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با مجوز وزارت علوم، تحقیقات و فن آوری

# جزوه زبان تخصصی

# مهندسی صنایع و

# مهندسی سیستمهای اقتصادی اجتماعی

# و مدیریت سیستم و بهره وری

**تالیف مهندس محسن شایان**

# UNIT 1

# What is Industrial Engineering?

***Vocabulary***

Branch/ a branch of

Deal

Deal with something / concerning with

Optimize

Process

Develop/developed/developing/development

Improve/improvement

Implement/ implementation

Evaluate/evaluation

Integrate/integration

Synthesis / synthesize

As well as/Likewise/ in like manner/ along with/ moreover/ similarly

Principle/ principal

Specify/ specification

Obtain

Underlie/ underlying

Concept/conception/ preconception

Overlap

Consider/ considerable/ considerably

Orient/ direct/ lead/ guide

Business-oriented

Emphasize/ emphasis

Extensive

Profession/ proficient/ proficiency/professional

Use/ usage

Depend on/ independent/dependable

Quantitative/Qualitative

Specialty/specialist

Viewpoint/ point of view/ opinion

Recruiter

## What is Industrial Engineering?

Industrial engineering is a branch of engineering dealing with the optimization of complex processes or systems. It is concerned with the development, improvement, implementation and evaluation of integrated systems of people, money, knowledge, information, equipment, energy, materials, analysis and synthesis, as well as the mathematical, physical and social sciences together with the principles and methods of engineering design to specify, predict, and evaluate the results to be obtained from such systems or processes. Its underlying concepts overlap considerably with certain business-oriented disciplines such as Operations Management, but the engineering side tends to emphasize extensive *mathematical* proficiency and usage of quantitative methods.

Depending on the sub-specialty(ies) involved, industrial engineering may also be known as operations management, management science, operations research, systems engineering, or manufacturing, usually depending on the viewpoint or motives of the user. Recruiters or educational establishments use the names to differentiate themselves from others. In health care, industrial engineers are more commonly known as health management engineers or health systems engineers.

***Vocabulary***

*Concern:* to relate to; to have an influence on

*Integrate:* to form, coordinate, or blend into a functioning or unified whole; unite

*Draw upon*: to use as a source of supply; draw on

*Principle*: a comprehensive and fundamental law, doctrine, or assumption

*Specify*: to name or state explicitly or in detail; to include as an item in a specification

*Predict*: to declare or indicate in advance; forecast; prophesy; foretell

*Evaluate*: to determine the significance, worth, or condition of usually by careful appraisal and study; assess

*Obtain*: to gain or attain usually by planned action or effort; acquire

*Facilitate*: make easy or easier; ease

*Discipline*: a field of study; a rule or system of rules governing conduct or activity

*Interface*: to interact or coordinate harmoniously

*Explicit*: clean-cut, definite, definitive, express, specific

***Strategies***
***Skimming*** is reading quickly for a general understanding of the topic and organization of the passage.
***Scanning*** is looking through a passage to find specific information.

Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, equipment and energy. It draws upon specialized knowledge and social sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems.

To be more specific, the function of an industrial engineer is to integrate people, machines, materials and information to facilitate an effective operation and to maximize productivity. Therefore, system management becomes one of the key functions of an industrial engineer.

Industrial engineering is the interfacing of people with machines. The design of a total system must include the behavioral characteristics, stress-strain relationships, load carrying energy characteristics, and motivational responses of the people who are vital links in a system in

addition to the physical elements of the machines. Therefore, the uniqueness of industrial engineering is the explicit reference to people and social sciences in addition to natural sciences. Not only the design, installation, evaluation and redesign of machine systems are the major concerns of industrial engineering, but also the human factors in the system.

**1- What is the main idea of the first paragraph?**

1. Methods which are used in industrial engineering.
2. What industrial engineering does with methods and science.
3. Definition of industrial engineering.
4. None of the above mentioned

**2- What is the main idea of the second paragraph?**

1. Maximizing productivity
2. Use of industrial engineering.
3. The key functions of an industrial engineer.
4. System management as a single function

**3- What author is going to say in paragraph 3?**

1. Definition of industrial engineering
2. Deference between industrial engineering and other engineering disciplines.
3. Role of human factor in industrial engineering.
4. Shining function of industrial engineering.

**4- According to the passage what industrial engineering is concerned with?**

1. Designing, classification and integration.
2. Optimization, installation and integration.
3. Improvement, design and installation.
4. Qualification, installation and design.

**5- All the options are the specific objective of industrial engineering EXCEPT….?**

1. Designing various systems
2. Integrating people, machines, materials and information
3. Facilitate an effective operation
4. Maximize productivity

**6- According to the passage, which one is a key function in industrial engineering?**

1. Integration of people, machines, materials and information
2. Optimization
3. Maximizing productivity
4. System management

**7- The uniqueness of industrial engineering is …….. .**

1. Clear-cut reference to people and social sciences
2. Explicit reference to natural sciences
3. Unambiguous reference to the human factors
4. Precise reference to behavioral characteristics

*UNIT 2*

# Plant Layout

Layout
Plant
arrangement
facility
equipment
furniture
flow of material
handling
receipt
raw material
delivery
final product
line layout
Product layout
sequence
sequentially
backtrack
batch production
stationary
bulky
combination
likelihood
work-in-progress(WIP)
lead time
confine to
manpower
autonomy
master
fulfill
retrieval
scratch
innovative
exploitation
as per(in accordance with)
component
embodiment
accrue from
conventional

**Definition:** Plant layout refers to the arrangement of physical facilities such as machines, equipment, tools, furniture etc. in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of handling in processing the product from the receipt of raw material to the delivery of the final product.

