By focusing on attaining breakthrough improvement, leaders can create a system to increase the rate of improvement. By attaining just a few vital breakthroughs year after year (The Pareto Principle), the organization can outperform its competitors and meet stakeholder needs. As used here, "breakthrough" means "the organized creation of beneficial change and the attainment of unprecedented levels of performance." Synonyms are "quality improvement" or "Six Sigma improvement." Unprecedented change may require attaining a Six Sigma level (3.4 ppm) or 10-fold levels of improvement over current levels of process performance. Breakthrough results in significant cost reduction, customer satisfaction enhancement and superior results that will satisfy stakeholders.

Quality Control (Process Control & Regulatory)

Compliance or quality control is the third universal process in the Juran Trilogy. The term "control of quality" emerged early in the twentieth century.

1. The concept was to broaden the approach to achieving quality, from the then-prevailing after-the-fact inspection (detection control) to what we now call "prevention (proactive control)." For a few decades, the word "control" had a broad meaning, which included the concept of quality planning. Then came events that narrowed the meaning of "quality control."

2. The "statistical quality control" movement gave the impression that quality control consisted of using statistical methods. The "reliability" movement claimed that quality control applied only to quality at the time of test but not during service life. Today, the term "quality control" often means quality control and compliance. The goal is to comply with international standards or regulatory authorities such as ISO 9000.

3. The Juran Trilogy has evolved over time in some industries. This evolution has not altered the intent of the trilogy. It only changes the names. For instance, traditional goods producers call it QC, QI and QP while another may say QA/QC, CI and DFSS. The Trilogy continues to be the means to present total quality management to all employees looking to find a way to keep it simple.

DEMING'S 14 PRINCIPLES:

1. Create a constant purpose toward improvement.

1. Plan for quality in the long term.
2. Resist reacting with short-term solutions.
3. Don't just do the same things better – find better things to do.
4. Predict and prepare for future challenges, and always have the goal of getting better

.

2.Adopt the new philosophy.

1. Embrace quality throughout the organization.
2. Put your customers' needs first, rather than react to competitive pressure – and design products and services to meet those needs.
3. Be prepared for a major change in the way business is done. It's about leading, not simply managing.
4. Create your quality vision, and implement it.

3.Stop depending on inspections.

1. Inspections are costly and unreliable – and they don't improve quality, they merely find a lack of quality.
2. Build quality into the process from start to finish.
3. Don't just find what you did wrong – eliminate the "wrongs" altogether.
4. Use statistical control methods – not physical inspections alone – to prove that the process is working.

4. Use a single supplier for any one item.

1. Quality relies on consistency – the less variation you have in the input, the less variation you'll have in the output.
2. Look at suppliers as your partners in quality. Encourage them to spend time improving their own quality – they shouldn't compete for your business based on price alone.
3. Analyze the total cost to you, not just the initial cost of the product.
4. Use quality statistics to ensure that suppliers meet your quality standards.

5.Improve constantly and forever.

1. Continuously improve your systems and processes. Deming promoted the Plan-Do-Check-Act approach to process analysis and improvement.
2. Emphasize training and education so everyone can do their jobs better.
3. Use kaizen as a model to reduce waste and to improve productivity, effectiveness, and safety.
4. Use training on the job.

6.Train for consistency to help reduce variation.

1. Build a foundation of common knowledge.
2. Allow workers to understand their roles in the "big picture."

3. Encourage staff to learn from one another, and provide a culture and environment for effective teamwork.

7.Implement leadership.

1. Expect your supervisors and managers to understand their workers and the processes they use.
2. Don't simply supervise – provide support and resources so that each staff member can do his or her best. Be a coach instead of a policeman.
3. Figure out what each person actually needs to do his or her best.
4. Emphasize the importance of participative management and transformational leadership.
5. Find ways to reach full potential, and don't just focus on meeting targets and quotas.

8.Eliminate fear.

1. Allow people to perform at their best by ensuring that they're not afraid to express ideas or concerns.
2. Let everyone know that the goal is to achieve high quality by doing more things right – and that you're not interested in blaming people when mistakes happen.
3. Make workers feel valued, and encourage them to look for better ways to do things.
4. Ensure that your leaders are approachable and that they work with teams to act in the company's best interests.
5. Use open and honest communication to remove fear from the organization.

9.Break down barriers between departments.

1. Build the "internal customer" concept – recognize that each department or function serves other departments that use their output.
2. Build a shared vision.
3. Use cross-functional teamwork to build understanding and reduce adversarial relationships.
4. Focus on collaboration and consensus instead of compromise.

10.Get rid of unclear slogans.

1. Let people know exactly what you want – don't make them guess. "Excellence in service" is short and memorable, but what does it mean? How is it achieved? The message is clearer in a slogan like "You can do better if you try."
2. Don't let words and nice-sounding phrases replace effective leadership. Outline your expectations, and then praise people face-to-face for doing good work.

QUALITY IMPROVEMENT AND COST REDUCTION:

The ultimate goal in calculating the cost of quality is to find ways to reduce the cost of good quality and poor quality without reducing the actual quality of your product. A QMS is beneficial for reducing both kinds of costs, as it dramatically increases workflow efficiency while also allowing you to easily keep track of any potential risk or waste during the

production process.

How to reduce cost of production with a QMS:

1. Solve Problems Faster

Reducing costs starts with addressing adverse issues before systemic issues occur. Looking at the most prominent recall cases in recent years, it's clear the costliest problems are those without effective management from the start.

How does a QMS solve problems quicker?

Corrective and Preventive Action (CAPA) process automation: From the review to root cause and actions to follow-up, a QMS keeps Corrective Actions moving forward to ensure problems don't go undetected.It shows which issues you must handle first: When dealing with a laundry list of CAPAs, risk-based filtering allows you to prioritize work, preventing costly delays.Total visibility allows you to pinpoint the source of problems: A QMS can integrate multiple data sources across your organization, from your Manufacturing Execution System to your Supplier Management data. Increasing visibility makes it easier to locate the source of a problem faster.There's no need to put fires out constantly. Instead, embracing the benefits of a quality management system provides a methodical approach to problem-solving. Doing so reduces quality costs by preventing recurrence.

2. Change Management Tools

1. In today's economy, keeping up with the competition involves being able to evolve. However, the sheer cost of any proposed change can make it challenging for companies to stay agile. Ask yourself the following:
2. How can you deter some if you're making the right choice?
3. What can I expect alternatives to cost?
4. How could these changes potentially affect other areas of the company?
5. A QMS reduces the uncertainty involved. With change management tools tracking costs, you can analyze the risks associated with various options and plan for a smooth transition. Using an integrated QMS also simplifies things. It links related processes like Employee Training and Document Control.

3. Reduction of Operational Errors

Don't underestimate the human element when addressing quality problems. For example, you could design the most sophisticated production system imaginable and still have quality problems if your people don't have adequate training. An integrated QMS limits probabilities and impacts of human error. Here are some ways how:

1. It improves Employee Training programs: A QMS ensures your employees receive appropriate training customized to their location, department, and role while allowing you to track proficiency test results.
2. It raises visibility: An integrated QMS gives you real-time data and automated alerts, helping you prevent problems before they occur.
3. It automates workflows: Automated workflows mean you can customize procedures, and a QMS helps standardize your process while ensuring important requests and objectives keep moving.

4. Effective Risk Management

Reducing quality costs requires effective risk management. A quality management system allows you to build risk tools within any process, including bowtie analysis, decision trees, and risk matrices.

Below are several examples:

1. Audit Management: Audits generate massive amounts of data, often leading to an extensive list of potential action items. Audit management capabilities clearly show which items are high-risk (and likely contributing the most regarding quality costs), helping you prioritize follow-up strategically

2. Legislative and Regulatory Requirements: Assessing regulatory compliance may require your company to address multiple gaps. The benefits of a quality management system allow you to identify high-risk gaps to fix first. Doing so ensures you're spending time in the most effective way possible. That includes software validation regulations governing life and health science industries, where up-to-date software is an absolute requirement.