**TYPES OF LAYOUT:**

There are mainly four types of plant layout:

**(a) Product or line layout**

**(b) Process or functional layout**

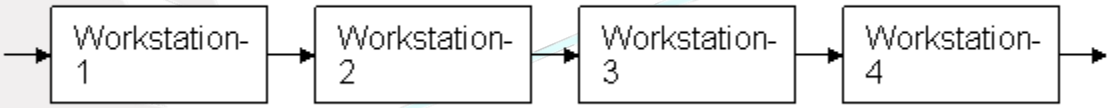
**(c) Fixed position or location layout**

**(d) Combined or group layout**

**PRODUCT OR LINE LAYOUT:**

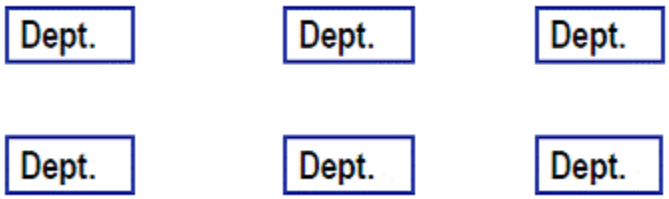
In this type of layout the machines and equipments are arranged in one line depending upon the sequence of operations required for the product. It is also called as line layout. The material moves to another machine sequentially without any backtracking or deviation i.e. the output of one machine becomes input of the next machine. It requires a very little material handling.

It is used for mass production of standardized products.




**PROCESS LAYOUT:**

In this type of layout the machines of a similar type are arranged together at one place. This type of layout is used for batch production. It is preferred when the product is not standardized and the quantity produced is very small.



**FIXED POSITION OR LOCATION LAYOUT:**

Fixed position layout involves the movement of manpower and machines to the product which remains stationary. The movement of men and machines is advisable as the cost of moving them would be lesser. This type of layout is preferred where the size of the job is bulky and heavy. Example of such type of layout is locomotives, ships, boilers, generators, wagon building, aircraft manufacturing, etc.


**Combined layout**:

A combination of process & product layout is known as combined layout.

Manufacturing concerns where several products are produced in repeated numbers with no likelihood of continuous production, combined layout is followed

# Group Technology (GT)

Group Technology or GT is a manufacturing philosophy in which the parts having similarities (Geometry, manufacturing process and/or function) are grouped together to achieve higher level of integration between the design and manufacturing functions of a firm. The aim is to reduce work-in-progress and improve delivery performance by reducing lead times. GT is based on a general principle that many problems are similar and by grouping similar problems, a single solution can be found to a set of problems, thus saving time and effort. The group of similar parts is known as part family and the group of machineries used to process an individual part family is known as machine cell. It is not necessary for each part of a part family to be processed by every machine of corresponding machine cell. This type of manufacturing in which a part family is produced by a machine cell is known as cellular. The

manufacturing efficiencies are generally increased by employing GT because the required operations may be confined to only a small cell and thus avoiding the need for transportation of in-process parts

# Cellular Manufacturing

Cellular manufacturing is a manufacturing process that produces families of parts within a single line or cell of machines operated by machinists who work only within the line or cell. A cell is a small scale, clearly-defined production unit within a larger factory. This unit has complete responsibility for producing a family of like parts or a product. All necessary machines and manpower are contained within this cell, thus giving it a degree of operational autonomy. Each worker is expected to have mastered a full range of operating skills required by his or her cell. Therefore, systematic job rotation and training are necessary conditions for effective cell development. Complete worker training is needed to ensure that flexible worker assignments can be fulfilled.

# Passage 1

Group Technology (GT) has traditionally been a manufacturing philosophy in which parts are identified and grouped together to take advantage of their similarities in manufacturing and design. Similar parts are arranged into part families. In case of manufacturing, since each family possesses similar manufacturing characteristics, therefore the processing of each member of a family is similar. However, in case of design, Group Technology's use has been limited to standardization of parts and design retrieval only. For example, a designer faced with the task of developing a new part can use the design-retrieval system to determine if a similar part is already in existence. A simple change in an existing part would be much less time consuming than designing from scratch. But this does not contribute to the designing of innovative new products in any way. However, the advent of modern concept of functional reasoning in design provides a great opportunity for exploitation of GT classification techniques. The idea behind designing a product as per functionality is that, once the designer has been able to identify the intended function, he/she can expand it into sub-functions and subsequently map those sub-functions with components capable of fulfilling them. This thesis intends to fill the vast existing gap between functional requirements (sub-functions) and actual embodiments (workparts) which satisfy those functions. It enhances the GT classification of various parts on the basis of their functional applications. The classification provides the designers an important resource for selecting various parts of a product during the initial design phase. It expands the scope and utility of GT part coding and makes it more sensitive. Thus the benefits which accrue from this classification include: providing a design database, significant reduction in design time and effort, providing innovative design solutions, allowing maximum design freedom, avoiding design

duplication and encouraging standards to develop. The classification is merged with the existing GT coding systems and hence retains the advantages of a conventional GT code. The underlying concepts, development and application of the new system have been discussed in detail during the course of the thesis

***Vocabulary***

*Attribute:* ascribe to, credit with

*Carry out:* put into practice, accomplish, perform

*Initial:* placed at the beginning, first

*Investigation*: probe, examination, inspection

*Progress:* advance, move forward, gain, proceed

*Gradual:* little by little, progressive

*Adoption:* choose to take up or follow (an option or course of action).

*Trace:* follow; find; investigate; follow a program procedure proposition after proposition

*Batch:* group, collection, bundle

*Extend:* stretch, pull out to its greatest possible length; enlarge, lengthen; give, bestow; reach

*Publication:* the action or process of publishing something; a book or journal that is published

*Component:* ingredient; part, constituent

*Incorporate:* take in or include as part of a whole; constitute as a legal corporation

*Set-up:* the way in which something is organized or arranged

*Set up:* assemble; arrange; establish; operate

*Spectrum:* broad range of connected ideas or events

*Manufacture:* make by machine; create, make, produce; mass-produce; fabricate, invent

*Establish:* set up, found; base

*Codify:* reduce to code; arrange systematically

*Approximately:* nearly

***Strategies***
***Identifying the Best Title***
Sometimes it is requested to recognize the best title for the passage. The best title is one that implies what whole passage is all about.
For passages which have only one paragraph, the ***Main Idea*** is the best indicator of appropriate ***Title*****.** Needless to say, for the ones which have several paragraphs, the Best Title is the option that covers all the main ideas contained in the passage.

# Passage 2

The basic thinking behind Group Technology can be attributed to the Russians, who carried out initial investigations during the 1920s. The progress of GT since then and its gradual adoption in other countries has been traced by Grayson. The early work stressed the importance of industrial classification, and initial applications were limited to the medium and large batch productions. The work was extended during the war years by Mitrofanov to include workpieces produced in small batches. His major publication on Group Technology first appeared in 1959 and was translated into English in 1966. Mitrofanov proposed that it was possible to produce a theoretical composite component which incorporated all the major features of components belonging to a family, and that a machine could be tooled up to produce the composite component, thus providing the set-ups required for each component in the family.
In the early 1960s, Opitz carried out an investigation into workpiece statistics, which showed that although firms manufacture a variety of products, the spectrum of them all was remarkably similar. Based on the findings of this investigation, he established a classification system which enabled components to be codified by means of their geometrical similarity. A number of methods for classification and coding were being investigated at approximately the same time.

**1- What is the main idea of the first paragraph?**

1. What GT exactly is.
2. Progression of GT.
3. Different classifications of GT.
4. None of the above mentioned.

**2- What is the main idea of the second paragraph?**

1. The date GT started seriously.
2. Statistical Group Technology
3. GT change remarkably
4. None of the above mentioned

**3- What is the best title for the passage?**

1. Who developed GT?
2. Emerging of GT.
3. Kinds of GTs.
4. Use of GT.

**4- Mitrofanov's major English publications first appear in……. .**

1. 1920s
2. 1959
3. 1966
4. 1960s

**5- According to the passage, which of the following statements is true?**

1. Gradual adoption in other countries has been traced by Opitz.
2. The work was extended during the war years by Grayson.
3. Grayson established a classification system which enabled components to be codified.
4. Mitrofanov extended the work during the war years.

**6- According to last paragraph, what is the main cause of emerging Group Technology?**

1. Investigations showed that working in groups would have better results.
2. Group of technologies is needed to produce a product.
3. Variety of products needs a group of technologies.
4. The spectrum of the variety of products is notably similar.

**7- In first paragraph, what does the author say about development of GT?**

1. Firstly, GT was started to develop by Russians during the war.
2. During the war, developing of GT stopped temporarily.
3. Initiation of GT was not by Russians.
4. Development of GT was not limited to Russia.

## Passage 3(Industrial Engineering 88)

The biggest challenge when implementing cellular manufacturing in a company is dividing the entire manufacturing system into cells. The issues may be conceptually divided in the "hard" issues of equipment, such as material flow and layout, and the "soft" issues of management, such as upskilling and corporate culture.

The hard issues are the matter of design and investment. The entire factory floor is rearranged, and equipment is modified or replaced to enable cell manufacturing. The cost of work stoppage during implementation can be considerable, and lean manufacturing literature recommend that implementation should be phased to minimize the impacts of such disruptions as much as possible. The rearrangement of equipment or replacement of equipment that are no flexible or reliable enough to cell manufacturing also pose considerable costs, although it may be justified as the upgrading obsolete equipment. In both cases, the cost have to be justified by the cost saving that can be realistically expected from the more flexible cell manufacturing system being introduced, and miscalculations can be disastrous.

The soft issues are more difficult to calculate and control. The implementation of cell manufacturing often involves employee training and redefinition and reassignment of jobs. Each of the workers in each sell should ideally be able to complete the entire range of tasks required from the cell, and often means being more multi-skilled than they were previously. In addition, cells are expected to be self-managing and therefore workers need to learn the tools and strategies for effective team work and management, tasks that workers in conventional factory environments are entirely unused to. At the other end of spectrum, the management will also find their job redefined, as they more "hands-off" approach to allow work cells to effectively self manage.

1. **The best title for the passage could be ….**
    1. Cellular manufacturing system design
    2. Costs of implementing cellar manufacturing
    3. Challenges to implementation of cell manufacturing
    4. Integrating cellular manufacturing and management
2. **In order to reduce the costs of work stoppages, …. .**
    1. Works are expected to be self managing
    2. More flexible cell manufacturing are introduced
    3. Part movement and wait time between operations are reduced
    4. Implementation should be complemented in stages over a period of time
3. **According to the third paragraph ….. .**
    1. Workers should be able to accomplish tasks required from any cell
    2. The soft issue pose considerable challenge for cell manufacturing Implementation
    3. Each individual work cell is optimized for a wide range of tasks
    4. The cost of employee training are less than those of work stoppage
4. **By more “hands-off” approach the author means that…**
    1. Managers will have to learn the strategies for team work
    2. Managers must learn to perform a more oversight and support role
    3. The management should carry out the detailed observation in behavior of workers
    4. The management should monitor the output and interrelationship of every worker
5. **The implementation of cell manufacturing involves all of the following EXCEPT…..**
    1. Upskilling
    2. Overproduction
    3. Redefinition of jobs
    4. Reorganizing the manufacturing floor