3. Reporting: Centralized reporting capabilities using risk as a common yardstick allow teams to make more informed and strategic decisions and reduce quality costs.

4. Risk-based decision-making is central to continuous improvement. It provides an objective measure to determine whether your work has reduced risk to acceptable levels.

5. Supplier Quality Improvements

Increased production costs are often the direct result of poor supplier quality. An integrated quality management system includes supplier management tools allowing you to benchmark performance, increase supplier communication effectively, and help them understand your company's needs.

How supplier management tools reduce the cost of quality:

1. Detailed supplier ratings allow you to identify your best-performing suppliers and those contributing the most regarding quality costs.
2. Secure cloud-based portals enable suppliers to view open corrective actions, which help them resolve problems faster.
3. Reporting tools provide teams with fast access to data to use in supplier negotiations.

ISO9000-2000 clauses & coverage.:

The ISO 9000:2000 draft review process moving into its last phase, there has been a sudden increase of interest in the scope and interpretation of the new requirements. Registrars, auditors, consultants and course providers are all under pressure to develop their positions on specific, technical issues. Companies using ISO 9000 quality systems are also growing impatient as they wait to find out what they'll need to do to upgrade their systems. The most visible changes are in the structure of the ISO 9000 family of standards and in the sectional organization of the ISO 9001 standard. New requirements are predominantly in the areas of customer-related processes and continual improvement. There are also miscellaneous new

requirements pertaining to process control, measuring and monitoring devices, training and awareness, internal communication, work environment, and legal and regulatory requirements.

Structure

The ISO 9000 series now consists of three standards:

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

ISO 9000 discusses the underlying concepts, approaches and roles of key elements and provides definitions for the new vocabulary. ISO 9000 is not intended to be used as a specification; however, it is named in ISO 9001 as a normative reference and thus can be used by auditors to support their interpretations of ISO 9001 requirements. ISO 9001 is the actual specification for the quality management system. Its requirements define the criteria for the quality system audit. The role of this standard in the series has not changed, but its content and sectional organization are completely revised. Quality system requirements are now organized into four sections:

Section 5 -- Management Responsibility;

Section 6 -- Resource Management;

Section 7 -- Product and/or Service Realization;

Section 8 -- Measurement, Analysis and Improvement.

This new organization makes ISO 9001 more compatible with the ISO 14001 (environmental) standard, and is consistent with ISO 9004's Plan-Do-Check-Act improvement cycle. It also corrects the undue emphasis on the manufacturing industries that characterized previous editions.

ISO 9002 and ISO 9003 will be discontinued. Instead of choosing a standard with the appropriate scope, all companies will now use ISO 9001, but they're allowed to reduce the scope of the standard to exclude requirements that don't apply. The reduction of scope may only be applied to Section 7 -- Product and/or Service Realization, and exclusions may not affect the organization's ability to meet requirements. Reduction of scope must be clearly identified in the quality manual. The role of ISO 9004 in the series is unchanged. As in previous editions, it's a guide for developing quality management systems. However, it has been completely rewritten to align it with the new ISO 9001. ISO 9004 is not named in ISO 9001 as a normative reference, and thus it can't be used to define audit criteria for the ISO 9001 certification audit.

Overview of new requirements

The most important new requirements in ISO 9001:2000 concern customer- related processes and continual improvement. With regard to customer processes, the new requirements call for identifying customer requirements, needs and expectations; determining customer satisfaction; establishing procedures for customer communication; and making employees aware of the importance of meeting customer requirements. In the area of continual improvement, the new requirements concern the quality policy, quality objectives, quality planning, quality

performance data and management reviews. There are also miscellaneous new requirements for process control, measuring and monitoring devices, training and awareness, internal communication, work environment, and legal and regulatory requirements.Rather than being grouped in specific, additional clauses, the new requirements are spread throughout the standard and are often restated and expanded under several sections. For example, requirements pertaining to process control are first introduced in Section 5, are developed in two separate clauses of Section 7, and then are restated in Section 8. This approach follows the logic of the standard's new organization, but it also makes it difficult to identify and interpret the requirements. Often the intent of the standard can be interpreted only after related requirements are culled from different sections and analyzed together.

Customer-related processes

ISO 9001:1994 had two clauses directly relevant to customer-related processes: Clause 4.3 -- Contract Review and Clause 4.7 -- Customer-Supplied Product. In the new revision, both clauses have been renamed and edited, but the underlying requirements are basically unchanged. The corresponding clauses in ISO 9000:2000 are 7.2.2 -- Review of Customer Requirements and 7.5.3 -- Customer Property.

In addition to these two, there are six new clauses relevant to customer-related processes:

- Clause 5.1 requires top management to demonstrate its commitment to creating awareness of the importance of fulfilling customer requirements.
- Clause 5.2 requires top management to ensure that customer needs and expectations are determined and converted into specific requirements.
- Clause 5.6.3 requires that the management representative ensure awareness of customer requirements throughout the organization.
- Clause 7.2.1 requires the organization to implement a process for identifying customer requirements. The process is to include requirements that are not specified but are necessary for fitness of purpose; requirements dictated by laws and regulations; and requirements for availability, delivery and support.
- Clause 7.2.3 requires the organization to define and implement arrangements for communication with customers.
- Clause 8.2.1.1 requires the organization to establish a system for obtaining and using information on customer satisfaction and dissatisfaction.

Together, these clauses seem to demonstrate that the standard now requires organizations to include in the quality system all departments and functions that deal with and represent customers. Typically, these would include marketing, sales, customer service, billing and servicing. Once this intent is understood and accepted, interpretation and implementation of all underlying requirements will follow naturally. Like everyone else in the system, these functions must develop effective methods and processes, document them in procedures, and maintain records of their activities. To be sure, there will be a lot of resistance to such a sweeping interpretation in many companies. Marketing and sales people genuinely care about the quality of the product or service they sell, but they don't necessarily see their own work as being directly relevant to quality. Many engineers had this kind of adverse reaction when ISO 9000 asked them to define their methods and write procedures for the design and development process.

The effort necessary to implement the new requirements will depend on the complexity of marketing, sales and customer service operations, and on how much documentation already exists. Typically, implementation will consist of the following actions:

- Revising existing contract review procedures and/or developing new procedures to document the processes for identification of customer requirements
- Developing a new procedure for measuring customer satisfaction and dissatisfaction, which may incorporate or reference the existing procedure for customer complaints
- Developing procedures and work instructions defining arrangements for communication with customers in matters pertaining to product information, order handling, customer complaints and customer feedback
- Establishing programs for creating awareness of customer requirements and the importance of meeting these requirements
- Developing measures to ensure that customer needs and expectations are determined and converted into specific requirements. A written procedure is not explicitly required, but there must be a means of demonstrating conformance.

Continual improvement

ISO 9001:2000 doesn't actually have a clause named "Continual Improvement," which is curious because references to that concept are everywhere. Many of the elements supporting the continual improvement cycle were already required in previous editions of the standard. But now there is a new, stronger linkage between these elements, and there are several completely new requirements. Identifying the requirements that pertain to continual improvement is not a precise science. The following requirements are all new; whether they're discussed here or under another heading doesn't really matter:

- Clause 5.4 requires the quality policy to include commitments to meeting requirements and to continual improvement, provide a framework for establishing and reviewing quality objectives, and be periodically reviewed for continuing suitability.
- Clause 5.5.1 requires the organization to establish quality objectives supporting the quality policy and the commitment to meet requirements and pursue continual improvement.
- Clause 5.5.2 requires the organization to identify and plan activities and resources needed to achieve quality objectives.
- Clause 5.7 requires the management review to evaluate the need for changes to the quality system, policy and objectives and include review of performance and improvement opportunities. It also requires the outputs from the management review to include actions related to improvement of the quality system, audits and resource needs.
- Clause 8.4 requires the organization to collect and analyze data to determine the effectiveness of the quality system and to identify where improvements can be made.
- Clause 8.5.1 requires the organization to establish a procedure for the use of quality policy, objectives, and quality-related data and information to facilitate continual improvement.

These clauses clarify how the cycle of continual improvement is intended to work. General policies (Clause 5.4) create a framework for more specific objectives (Clause 5.5.1) that are

supported by planned activities and resources (Clause 5.5.2). The organization collects and analyzes data to determine the effectiveness of the implemented activities (Clause 8.4). The quality policy, objectives and data on quality performance are input into the management review (Clause 8.5.1), which then outputs changes to the policy, shifts in objectives and actions to improve the system (Clause 5.7). It's imperative to understand these clauses as elements of such a continual cycle and to create appropriate interfaces and linkages.

This basic structure for continual improvement is supported by many other elements of the quality system. Some of these elements have already been required in previous editions of the standard, but others (such as activities for collecting quality performance data, internal audits and measurement of customer satisfaction) are new. Indeed, it can be argued that each and every element of the quality system has a role in the continual improvement cycle.

Implementation of these requirements will include:

- Revision of the quality policy to include commitments to meeting requirements and to continual improvement
- Establishment of quality objectives consistent with the quality policy and the commitment to continual improvement
- Establishment of plans to achieve quality objectives
- Development of a new procedure for collecting and analyzing quality performance data
- Development of a new procedure for using relevant information and data to facilitate continual improvement
- Revision of the existing management review procedure to address new requirements concerning the scope and output of the review

Training, awareness and communication

Training requirements in ISO 9001 :2000 are considerably broader. Most of Section 6 -- Resource Management is dedicated to training and related issues. In addition to the old requirements for identifying training needs, providing training, assigning qualified personnel and maintaining records, the standard now also requires organizations to evaluate the effectiveness of training and establish employee awareness programs.

There are also new requirements for internal communication in Section 5 -- Management Responsibility. Although these requirements are not specifically linked to training, it will be natural to integrate training and employee awareness programs with the communication system.

The following clauses include requirements pertaining to training, awareness and communication:

- Clause 5.1 requires top managers to demonstrate their commitment to creating an awareness of the importance of fulfilling customer requirements.
- Clause 5.6.3 requires the management representative to ensure awareness of customer requirements throughout the organization.
- Clause 5.6.4 requires the organization to establish a procedure for internal communication regarding the quality management system.
- Clause 6.2.2 requires the organization to evaluate the effectiveness of training and establish procedures for making employees aware of the importance of the quality management system and of their own roles in achieving conformance with policies, objectives and requirements.

Implementation of these requirements will include:

- Revision of the training procedure to define how training effectiveness is evaluated
- Establishment of employee awareness programs (documented in procedures)
- Development of new procedures for internal communication

Process control

Requirements related to process control are concentrated in Section 7 -- Product and/or Service Realization, particularly in Clause 7.1 -- General Requirements and in Clause 7.5.5 -- Validation of Processes. Clause 7.1 includes a long and detailed list of formal process control measures and activities, but doesn't clearly state the extent to which implementation of these measures is mandatory.

The clause states that "The organization shall determine how each process affects the ability to meet product and/or service requirements and shall determine and implement criteria and methods to control processes, to the extent necessary, to achieve product and/or service conformity with the customer requirements." If this means that process control measures must be sufficient to eliminate the occurrence of nonconformity, it's the same as requiring implementation of the best-known process control system for each process. But this could not be the intent of the standard. If such a requirement were to be enforced, it would cost billions of dollars. On the other hand, if this clause means that process control measures are sufficient as long as the shipped product conforms to requirements, one could comply by inspecting and segregating nonconforming product without any process control measures at all. Again, this could not be the intent of the standard. The criteria for selecting and implementing appropriate process control systems must be somewhere in between, but the standard fails to specify where. There is also a process control-related requirement in Clause 8.2.2. The requirement is to " apply suitable methods for measurement and monitoring of processes necessary to meet customer requirements and to demonstrate the process's continuing ability to satisfy its intended purpose." Here, again, the language is indefinite. It could imply formal process capability and process performance studies, but could also mean a simple inspection of output. It will be a challenge for auditors to find a nonconformance based on this clause. Because the new standard fails to provide any meaningful criteria for selecting and implementing process control measures, one can argue that nothing has changed from the previous editions. Organizations can still decide on their own how they want (or don't want) to control their processes. Auditors can only require that each process be reviewed for relevant process control measures, and that the implemented process control systems are properly operated and maintained.

Lack of clarity aside, it's obvious that the new standard has moved significantly toward requiring implementation of formal process control systems for all relevant processes. Process control is no longer an optional activity expected only in special industries such as automotive or aerospace. With this new standard, auditors will expect every organization, regardless of the nature of its product or service, to have the knowledge of process control techniques and systematically evaluate all processes to determine which should be controlled and how.

The following clauses contain new requirements relevant to process control:

- Clause 7.1 requires organizations to determine and implement the criteria and methods to

control processes to the extent necessary to achieve product conformity and consistent operation; to monitor processes, including measurement and follow-up actions, to ensure that processes continue to operate satisfactorily; and to maintain records of the results of process control measures.

- Clause 8.2.2 requires application of suitable methods for measurement and monitoring of processes

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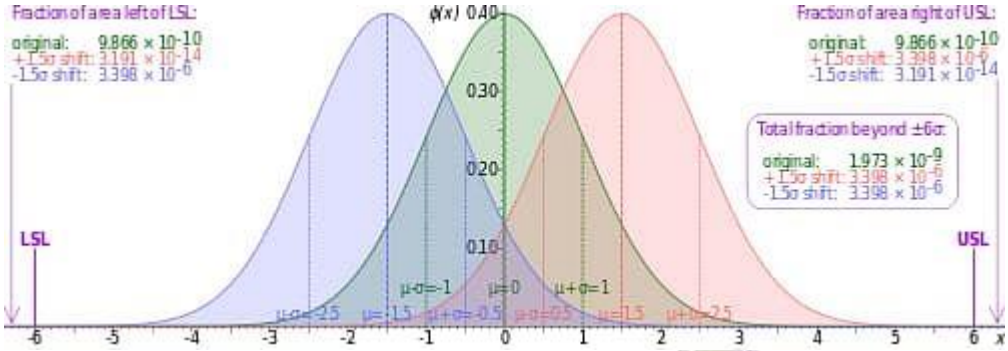
Overall, ISO 9001:2000 is a much better standard than its predecessors. It represents a more modern approach to quality management and is closer to current management system thinking. The most important improvements are the reorganization of the standard to follow the Plan-Do-Check-Act loop, the introduction of systems and activities to facilitate continual improvement, greater emphasis on employee awareness and involvement, and the incorporation of functions representing the voice of the customer into the quality system.

On the negative side, the standard introduces these new ideas and concepts with some hesitation and a lack of conviction. A typical example is Clause 5.5.1 -- Objectives. It calls for establishment of quality objectives, but there are no specific requirements for defining the process for establishing the objectives and no requirements for developing programs to support, monitor and review the objectives. The same is true for the identification of customer needs and expectations and many other new elements. At this stage, it seems that the standard only introduces the new concepts without requiring proper structures to implement them.

SIX SIGMA:

The term "Six Sigma" refers to a statistical measure of how far a process deviates from perfection. A process that operates at six sigma has a failure rate of only 0.00034%, which means it produces virtually no defects. Six Sigma was developed by Motorola in the 1980s, and it has since been adopted by many other companies around the world, including General Electric, Toyota, and Amazon. It is used in industries such as manufacturing, healthcare, finance, and service industries to improve customer satisfaction, reduce costs, and increase profits.Six Sigma is a set of methodologies and tools used to improve business processes by reducing defects and errors, minimizing variation, and increasing quality and efficiency. The goal of Six Sigma is to achieve a level of quality that is nearly perfect, with only 3.4 defects per million opportunities. This is achieved by using a structured approach called DMAIC (Define, Measure, Analyze, Improve, Control) to identify and eliminate causes of variation and improve processes.The etymology is based on the Greek symbol "sigma" or "σ," a statistical term for measuring process deviation from the process mean or target. "Six Sigma" comes from the bell curve used in statistics, where one Sigma symbolizes a single standard deviation from the mean. If the process has six Sigmas, three above and three below the mean, the defect rate is classified as "extremely low."