# UNIT 3

# Production planning and control

| | |
|---|---|
| Aspect | Assessment |
| Coordinate | Initial |
| Supplier | Ongoing |
| Customer | Collapse |
| Critical | Excessive |
| Undertaking | Misallocation |
| Arena | Smooth |
| supply chain | Productivity |
| desired | cost-effective |
| breakdown | collaboration |
| Consequently | marketing |
| Trigger | corporate |
| Interpretation | carry out |
| Scope | cast aside |
| Approach | maturity |
| Purview | Introduce |
| Aggregate | yield |
| entail | fill |

A production (or manufacturing) planning and control (MPC) system is concerned with planning and controlling all aspects of manufacturing, including materials, scheduling machines and people, and coordinating suppliers and customers. An effective MPC system is critical to the success of any company. An MPC system's design is not a one-of undertaking; it should be

adaptive to respond to changes in the competitive arena, customer requirements, strategy, supply chain and other possible problems.

Production planning and control are usually used together. Planning the manufacture of products in the desired quantity and quality is a crucial issue in production management. However, even the best-conceived plans can go haywire because of delays, low inventories and machinery breakdowns. Consequently, there is a need for control over the operations to signal deviations from plans and trigger corrective measures.

There are two interpretations regarding the scope of production planning and control:
1. According to the first approach, the planning of all materials, processes and operations ending with the finished product fall under the purview of production planning and control. Inventory control, scheduling of operations and the planning of required equipment are also included.
2. The second approach views planning as an aggregate overall concept. The starting point is the sales forecast or sales orders, then production capacity assessment is done and scheduling of operations is completed.

**Costs and benefits**

Initial costs of establishing a production planning and control system can be high. Ongoing operational costs can also be high given the number of professionals and resources such as computers, training and space needed. Moreover, an ineffective MPC system can even lead to the collapse of the whole business because of poor customer service, excessive inventory and misallocation of material, workers and equipment. On the other hand, successful implementation of a production planning and control system can have crosscutting benefits such as appropriate level of work-in-process, smooth production, rapid delivery times, economic production lot sizes and improved labor productivity.

**Production engineering**

A branch of engineering that involves the design, control, and continuous improvement of integrated systems in order to provide customers with high-quality goods and services in a timely, cost-effective manner. It is an interdisciplinary area requiring the collaboration of

individuals trained in industrial engineering, manufacturing engineering, product design, marketing, finance, and corporate planning. In many organizations, production engineering activities are carried out by teams of individuals with different skills rather than by a formal production engineering department.

***Question:*** Production planning and control may be defined as the …… of a series of functions according to a plan which will, economically utilize the plant …… and regulate the orderly movement of goods through their entire manufacturing cycle, from the procurement of all materials to the shipping of finished goods at a predetermined rate.

**1)** coordination/ facilities
**2)** classification/layout
**3)** organization/circumstances
**4)** discrimination/ machinery

***Question:*** Control system is …… of components (electrical, mechanical, thermal, or hydraulic) that act together to maintain actual system performance close to a desired set of performance specifications.

**1)** coordination
**2)** formations
**3)** collaborations
**4)** combinations

***Question:*** Manufacturing planning and control entails the ……(1)……. and allocation of limited resources to production activities so as to satisfy customer demand over a specified ……(2)……. As such, planning and control problems are inherently optimization problems, where the objective is to develop a plan that meets demand at minimum cost or that fills the demand that maximizes profit. The underlying optimization problem will vary due to differences in the manufacturing and market context.

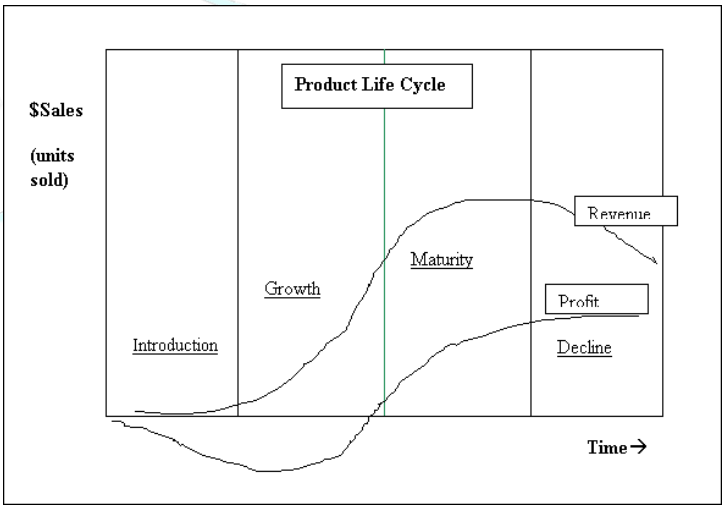
| | | | | |
|---|---|---|---|---|
| **1)** | 1- application | 2- acquisition | 3- optimization | 4- combination |
| **2)** | 1- time horizon | 2- life span | 3- life cycle | 4- deadline |

***Industrial Engineering (81)***

Products are born. They live and they die. They are cast aside by a changing society. It may be helpful to think of product's life as divided into four phases of introduction, growth, maturity, and decline.

Product life cycles may be a matter of few hours (a newspaper), months (seasonal fashions and personal computer), years (Betamax video recorders), or decades (Volkswagen Beetle). Regardless of the length of the cycle, the task for the operations manager is the same: to design a system that helps introduce new products successfully. If the operations function cannot perform effectively at this stage the firm may be saddled with losers- products that cannot be produced efficiently and perhaps not at all. The POM in Action box "Cannibalism at Tandem Computer" indicates just how vicious the product life cycle can be.

The following figure shows the four life cycles and the relationship of product sales, costs, and profit over the life cycle of a product. Note that typically a firm has a negative cash flow while it develops a product. When the product is successful, those losses may be recovered. Eventually, the successful product may yield a profit to its decline.




**1- Having been developed, a product …….**

1) Is born, lives, and dies
2) lives for a while and dies
3) continues the process of development
4) improves to higher cycles of life and death

**2- We can infer from the text that ……..**

1) a product's life depends on its characteristics

2) new areas of need emerge as the societies change

3) a product's life determines a society's evolution

4) new societies form as the rate of production changes

**3- It can be concluded from the text that ……**

1) organizations are authorized to change the order of introduction, growth, maturity, and decline

2) operations managers do not usually participate in the introduction of new products

3) an organization cannot survive without introducing new products

4) most products do not undergo periods of decline

**4- As the figure shows ……**

1) one developed, a product may bring about a negative cash flow

2) a substantial portion of sales occur prior to maturity

3) the profile that a successful product yields is fleeting

4) negative cash flow may also occur after maturity

**5- Which of the following would be a good title for this passage?**

1) Product Life Cycles

2) Products Are Born

3) Operations Function

4) Operations Manager

***Vocabulary***

*Continuous:* uninterrupted, unbroken; successive

*Competitive:* involving competition; tending to compete, desiring competition

*Availability:* accessibility, attainability

*Destructive:* ruinous, tending to destroy

*Inspection:* official examination, review check-up, probe, exploration, investigation; assessment, appraisal

*Assess:* estimate, appraise

*Arbitrarily:* wantonly, based on random choice

*Warrant:* authorize; justify, entitle; empower; permit; sanction

*Interval:* space of time between two events or actions; break, pause, intermission

*Determine:* decide, settle; conclude; cause, affect

*Govern:* rule; control; manage, administrate; supervise; regulate

*Diagnostic:* concerned with the diagnosis of illness or other problems

*Prognostic:* predicting the likely course of a disease or ailment

*Protocol:* conventions, rules of conduct

*Precision:* exactness, accuracy

*Consequence:* result, outcome; importance

*Applicable:* suitable, appropriate; feasible

***Strategies***
***Locating reference***
***References*** are words in a passage that other words refer to. Pronouns such as *they* and *those* refer to nouns elsewhere in the passage. These nouns are the referents of the pronouns. The noun referents are the words that the pronouns replace.
Usually the referent is mentioned before the pronoun in the passage, often immediately before it, but sometimes the referent appears after the pronoun. The referent may be in the same sentence as the pronoun, or it may be in another sentence.
Word such as this, that, many and some can also have noun referents in a passage. The referent may be in the same sentence as referring word, or it may be in another sentence.

In a continuous growing global market productivity is playing a key role to stay competitive, for any manufacturing company. Productivity can be achieved through availability, and availability can be increased through adopting the efficient maintenance practices, by focusing on different types of maintenance and strategies.

Condition based Maintenance or predictive maintenance, uses primarily non destructive testing techniques, visual inspection, and performance data to assess a machinery condition. It replaces arbitrarily timed maintenance tasks with an appropriate maintenance task at only when warranted

by equipment condition. Condition-monitoring maintenance task intervals must be properly understood and task intervals should be determined based on the expected P-F interval. The P-F interval governs the frequency with which the predictive task must be done. Technological advances are accepted and applied to CBM systems, which includes improved knowledge of failure mechanisms, advancements in failure forecasting techniques, advancements in monitoring and sensor devices, advancements in diagnostic and prognostic software, acceptance of communication protocols, developments in maintenance software applications and computer networking technologies.

The measurement precision and sensitivity of the CM technique being used, need to be understood because they affect the reaction time available to reduce or eliminate the consequences of the functional failure. Condition monitoring maintenance tasks must be applicable and cost effective.

**1- What is the main idea of the first paragraph?**

1. Globalization is growing fast.
2. Maintenance influences productivity.
3. Productivity is dependent on availability.
4. Productivity is no more important.

**2- What is the main idea of the second paragraph?**

1. Brief definition of CBM
2. Technologies which are used in CBM.
3. Suitable condition for implementing CBM.
4. Introducing CBM as a key role in productivity.

**3- What is the best title for the passage?**

1. Condition based Maintenance
2. Preventive Maintenance
3. Maintenance
4. Productivity

**4- In second paragraph, “it” (underlined) refers to…….. .**

1. non destructive testing
2. visual inspection
3. machinery condition
4. predictive maintenance

**5- The word “which” in paragraph two refers to …… .**

1. CBM systems
2. technological advances
3. techniques
4. improved knowledge

**6- In last paragraph, “they” (underlined) refers to…….. .**

1. measurement precision and sensitivity
2. CM technique
3. functional failure
4. protocols

**7- Author believes …… .**

1. productivity will result in efficient maintenance by availability
2. availability will result in productivity by efficient maintenance
3. productivity will result in availability by efficient maintenance
4. availability will result in efficient maintenance by Productivity

**8- According to the passage, maintenance tasks in CBM…… .**

1. is arbitrarily
2. is orderly
3. is at only when warranted by equipment condition
4. is by statistical distributions

**9- According to the passage, which one is true?**

1. Technological advances have nothing to do with CBM.
2. Computers are completely useless in CBM.
3. Statistical analysis has a major role in CBM.
4. Relatively, computers have an important role on CBM.

10- **According to the passage, which one is true?**

1. Precision of CM technique affects the elimination of functional failure.
2. Condition monitoring maintenance tasks are always cost effective.
3. Both of them.
4. None of them.