The graph of the normal distribution below underscores the statistical assumptions of the Six Sigma model. The higher the standard deviation, the higher is the spread of values encountered. So, processes, where the mean is minimum 6σ away from the closest specification limit, are aimed at Six Sigma.



The 5 Key Principles of Six Sigma

The concept of Six Sigma has a simple goal – delivering near-perfect goods and services for business transformation for optimal customer satisfaction (CX).

Goals are achieved through a two-pronged approach:

Six Sigma has its foundations in five key principles:

1.**Focus on the Customer**

This is based on the popular belief that the "customer is the king." The primary goal is to bring maximum benefit to the customer. For this, a business needs to understand its customers, their needs, and what drives sales or loyalty. This requires establishing the standard of quality as defined by what the customer or market demands.

2.**Measure the Value Stream and Find Your Problem**

Map the steps in a given process to determine areas of waste. Gather data to discover the specific problem area that is to be addressed or transformed. Have clearly defined goals for data collection, including defining the data to be collected, the reason for the data gathering, insights expected, ensuring the accuracy of measurements, and establishing a standardized data collection system. Ascertain if the data is helping to achieve the goals, whether or not the data needs to be refined, or additional information collected. Identify the problem. Ask questions and find the root cause.

3.**Get Rid of the Junk**

Once the problem is identified, make changes to the process to eliminate variation, thus removing defects. Remove the activities in the process that do not add to the customer value. If the value stream doesn't reveal where the problem lies, tools are used to help discover the outliers and problem areas. Streamline functions to achieve quality control and efficiency. In the end, by taking out the above-mentioned junk, bottlenecks in the process are removed.

4.**Keep the Ball Rolling**

Involve all stakeholders. Adopt a structured process where your team contributes and collaborates their varied expertise for problem-solving.Six Sigma processes can have a great impact on an organization, so the team has to be proficient in the principles and methodologies used. Hence, specialized training and knowledge are required to reduce the risk of project or re-design failures and ensure that the process performs optimally.

5.Ensure a Flexible and Responsive Ecosystem

The essence of Six Sigma is business transformation and change. When a faulty or inefficient process is removed, it calls for a change in the work practice and employee approach. A robust culture of flexibility and responsiveness to changes in procedures can ensure streamlined

project implementation. The people and departments involved should be able to adapt to change with ease, so to facilitate this, processes should be designed for quick and seamless adoption. Ultimately, the company that has an eye fixed on the data examines the bottom line periodically and adjusts its processes where necessary, can gain a competitive edge.

PRODUCTIVITY-FACTORS AFFECTING PRODUCTIVITY - MEASUREMENT & IMPROVEMENTS IN PRODUCTIVITY-NEW PRODUCT DEVELOPMENT AND DESIGN-STAGES

PRODUCTIVITY MEANING:

Productivity refers to the physical relationship between the quantity produced (output) and the quantity of resources used in the course of production (input). "It is the ratio between the output of goods and services and the input of resources consumed in the process of production."

$$\text{Productivity } (P) = \frac{\text{Output } (O)}{\text{Input } (I)}$$

Output implies total production while input means land, labour, capital, management, etc. Productivity measures the efficiency of the production system. The efficiency with which resources are utilized is called productive efficiency. Higher productivity means producing more from a given amount of inputs or producing a given amount with lesser inputs.

At the level of a plant or an industry productivity is an output-input ratio. But at the macro level, productivity is a measure of performance of an economy or country. From a nation's viewpoint productivity is the ratio of available goods and services to the potential resources of the country. Productivity means an economic measure of output per unit of input. Output refers to the total production in terms of units or in terms of revenues while input refers to all the factors of production used like capital, labour, equipment, etc. Productivity is a good indicator of the efficiency with which a factory is operating. If a firm has higher productivity, i.e. it produces more with a given amount of inputs, it means it is utilizing the resources properly.

Similarly, a lower productivity indicates wastage of resources and time. It is vital to have a high productivity rate because resources like capital and time are scarce and should be exploited in the best possible way. Productivity can be calculated as the ratio of the volume of output to the volume of inputs.

Factors That Affect Productivity

There are many barriers to productivity in the workplace. We've highlighted some of the most common organizational barriers to productivity.

1. **Work Environment**

1. As you can imagine, no one enjoys working in a negative or toxic environment. Make sure to create a workplace atmosphere that is based on your company's values, where your employees feel supported, valued, and safe.
2. Put honesty and co-operation first, remember to reward your employees when they deserve it. Give your employees access to the right environment where they can

cooperate, compete, and emphasize with their co-workers. This type of environment helps your employees develop healthy work habits, which contributes to creating a productive workforce.

2. Training & Career Development Opportunities

Every employee wants to grow in their career, so it's essential that they feel like their employer is invested in their professional development and provides them with the relevant training opportunities throughout their journey in the company.

If you don't have a training program yet, it might be time for you to develop one. An untrained employee would not know what they need to do or how to do it more efficiently, which can negatively affect productivity. One good way of facilitating training programs is through microlearning. This human resources tool gives your new employees the information they need and the knowledge they need to thrive in the office.

Plus, make sure each team member has a chance to grow within the company hierarchy, and won't end up feeling stuck in the same position for too long.

3. Processes

From recruiting to on boarding, compensation, performance management, task delegation and more: establishing processes for your company will allow you to provide your employees with positive experiences from the get-go. Developing these processes can be time-consuming and it is very much a matter of trial and error. However, once you have them, you'll be a lot more organized and efficient - and so will the rest of the team. Companies with high productivity levels build processes for most of their recurring tasks and projects.

For example, many organizations often overlook employee surveys. This can lead to workers feeling neglected and unseen, which can negatively affect employee productivity. However, implementing a project management tool can help your HR managers facilitate job satisfaction surveys easily. Another example is employee off boarding. When a worker leaves, many managers often forget to revoke the worker's platform access, which can lead to data privacy issues. With an employee and project management tool, your HR personnel can easily remove the outgoing employee's ability to access confidential information and company tools with a few clicks. This makes it easier for your HR department to off board an employee, as well as increase employee's productivity as it allows them to focus their time on another particular task.

4. Pay Structure

Your employees have bills to pay, children to take care of, and goals to accomplish, and the monetary benefits are obviously one of the reasons why they took a job in your company. Use this as a motivational tool, by explaining clearly and transparently how your pay structure works and what you consider when deciding if an employee deserves a promotion and raise.

5. Employee Wellness

Employee wellness has become a popular topic over the past few years, and it refers to the physical and mental health of your team members. As an employer, you want to provide your employees with all the tools and resources they might need whenever they don't feel their

best, as doing so will show them that you care and also prevent small problems from developing into something more serious. Creating a wellness program, offering healthy food options at the office cafeteria, and encouraging your workers to put their welfare first help create a healthy and happy employee and could greatly boost employee productivity. Another way your company can have a positive impact on employees productivity levels is by encouraging workers to lead a healthier lifestyle. This can be done by giving them access to physical activities that encourage them to get off their seats and move. You can also propose them to have a "walk to work" day or give them more storage spaces to store their office equipment.

IMRPOVEMENT IN PRODUCTIVITY

1. Keep things simple

While having a productivity strategy is key, it doesn't have to be elaborate. Creating a simple, focused plan with clear steps and outcomes helps people stay on task and sets them up for success. so everyone knows exactly what to do.

2. **Set reminders**

Smart calendars and reminder apps like Today's track what needs to be done on specific days and times, so your brain doesn't have to. More importantly, you can integrate them with collaboration tools like slack that let you organize by channels, topics and teams. Set major milestone alerts and notifications at the team level and have individuals set their own tasks within the same channel for more granular items.