UNIT 4

# System definition & concepts

Interact
Obtainable
Baselines
Track
Viable
Throughout
Construct(n)
Holistic
Coherent
Cohesive
Verification
Validation
Retirement
value added
beyond
primarily
interconnected
stakeholder
wherein
dominate
perspective
opposing
multiple
instinct
expense
probe
tag
prescribe
trade
preliminary
interface

**System** is a set of interacting or interdependent components forming an integrated whole. A system is a set of elements and relationships which are different from relationships of the set or its elements to other elements or sets.

A “system” is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results.

**Systems engineering** is an interdisciplinary field of engineering that focuses on how complex engineering projects should be designed and managed over the life cycle of the project. Issues such as logistics, the coordination of different teams, and automatic control of machinery become more difficult when dealing with large, complex projects. Systems engineering deals with work-processes and tools to handle such projects, and it overlaps with both technical and human-centered disciplines such as control engineering, industrial engineering, organizational studies, and management.

**Systems engineering management** is accomplished by integrating three major activities:

• Development phasing that controls the design process and provides baselines that coordinate design efforts,

• A systems engineering process that provides a structure for solving design problems and tracking requirements flow through the design effort, and

• Life cycle integration that involves customers in the design process and ensures that the system developed is viable throughout its life.

## passage 1

Systems engineering is a methodical, disciplined approach for the design, realization, technical management, operations, and retirement of a system. A “system” is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results. The results include system-level qualities, properties, characteristics, functions, behavior, and performance. The value added by the system as a whole, beyond that contributed independently by the parts, is primarily created by the relationship among the parts; that is, how they are interconnected. It is a way of looking at the “big picture” when making technical decisions. It is a way of achieving stakeholder functional, physical, and operational performance requirements in the intended use environment over the planned life of the systems. In other words, systems engineering is a logical way of thinking.

Systems engineering is the art and science of developing an operable system capable of meeting requirements within often opposed constraints. Systems engineering is a holistic, integrative discipline, wherein the contributions of structural engineers, electrical engineers, mechanism

designers, power engineers, human factors engineers, and many more disciplines are evaluated and balanced, one against another, to produce a coherent whole that is not dominated by the perspective of a single discipline.

Systems engineering seeks a safe and balanced design in the face of opposing interests and multiple, sometimes conflicting constraints. The systems engineer must develop the skill and instinct for identifying and focusing efforts on assessments to optimize the overall design and not favor one system/subsystem at the expense of another. The art is in knowing when and where to probe. Personnel with these skills are usually tagged as "systems engineers." They may have other titles such as lead systems engineer, technical manager, and chief engineer.

**Question.** A "system" is a construct or collection of different elements that together produce results not obtainable by the …….. alone.

1) workers 2) establishers 3) combinations 4) elements

**Question.** Systems engineering is a ……., integrative discipline, wherein the contributions of structural engineers, electrical engineers, mechanism designers, power engineers, human factors engineers, and many more disciplines are evaluated and balanced, one against another, to produce a …….. whole that is not dominated by the perspective of a single discipline.

**1)** holistic/ coherent
**2)** individual/ cohesive
**3)** method/ inherent
**4)** combined/intrinsic

**Question.** The systems engineer will usually play the key role in leading the development of the system ……., defining and allocating requirements, balancing technical risk between systems, defining and assessing interfaces, providing oversight of verification and …… activities, as well as many other tasks.

**1)** regulation/ validation
**2)** justification/ organization
**3)** stabilization/organization
**4)** architecture/ validation

**Question.** The product realization processes are applied to each operational/mission product in the system structure starting from the lowest level product and working up to ……. level integrated products. These processes are used to create the design solution for each product and to verify, validate, and transition up to the next hierarchical level products that satisfy their design solutions and meet stakeholder ……. as a function of the applicable life-cycle phase.

**1)** toppest/limitation
**2)** higher/ expectations
**3)** customer/ requirement
**4)** engineering/interests

***Vocabulary***

*Apply:* make a request; implement; put to use; enforce

*Build:* construct, create; energize, increase intensity

*Capture:* entrap, take prisoner

*Convey:* carry, transport; bear, transmit; impart, disclose

*Cradle:* hold gently and protectively

*Questionnaire:* document containing a list of questions to be answered

*Context:* overall situation, background

*Interpret:* clarify, elucidate*:*

*Emerge:* appear, come out, be revealed

*Executive:* manager

*Illustrate:* demonstrate, exemplify; clarify; embellish, depict with pictures or words; elucidate

*Survive:* continue to live or exist

*Particularly:* especially; specifically

*Implementation:* execution, carrying out

***Strategies***
***Identifying restatements***
To answer some questions in the exam, you need to read a part of passage to see which option is close to a special notion or is a ***restatement*** of a point in the passage.
Selecting keywords will help you to answer these kinds of questions. Search the keyword in the passage then compare the sentence(s) to find a correct option.

## Passage 2

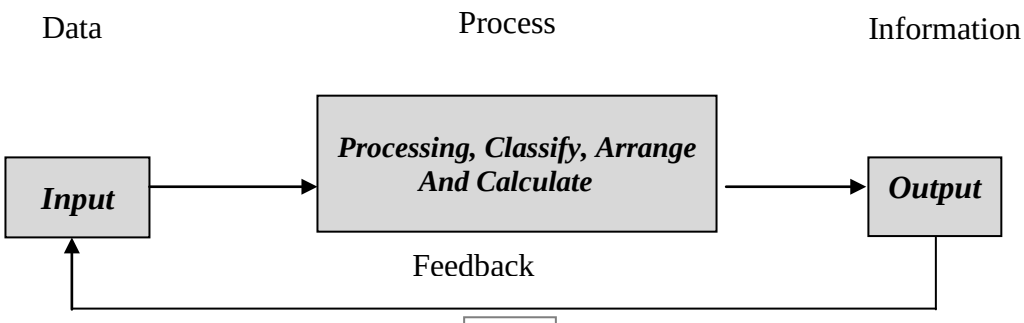
Management information systems (MIS) are applying computer-base for managing information in organizations for management roles such as interpersonal roles, informational roles and decisional roles. MIS is compounded of theories of computer science and management science. These theories build systems and program utilization. Normally, MIS is integrated systems of users and machines (computers) with aiming to provide organizations' information for operation, management and decision-making. The 5Cs are processes to change data into information. They consist of capturing information, conveying, creating, cradling and communicating. The information must have accuracy and verification, completeness, timeliness and relevance. MIS can be divided by using of each organization level like operational – level systems, knowledge – level systems, management – level systems and strategic – level systems.

Data mean any facts of persons, objects and places that are collected from observations, questionnaires, and measurements. Data can be context and figures which are true. False context and figures are useless like trash that nobody needs it. If an organization applies false data, it may get a wrong way or it cannot solve a problem. Sometimes, we call data as raw data because they're unused or inappropriate for users.

When data have been recorded, classified, and organized, related or interpreted within a framework so that meaning emerges, they become information. There are activities involved in turning data into information, and these activities are known as process. In briefly, information means outputs of processed data. Therefore, users can apply it. For example, an executive requires total sales of each product in the last year as a chart. Because he needs summarized data for planning sales (It's easier and quicker to understand the chart information than raw data of each product). In another example, teachers are grading each student by using total scores. The figure 1 illustrates the data and information.

**Figure 1**

Data and Information



At the present, organizations realize that information is important as a property. It can add value to organizations. As well as, it helps organizations to survive among intensive competition. Therefore, organizations need information for management. Particularly, information must be a system to implementation for adding value of organizations. Each organization must manage information by systematically collecting. Then, there will be sending, receiving and analyzing information.

Due to a lot of information in organizations, organizations use information technologies (IT) to manage information. Information technologies are applying science that is used for managing information. They are both hardware and software such as computers, cables, magnetic taps, CDs, monitors, operating systems, application software, signal and so on. Information technologies, particularly computer-base, systemize information in organizations. Therefore, users can quickly and easily adopt information. Information technologies can process data to be required information and sending receiving information.

**1- According to the passage, components of MIS are:**

1. Decision& Management science
2. IT& Decision science
3. IT& Management science
4. Computer& Management science

**2- Author claims that the purpose of integration in MIS is:**

1. Having smooth organization's information flow.
2. Convenience in managing various parts of organization.
3. Providing organization's information for operations.
4. Scattering information across the organization.

**3- According to the passage, organizations are divided to ….. Levels.**

1. operational, knowledge, inventory
2. strategic, management, operational
3. information, management, strategic
4. information, data, decision

**4- According to the second paragraph, how should be the precision of data to get used?**

1. Data should be completely true.
2. A little imprecision can be ignored.
3. Precision of data is unimportant.
4. There is a specified tolerance for precision.

**5- According to the passage, information can be obtained…… .**

1. through observations, questionnaires, and measurements
2. by Design Of Experiments(DOE)
3. by management information system
4. through recording, classifying, interpreting data

**6- Why information has importance for organizations?**

1. Because information is property.
2. Because it can add value.
3. Because it helps to survive among intensive competition.
4. All the statements are true.

**7- According to the passage, why we need a system of information?**

1. Because of accessibility of systems.
2. Because of accuracy of systems.
3. So that can add value.
4. There are a lot of privileges for systems that can help us in decision making.

**8- Why IT is getting used in organizations?**

1. Due to lots of facilities bring about.
2. Due to a lot of information in organizations.
3. Due to optimize time in processes.
4. Due to save costs.

**9- According to the passage…. .**

1. Magnetic taps are not used in IT because they are old-fashioned.
2. IT is related to soft wares.
3. IT is in computer discipline not in any other ones.
4. IT implements both hardware and software.

**10- According to the passage which one is true?**

1. Information means outputs of processed data.
2. The 5Cs are processes which change information into data.
3. Data can be context and figures which are almost true.
4. None of them.

## Passage 3(system 87)

In looking for more recent and more specific sources for the systems approach, on the other hand, there are two in particular that stand out. First is the general field of communications, particularly commercial telephony, where systems engineering first appeared as an explicit discipline in its own right. Traces of the systems approach are to be found in telephone engineering at least as far back as the beginning years of the century, and systems ideas were fairly common in telephony by the 1920s and '30s. When bell telephone laboratories, the research arm of the American Telephone

Telegraph Company was officially incorporated in 1925. Its two principal engineering divisions were called respectively Apparatus Development and systems Development. A complete formal doctrine of the role of systems engineering, however, first emerged in the years after World War II as part of an effort to redefine the policy and structure of the research and development. This doctrine set the engineering effort on a level of logical parity with the research and development efforts and made it of almost comparable actual size, at least with research. The system's engineer had a multitude of functions, with special emphasis on effective utilization of scientific and technical advances in planning new communications systems. This particular set of ideas, of course, reflected the special needs of telephony. Nevertheless, as an example and a point of departure it had a wide effect. It seems to be one of the reasons why so esoteric a subject as systems engineering advanced as rapidly as it did.

**1- The passage is discussing the systems approach in regard to its…… .**

1) effects on other disciplines 2) areas of inquiry it involves

3) functions 4) genesis

**2- By "two" in line 2 the author means two…….. .**

1) fields 2) sources 3) systems 4) approaches

**3- Where in the passage does the author start to discuss the second source of the subject of the passage?**

1) Line 5 2) line 9 3) line 11 4) line 17

**4- According to the passage, all of the following are true about systems approach EXCEPT that it …….. .**

1) progressed at a slow pace

2) is very specialized

3) fulfils a myriad of functions

4) can be traced to the field of communications.