3. **Review goals daily (or at least regularly)**

Setting goals is one of the most important parts of any business strategy. But they mean nothing if they aren't consistently being reviewed and revised. After establishing clear goals, make sure everyone has a way to check progress daily. If daily doesn't make sense in a given scenario, set realistic expectations, like sending weekly progress summaries or responding within 48 hours.

4**. Minimize time-wasting activities**

Whether at home or in the office, countless things can steal our attention away from work. Successful managers know this and tee up ways to combat the worst of them. Here's how to avoid some common productivity killers:

Meetings: Limit the number of meetings you have and who attends them. If a meeting is absolutely necessary, it should have a clear, focused agenda, time limits by topic and end as soon as there's a resolution (yes, we want our 15 minutes back!).

Emails: There are many faster ways to get or share information than email. Send a quick slack message or Dm launcha important video chat or (gasp) pick up the phone. Connecting directly through real-time tools is almost always more efficient.

Coworkers: While you always want a good rapport with colleagues, there's a time and place

for personal conversations. Provide opportunities for people to have lunches together, offer video happy hours, create topical chat channels and encourage other activities to connect outside of work time.

Lack of organization: Disorganization forces people to waste time looking for what they need (see: 5,000-email inbox). Beyond clean desks and well-labeled folders, organizing digital workflows can dramatically increase productivity. For example, managing teams through Slack allows you to search conversations by channel, share files within projects, pin important docs for faster access and launch meetings all in one place.

Social media: According to GlobalWebIndex's "2021 Social Media Trends" report, people spend an average of nearly two and half hours per day on social media platforms. Have a policy in place that clearly states when it's OK to use social media and when to focus on work.

Procrastination: We all do it. The best way to prevent it is through clearly stated deadlines and accountability. Every person who has a due date for their project should have someone following up with them, ensuring that the target is met. You can also use goal-tracking tools like Coach.me or ATracker.

5. Use productivity apps

Technology can be our biggest help and our biggest distraction. When used for good, apps can significantly boost business productivity. Some of the most popular productivity apps include:

1. Slack
2. Todoist
3. Dropbox
4. Evernote
5. Asana

6. Motivate your team

One of the most difficult (and important) business growth strategies is keeping your team members motivated. The "how" might be different for just about anyone you ask. So it's crucial to have a clear understanding of what's most important to each person you work with.Finding a balance between intrinsic and extrinsic motivation is key to reaching the productivity sweet spot. Intrinsic motivation promotes self-reflective benefits that make a person want to be successful for no other reason than their own personal satisfaction. On the flip side, extrinsic motivation provides external rewards for good behavior and reaching goals, like extra vacation days or a company party.

NEW PRODUCT DEVELOPMENT STAGES

Stage 1: Idea Generation

The goal should be to generate many worthy ideas that can form the foundation for the New Product Development strategy. The major focus for stage 1 should be to arrange brainstorming sessions where solving customer problems is given precedence. This phase is not about generating foolproof ideas that are ready for implementation. Instead, raw and unproven ideas that can be shortlisted later should be discussed.

Here's how a business can do that:

1. Emphasize on Customer Problems

The problem that is well described is a problem half-solved. Here's how to identify the issues that the target audience is facing:

a. Personal Problems

It is a good idea to look at problems the business is facing to come up with the idea. All a business needs to focus on that specific problem and build a solution that can be tagged as a "one for all" solution to the common problem. To start with, a business needs to understand the human story behind digital offerings.

For instance, Jeff Lawson, the founder of Twilio, has an interesting story behind its communication-based software product launch. He was associated with three business companies in the past, and all of them lacked one thing — Productivity. When he was driven to start again with something of his own, he knew that he needed to cover up the communication gaps as these were, in his experience, the biggest hurdles on the path to productivity. That is when product innovation happened in the form of Twilio. The product building and launching had their ups and downs, but his conviction to have this product led to a great business idea.

Here is an inspiring extract of his speech from the Web Summit.

b. Qualify Each of the Listed Problems

This step helps check the feasibility of the shortlisted problems and their solutions based on the 4U approach by Michael Skok, the founder of Startup Secrets.

The 4U stands for:

Taking a deeper look at each of these aspects in detail will provide greater clarity.

Unworkable: Figure out whether the brainstormed product concepts will address some real problems. Will the product be able to fill the existing customer experience gaps and will the product achieve product-market fit?

Unavoidable: Is the problem the product will address unavoidable to the extent that it becomes mandatory to comply? It is necessary to find out whether solving that problem is a choice or a compulsion.

Urgent: Is the problem urgent and is a solution highly demanded by the target market? If the answer is affirmative, this could be a chance to cover the white space in the market with the original product.

Underserved: Are there no available products that address the existing user problems? Look for the whitespace in the market and hold on to the idea that looks promising.

c. Coming Up With Possible Solutions

If a problem has been identified, it's time to look for possible solutions. For every user problem, there ought to be potential New Product Development opportunities. Here's the workflow that starts with a problem and ends with strategizing around the solution. In all, no matter how common or uncommon the problem is, the solution should be unique. Even if a product already exists, ensure that the product can solve problems differently.

For instance, Slack and Zoom are both SaaS products that focus on promoting communication and collaboration. Zoom, however, does this differently by also enabling the conducting of webinars. In other words, webinars are their unique selling point (USP).

d. Narrowing Down Problems + Solutions

Create a comparison chart that lists all the shortlisted problems and solutions. Circulate the findings across the organizational structure to develop a viable problem set. If the stakeholders are not convinced regarding the shortlisted idea, try the Replicate, Re-Purpose, and Upgrade approach.

Replicate: This focuses on creating a similar product as that of a competitor but launching it in new market conditions. When done with launching the minimum viable product (MVP), the strategy should be to expand the business by introducing out-of-the-box and unique features later on.

Re-Purpose: This focuses on rewiring an existing business model. For instance, LinkedIn introduced LinkedIn Learning, an e-learning platform for professionals. This product was similar to an e-learning platform for students. However, they built new opportunities for expanding the target audience and market share.

Upgrading: This concept of New Product Development revolves around introducing a new business model that is better than existing solutions. Better could mean improved performance, better speed, addressing the challenges that a competitor is facing, or introducing added functionalities.

Stage 2: Idea Screening

This New Product Development stage revolves around choosing the one idea with the highest potential for success. Put all the ideas available on the table for internal review. That is, turn to people with industry knowledge and experience in the field for idea screening. A proof of concept (POC) should hold precedence for a new product development idea as it helps check the idea's feasibility. There is no point in zeroing in on an idea that is not technically feasible to build. Consult the Agile Development team. Their expertise can help with understanding the technical side of things, which, in turn, can assist with short listing ideas worth building a PoC for. SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis can be another good practice to consider when short listing New Product Development ideas.

In a SWOT analysis, the Agile Development team, the product owner, the scrum master, and the product manager conduct a detailed analysis of the idea to identify an idea where strengths and opportunities overpower threats and weaknesses. Conducting a SWOT is relatively simple. Getting started only requires a simple 2×2 grid: In conclusion, the New Product Development idea should be unique so that people do not need to be convinced to pay for it.

Stage 3: Concept Development & Testing

Before starting the New Product Development process, building a detailed version of the idea and the user stories should be prioritized. This value proposition evaluation is the first step towards concept development and testing. At the very least, it ensures that problems in the approach are discovered sooner and the team can course-correct earlier. That helps to ensure that technical debts will not accumulate. There is a 17% chance that [your] startup's idea fails, just because it was a poor product. — CBI Insights

The easy-to-follow concept development steps include:

1. Quantifying Gain/Pain Ratio

A business needs to create an insightful picture of the product from the user's perspective. This can be achieved by calculating the gain/pain ratio, where:

Gain = Benefits of the product for the customer. What is in it for them?

Pain = The efforts made by the customer to understand and use the product.

2. Conducting a Competitor Analysis

Knowing about existing market players is a critical strategic step to consider. Understanding the competition makes it easier to infer:

1. Where the competitor lacks
2. Where is the scope for improvement
3. Existing white space in the market

3. Enlisting the Major Product Features

The user stories involved in the New Product Development software project will make or break a business. When creating a list of such features, it is imperative to know — how is it an innovative feature, and how is it going to solve a problem?

4. Create a Value Proposition Chart

Even after being convinced of the wisdom & the utility of an idea, being able to state it clearly to the end-user, in their context, is quite a different story altogether. The end-user needs to be given a clear picture of what the new product is capable of doing. This clean & presentable fashion can be best represented in the form of a value proposition chart. The format of which should include:

UNIT-IV

Inventory and Inventory Models: Inventory Control-Different Systems of Inventory Control, Costs & Types of Inventory - ABC, VED. Value Analysis - importance in cost reduction - concepts and procedures. Inventory control -Types of Inventory-Safety stock - Inventory Control Systems-JIT.

INVENTORY MODELS:

Economic Order Quantity (EOQ)

The Economic Order Quantity inventory management method is one of the oldest and most popular. EOQ lets you know the number of inventory units you should order to reduce costs based on your company holding costs, ordering costs, and rate of demand.
Here's how to calculate your EOQ:

Economic Order Quantity

$$\frac{\sqrt{(2SD)}}{\text{Production Costs}}$$

S = Setup (Order) Costs
D = Demand Rate

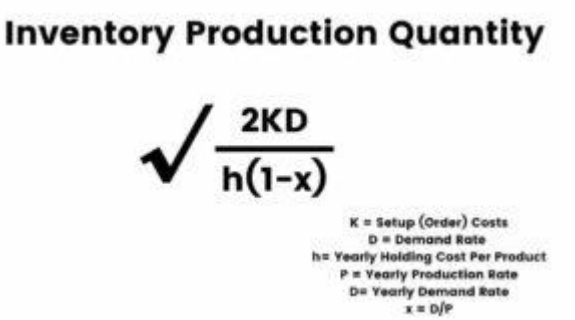
Take the square root of (2SD) / Production Cost
S is your setup (order) costs
D is your demand rate (units)
But the EOQ makes some big assumptions that won't work for every company. It assumes your rate of demand, ordering costs, and unit price of inventory is *constant*. So if you tend to have periods of time where the demand for your products is a lot lower or higher than other periods, the EOQ number will be meaningless.

Inventory Production Quantity

Also known as Economic Production Quantity, or EPQ, this inventory control model tells you the number of products your business should order in a *single batch*, in hopes of reducing holding costs and setup costs. It assumes that each order is delivered by your supplier *in parts* to your business, rather than in one full product.

This model is an extension of the EOQ model. The difference between the two models is the EOQ model assumes suppliers are delivering inventory *in full* to your customer or business.

Here's how to calculate your Inventory Production Quantity:



Take the square root of (2SD) / Production Cost (1 – x)

S is your setup (order) costs

D is your demand rate (units)

X is your Demand Rate / Production Rate

This model could be a good fit for your business if:

Your business tends to order inventory from suppliers in parts rather than one full order, such as for an automotive company.

Demand for products is consistent over periods of time.

Inventory Control-Different Systems of Inventory Control

1. Raw materials

Raw materials are inventory items used in the manufacturing process to create finished goods. What is considered a raw material to one company may be considered finished goods to another. For example, a company that creates parts or components for machinery or equipment would consider those components finished goods. A manufacturer that purchases those components for use in their manufacturing process would consider the same components raw materials. Raw materials may consist of things like paper or steel, nuts and bolts, chemicals, wheels, and other items.

2. Work-in-progress

Work-in-progress (WIP) inventory includes items that are currently being processed. WIP inventory can include raw materials and components that are going through the manufacturing process to produce finished goods as well as finished items that are waiting for final inspection or quality control. After those final steps are complete, these finished items would be considered finished goods.

3. Finished goods

Finished goods are comprised of all completed items that are ready for sale to the final customer.

4. MRO goods

MRO stands for maintenance, repair, and operations supplies. MRO inventory consists of items necessary to operate, such as equipment and machinery, and the items needed for maintaining equipment and infrastructure. That means MRO inventory can also include items that are sometimes considered raw materials but in this case are essentially spare parts. Nuts and bolts are a good example. When nuts and bolts are on hand to assemble finished products, they'd be classified as raw materials. Extra nuts and bolts a company keeps in storage to repair equipment, on the other hand, are classified as MRO. Other examples of MRO inventory include janitorial supplies such as cleaning solutions, mops, and brooms, tools, packaging materials, uniforms and gloves, and office supplies such as paper, pens, calculators, printer ink, and other items. Inventory can be further classified in several ways depending on the industry, the company's operations, and the types of inventory the company manages. Companies that purchase finished goods and sell them to customers at a markup have just one type of inventory called merchandising inventory. Some companies, such as manufacturers, need to manage a variety of inventory in different classifications, making efficient inventory tracking a must. To effectively manage inventory, an inventory tracking solution is paired with an **inventory control app or inventory management app**.

Costs & Types of Inventory - ABC, VED. Value Analysis

ABC Analysis

ABC analysis in inventory control classifies stocks based on their importance, price, and sales volume. These criteria determine the number of items a company will bring to the market.

Just as its name suggests, it consists of the following categories:

A class – expensive, high-class items with tight controls and small inventories

B class – average-priced, mid-priority items with medium sales volume and stocks

C class – low-value, low-cost items with high sales and huge inventories

Applying the ABC analysis of inventory control allows businesses to minimize the costs of carrying products while maximizing their stock returns.

VED Analysis

Meaning of VED Analysis

VED analysis is an inventory management technique that classifies inventory based on its functional importance. It categorizes stock under three heads based on its importance and necessity for an organization for production or any of its other activities. VED analysis stands for Vital, Essential, and Desirable.

V-Vital category

As the name suggests, the category "Vital" includes inventory, which is necessary for production or any other process in an organization. The shortage of items under this category can severely hamper or disrupt the proper functioning of operations. Hence, continuous checking, evaluation, and replenishment happen for such stocks. If any of such inventories are unavailable, the entire production chain may stop. Also, a missing essential component may be of need at the time of a breakdown. Therefore, the order for such inventory should be beforehand. Proper checks should be put in place by the management to ensure the continuous availability of items under the "vital" category.

E- Essential category

The essential category includes inventory, which is next to being vital. These, too, are very important for any organization because they may lead to a stoppage of production or hamper some other process. But the loss due to their unavailability may be temporary, or it might be possible to repair the stock item or part.

The management should also ensure optimum availability and maintenance of inventory under the "Essential" category. The unavailability of inventory under this category should not cause any stoppage or delays.

D- Desirable category

The desirable category of inventory is the least important among the three, and their unavailability may result in minor stoppages in production or other processes. Moreover, the easy replenishment of such shortages is possible in a short duration of time.

VALUE ANALYSIS:

Value analysis is a systematic review of the production, purchasing and product design processes to reduce overall product costs. This can be accomplished through a variety of activities, including the following:

Designing products to use lower-tolerance parts that are less expensive Switching to lower-cost components

Standardizing parts across product platforms in order to achieve volume discounts Altering production processes to minimize the amount of production cycle time, thereby reducing labor costs Introducing automation to strip labor costs out of the production process Altering product packaging to lower its cost while still protecting the product The process is not a wholesale attack on costs. Costs are only reduced when the result will not impact the perceived level of quality experienced by customers, or the level of customer satisfaction.

Importance in cost reduction - concepts and procedures. Inventory control

IMPORTANCE:

Cost reduction is the process of identifying and reducing expenses associated with running a business. The goal of cost reduction is to lower the overall costs of operating the business without compromising quality or negatively impacting other areas of the company.Cost reduction is crucial to a business's long-term profitability and sustainability. By reducing expenses, a company can increase its profits and reinvest those funds into other business areas or use them to lower prices and become more competitive.

The Difference Between Good and Bad Costs

Two types of costs need to be considered when making business decisions: good costs and bad costs. Good costs are those that add value to the company, while bad costs are those that do not. Knowing the difference between the two is important when making business decisions. Good costs are those that help the company generate revenue or save money. For example, investing in new equipment may be a good cost if it will help increase production. Hiring new staff may also be a good cost if it will help improve customer service. Bad costs, however, are those that do not contribute to the bottom line. They may even end up costing the company money. For example, maintenance on old equipment may also be a bad cost if it costs more to maintain the outdated equipment than to purchase new equipment. It is important to carefully consider all costs before making any decisions. Good costs should always be given priority

over bad costs. However, there are times when bad costs must be incurred to avoid even greater losses. In such cases, it is vital to understand the benefits and risks before making any decisions.

Benefits of Cost Reduction

Cost reduction has many potential benefits, including improved profitability, cash flow, and competitiveness. When done correctly, cost reduction can also help improve quality and service levels while still maintaining or improving bottom-line results.

Increased Profits

Perhaps the most obvious benefit of reducing business expenses is that it can help to increase profits. In a competitive marketplace, every little bit counts, and if a company can find ways to reduce its costs, it will put it ahead of the competition.

Improving Cash Flow

In addition to increasing profits, cost reduction can help improve cash flow. Spending less money on supplies and overhead leaves more money available to reinvest in the business or to pay back debts. Improved cash flow can be a real boon for businesses, particularly during tough economic times.

Remaining Competitive

By minimizing expenses, businesses can keep their prices low and attractive to consumers. Additionally, cost reduction can help improve profitability and make a company more sustainable.

CONCEPTS AND PROCEDURES:

1. Prioritize location and accessibility

Make sure that your warehouse and stock are well organized and accessible since it will reduce much time for staff to look for the location and find the products. As a result, all other following steps can run smoothly.

2. Establish the floor and layout arrangement

This will help the owners and staff have all the product locations on their minds so it will be much easier and faster to find any items when needed. Besides, creating a floor plan will assist you in determining the best location for your merchandise.

3. Optimize and forecast your inventory

Try to optimize and forecast your inventory by ensuring an adequate amount of goods, not too few or too many. It's also a good idea to make a list of hot items that sell faster than others. Regardless of the season, these things should always be in the warehouse. It will also be much easier to prepare for impending supply and demand concerns if sales rates are monitored and market trends are followed.

4. Get rid of unneeded stock

Try to get rid of items that have been in stock for an extended period of time by running promotions or offering discounts. It will create more space for you to put other needed items. Besides, such offers can also increase customer satisfaction, make inventory replenishment easier, and keep business going forward.

5. Set a cycle count schedule

Establish a cycle count timetable to adequately monitor product flow rather than waiting for a chance to count your inventory.

6. Check stock quickly after delivery

After each inventory order arrives, spend a few minutes checking to see if your delivered merchandise is correct or there are any problems with the product's quality and refuse any items that are not ordered or spoil. This step will help you avoid the case that the real stock is not enough or excess the inventory data from the system.

7. Label all products

Labels should have enough data such as product name, number, quantity, and description. Labeling all products makes it much easier and faster to recognize them.

Types of Inventory-Safety stock:

Importance of safety stock

Safety stock helps eliminate the hassle of running out of stock. If you hold sufficient safety stock, you needn't rely on your suppliers to deliver quickly or turn away customers because of depleted inventory levels. Safety stock covers you until your next batch of ordered stock arrives. Let's see how safety stock is important for your business:

Protection against demand spikes

Safety stock protects you against the sudden demand surges and inaccurate market forecasts that can happen during a busy or festive season. It serves as a cushion when the products you've ordered take longer to reach your warehouse than you expected. It ensures that your company doesn't run out of popular items and helps you keep fulfilling orders consistently.

Buffer stock for longer lead times

Even if your supplier has been consistent with delivering products on time and you've never faced a supply lag yet, this might not always be the case. Unexpected delays in production or transportation, such as a bottleneck at your supplier's end or a weather-related shipping delay, can cause your products to reach you later than expected. During these situations, safety stock acts as your defense against a possible stockout scenario and helps you fulfill your orders until your ordered stock is delivered to you.

Prevention against price fluctuations

Unpredicted market fluctuations can cause the cost of your goods to increase suddenly. This can be due to a sudden scarcity of raw materials, an increase in price of raw materials, unexpected demand surges in the market, new competitors, or new government policies. If you've got enough safety stock during these unpredictable situations, it can help you avoid the costs of buying stock at higher prices without sacrificing sales.

Inventory Control Systems-JIT:

What Is Just-in-Time (JIT)?

The just-in-time (JIT) inventory system is a management strategy that aligns raw-material orders from suppliers directly with production schedules. Companies employ this inventory strategy to increase efficiency and decrease waste by receiving goods only as they need them for the production process, which reduces inventory costs. This method requires producers to forecast demand accurately.

KEY TAKEAWAYS

1. The just-in-time (JIT) inventory system is a management strategy that minimizes inventory and increases efficiency.

2.Just-in-time manufacturing is also known as the Toyota Production System (TPS) because the car manufacturer Toyota adopted the system in the 1970s.

2. Kanban is a scheduling system often used in conjunction with JIT to avoid overcapacity of work in process.
3. The success of the JIT production process relies on steady production, high-quality workmanship, no machine breakdowns, and reliable suppliers.

4. The terms short-cycle manufacturing, used by Motorola, and continuous-flow manufacturing, used by IBM, are synonymous with the JIT system.

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UNIT-V

Networked Economy Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0- Benefits of adopting an Industrial 4.0

Networked Economy Drivers:

Many experts—including subject matter analysts at Deloitte—see the networked economy as the natural outcome of what happens when all the actors inside a business ecosystem are interconnected. Through technology, these interconnections enable customers to drive choices, select preferences, and make their predispositions known. This interconnectedness fundamentally flips the script. It takes some of the power away from producers of goods and services to drive value and puts it in the hands of consumers in the extended enterprise.

According to Brent Nickerson a Deloitte Risk and Financial Advisory partner at Deloitte &Touche LLP, the networked economy also transforms the "enterprise" as industries have defined it for years. Historically, this term encompassed the people, processes, technology, and systems within a company. But as Nickerson describes it, a networked economy broadens the scope of everything, necessitating a new way of thinking.

Networked economy trends to follow

These exterprises—and a networked economy itself, for that matter—don't happen in a vacuum. They need to capitalize on a number of trends to work. So what can you do?

Collaborate on business models. One of the biggest trends to drive the networked economy is collaborative business models, or models that enable different types of businesses to work together to drive sales. The Internet of Things (IoT), the ultimate extended enterprise, is a good enabler of this type of collaboration. If, for instance, a consumer has a smart washing machine, the customer can instruct it to order more detergent pods online whenever the supply runs low. In this case, collaboration breeds convenience, which typically leads to happy customers.

In fact, IoT in the networked economy is a win-win-win for customers, manufacturers, and goods and service providers:

Customers win because they have value added to their everyday products and they're happy.

Manufacturers win because customers are happy—not only with functionality but also with the "it" factor.

The goods or services providers win because they're taking care of their customers and can use the experience to hone their solutions.

Be radically transparent. Another important trend driving the networked economy: The widespread movement to radical transparency. Kevin Lane, a Deloitte Risk and Financial Advisory principal at Deloitte &Touche LLP, says that when companies begin to interlink networks, it's important that all parties be transparent about how they do business throughout their own respective extranets, so as not to alienate any potential customers. He adds that companies must ask themselves what kinds of networks they want to associate with and what sorts of belief systems they're willing to tolerate from partners they collaborate with.

"Everything out there can be seen, and the consumer sees it all and makes his or her own judgments," says Lane, who also serves as the retail industry leader for Deloitte's Enterprise Compliance Services practice. "No one ever fully gets his or her way, but the idea is that the networks, somewhat organically through the interconnection, develop their own consensus point and middle-ground answer."

Get a handle on your risks. Companies that wish to create exterprises must also have a handle on their risks. And they must perform regular risk assessments to quantify how vulnerable their networked economy is to threats.

On the most basic level, risk assessment is about physical security—locking down facilities so that only authorized employees come and go. But the broader day-to-day realities of risk

assessment go hand in hand with a push for more transparency: As companies learn more about the other companies in their exterprise, previously undisclosed risks emerge, creating an opportunity for remediation—or at least a backup plan. In evaluating this risk, companies must think not only of themselves but also their customers. Something could be both legal and ethical, but it may still not align to the preferences of the consumers involved.

Leveraging connections for the networked economy approach

As the first wave of companies begins to embrace the networked economy approach, opportunities abound to leverage the ensuing connections into smart business decisions for the extended enterprise. To create value, organizations can:

Extend and amplify connections. For starters, companies must extend and amplify connections through consortia and other industry groups. Some of these groups are more marketing-oriented in nature and enable participants to network with each other and share leading practices. Others are functional—participants meet to collaborate on devising standards, rules, and other forms of self-regulation.

Innovate to capture new revenue streams. Looking forward, companies must also figure out how to capture new revenue streams. Subject matter experts say this likely will be driven almost entirely by the networked economy and the enterprise—by third parties that spark new products, new development, and innovation. A number of contract manufacturers around the world have already set up product innovation centers where they offer design, engineering, prototyping, and manufacturing necessary to build out new products.

In addition to changing the product catalog, these centers have sparked a sea change in strategy. Now more than ever, innovation is coming from the edges of a corporate network and working its way in. The exterprise has also indirectly expanded distribution channels, since companies are now connected to so many other companies.

Ultimately, the one-two punch of more innovation and more places to sell new products enables companies to penetrate deeper into their existing consumer bases and, at the same time, acquire new consumers.

In the context of a networked economy, both scenarios can lead to additional revenue—yet another way risk, when managed well, can create value in the business world of today.

Compelling Forces and Challenges for Industry

Barriers to digital transformation

According to recent research, five common barriers to digital transformation include:

1. lack of skills or talent to manage complex Industry 4.0 structures
2. concerns regarding cyber security
3. other priorities for capital expenditure
4. lack of appropriate digital infrastructure
5. lack of knowledge of digitalization and how it can help the business

BDO digital transformation report

Lack of skills

Access to skills is often cited as the biggest barrier to digital transformation. Technology

adopters report difficulties with finding, training and re-skilling staff, particularly around the areas of user interface, data science, software development and machine-level controls. Problems also sometimes occur around the accessibility of technology, with people not willing - or finding it too difficult - to use new digital tools and applications. If this is a concern in your business, it may help to conduct a training needs analysis to determine what training your staff may need. See **how to identify staff training needs**.

Data and IT security

IT security can pose substantial risks in Industry 4.0 setting. Online integration of processes, systems and people potentially give room to security breaches and data leaks. Bear in mind, IT security is not limited to cyber attacks. Other prominent threats include network misconfigurations, erroneous commands, and software or device failures that can potentially disrupt business operations and production. Your IT infrastructure will also need to be up to the task of coping with the extra connectivity required for your digital transformation.

New business models

Another common hurdle faced by businesses adopting Industry 4.0 is the lack of internal alignment about which strategies to pursue. With the advent of digital technologies, new business models are emerging requiring companies to rethink the way they do business. Without a consensus on business strategy, or the right people in place to drive it, it can be difficult to overcome these internal challenges.

Culture change

Managing culture change is a vital part of Industry 4.0 success, as well as a potential hindrance if not executed well. If your workers aren't ready for the changes, they can be unwilling, resistant or unable to adapt. Preparing them for the technology shift and gaining their buy-in is critical to the success of your digital project. Leadership and leading from the top can play an important role in bringing about the cultural change needed for digital transformation. Read more about **change management**.

Capital investment

Depending on what you're looking to change, Industry 4.0 adoption sometimes involves high upfront costs. However, a large investment is not always required to transform the business. You can think big, but start small. Begin with a simple scalable solution, perhaps a smart section of lighting, and see how it works. You don't need to commit a huge investment to make a significant step forward

Benefits of adopting an industrial 4.0:

Big Data and AI analytics: In Industry 4.0, Big Data is collected from a wide range of sources, from factory equipment and Internet of Things (IoT) devices, to ERP and CRM systems, to weather and traffic apps. Analytics powered by artificial intelligence (AI) and machine learning are applied to the data in real time – and insights are leveraged to improve decision-making and automation in every area of supply chain management: supply chain planning, logistics management, manufacturing, R&D and engineering, enterprise asset management (EAM), and procurement.

Horizontal and vertical integration: The backbone of Industry 4.0 is horizontal and vertical integration. With horizontal integration, processes are tightly integrated at the “field level” –

on the production floor, across multiple production facilities, and across the entire supply chain. With vertical integration, all the layers of an organization are tied together – and data flows freely from the shop floor to the top floor and back down again. In other words, production is tightly integrated with business processes like R&D, quality assurance, sales and marketing, and other departments – and data and knowledge silos are a thing of the past.

Cloud computing: Cloud computing is the "great enabler" of Industry 4.0 and digital transformation. Today's cloud technology goes way beyond speed, scalability, storage, and cost efficiencies. It provides the foundation for most advanced technologies – from AI and machine learning to the Internet of Things – and gives businesses the means to innovate. The data that fuels Industry 4.0 technologies resides in the cloud, and the cyber-physical systems at the core of Industry 4.0 use the cloud to communicate and coordinate.

Augmented reality (AR): Augmented reality, which overlays digital content on a real environment, is a core concept of Industry 4.0. With an AR system, employees use smart glasses or mobile devices to visualize real-time IoT data, digitised parts, repair or assembly instructions, training content, and more when looking at a physical thing – like a piece of equipment or a product. AR is still emerging but has major implications for maintenance, service, and quality assurance as well as technician training and safety.

Industrial Internet of Things (IIoT): The Internet of Things (IoT) – more specifically, the Industrial Internet of Things – is so central to Industry 4.0 that the two terms are often used interchangeably. Most physical things in Industry 4.0 – devices, robots, machinery, equipment, products – use sensors and RFID tags to provide real-time data about their condition, performance, or location. This technology lets companies run smoother supply chains, rapidly design and modify products, prevent equipment downtime, stay on top of consumer preferences, track products and inventory, and much more.

Additive manufacturing/3D printing: Additive manufacturing, or 3D printing, is another key technology driving Industry 4.0. 3D printing was initially used to as a rapid prototyping tool but now offers a broader range of applications, from mass customization to distributed manufacturing. With 3D printing, for example, parts and products can be stored as design files in virtual inventories and printed on demand at the point of need – reducing both transportation distances and costs.

Autonomous robots: With Industry 4.0, a new generation of autonomous robots is emerging. Programmed to perform tasks with minimal human intervention, autonomous robots vary greatly in size and function, from inventory scanning drones to autonomous mobile robots for pick and place operations. Equipped with cutting-edge software, AI, sensors, and machine vision, these robots are capable of performing difficult and delicate tasks – and can recognize, analyze, and act on information they receive from their surroundings.

Simulation/digital twins: A digital twin is a virtual simulation of a real-world machine,

product, process, or system based on IoT sensor data. This core component of Industry 4.0 allows businesses to better understand, analyze, and improve the performance and maintenance of industrial systems and products. An asset operator, for example, can use a digital twin to identify a specific malfunctioning part, predict potential issues, and improve uptime.

Cybersecurity: With the increased connectivity and use of Big Data in Industry 4.0, effective Cybersecurity is paramount. By implementing a Zero Trust architecture and technologies like machine learning and block chain, companies can automate threat detection, prevention, and response – and minimize the risk of data breaches and production delays across their networks.

PREPARED BY;
M.ANANTH KUMAR
BALAJI INSTITUTE OF IT & MANAGEMENT KADAPA.