# UNIT 5

# Decision Theory

| | |
|---|---|
| Assist | hypothesis/ hypotheses |
| Rational/rationale | Furthermore/ further |
| Approach | Assumption |
| Determine | prescription |
| Forecast | in practice |
| Price(n;v) | aid |
| Crop | merely |
| Projection | conflict |
| Broad | cooperation |
| identify | lay out |
| relevant | preference |
| rationality | finite |
| normative | describe |
| prescriptive | evaluative |
| accuracy | priority |
| methodology | for instance |
| comprehensive | |
| axiomatic | |
| violation | |
| descriptive | |

**Decision science** is essentially the science of providing statistical, mathematical and/or numerical models and techniques in order to assist in making complex decisions. It involves a systematic, rational approach to problem solving and can be used to determine close to optimal answers to problems, or to examine and compare the outcomes of different decisions. These skills are applied to anything, from weather forecasting to pricing strategies, new financial services and crop projections. Decision science places a strong emphasis on mathematical modeling and programming, data analysis and applied statistics, while also providing a solid foundation in the broader economic and management environment. The emphasis is on attaining the ability to perform complex decision-making in areas such as operations and financial management, manufacturing and logistics.

**Operations research** (also referred to as **decision science** or **management science**) is an interdisciplinary mathematical science that focuses on the effective *use* of technology by organizations. In contrast, many other science & engineering disciplines focus on technology giving secondary considerations to its use.

**Decision theory** in economics, psychology, philosophy, mathematics, and statistics is concerned with identifying the values, uncertainties and other issues relevant in a given decision, its rationality, and the resulting optimal decision. It is very closely related to the field of game theory.

Most of decision theory is normative or prescriptive, *i.e.*, it is concerned with identifying the best decision to take, assuming an ideal decision maker who is fully informed, able to compute with perfect accuracy, and fully rational. The practical application of this prescriptive approach (how people *ought to* make decisions) is called decision analysis, and aimed at finding tools, methodologies and software to help people make better decisions. The most systematic and comprehensive software tools developed in this way are called decision support systems.

Since people usually do not behave in ways consistent with axiomatic rules, often their own, leading to violations of optimality, there is a related area of study, called a positive or descriptive discipline, attempting to describe what people will actually do. Since the normative, optimal decision often creates hypotheses for testing against actual behavior, the two fields are closely linked. Furthermore it is possible to relax the assumptions of perfect information, rationality and so forth in various ways, and produce a series of different prescriptions or predictions about behavior, allowing for further tests of the kind of decision-making that occurs in practice.

**Statistical decision theory**

Until a few years ago scientific aids to business management were used only when dealing with very specific problems such as inventory control. Recently, however, statistical decision theory has been developed and has been shown to have rather wide application to business management problems. It is this wide applicability that has made statistical decision theory so attractive to managers. With due respect to its complexities, the basis of the managerial process is decision making. Statistical decision theory is merely a description - written in mathematical terms -of this aspect of the management process. As such, it is a valuable aid to scientific management. Mathematical notation in no way makes the applicability of statistical decision theory less general. Instead, it simplifies application and understanding.

**Game theory** is the formal study of conflict and cooperation. Game theoretic concepts apply whenever the actions of several agents are interdependent. These agents may be individuals, groups, firms, or any combination of these. The concepts of game theory provide a language to formulate, structure, analyze, and understand strategic scenarios.

**Question1.** The object of study in game theory is the game, which is a formal model of an/a ..…….. situation. It typically involves several players; a game with only one player is usually called a ……. .The formal definition lays out the players, their preferences, their information, the strategic actions available to them, and how these influence the outcome.

**1)** interactive/ decision problem
**2)** controversial/monogamy
**3)** conflicting/ noncooperative game
**4)** cooperative/operational research

**Question2.** A major part of decision making involves the analysis of a finite set of …….. described in terms of some evaluative criteria. These criteria may be benefit or cost in nature. Then the problem might be to rank these alternatives in terms of how attractive they are to the decision maker(s) when all the criteria are considered …….. Another goal might be to just find the best alternative or to determine the relative total priority of each alternative (for instance, if alternatives represent projects competing for funds) when all the criteria are considered simultaneously. Solving such problems is the focus of multi-criteria decision analysis (MCDA) also known as multi-criteria decision making (MCDM).

**1-** 1) decisions 2) criterion 3) alternatives 4) criteria
**2-** 1) totally 2) spontaneously 3) reciprocally 4) simultaneously

**Question3.** Some decisions are difficult because of the need to …….. how other people in the situation will respond to the decision that is taken. The analysis of such social decisions is more often treated under the label of ……., rather than decision theory.

**1)** set into account/ operational research
**2)** take into account/ game theory
**3)** take into consideration/ operational research
**4)** set into consideration/ game theory

***Vocabulary***

*Fundamental:* basic, elemental; essential

*Typically:* characteristic of a particular person or thing

*Encounter:* meet by chance; face, meet with (difficulties, hardship, etc.)

*Property:* possessions, belongings; estate, assets; ownership; characteristic, attribute

*Correlation:* mutual relation, mutual connection (between two or more things); similarity

*Advance:* progress, move forward; promote; propose, suggest

*Invariant:* constant, unchanging amount

*Significantly:* remarkably, outstandingly, importantly

*Straightforward:* frank, candid; sincere; easy to do or understand

*Accurate:* precise, exact

*Conclusion:* end; final decision; deduction

***Strategies***
***Identifying negative facts***
You might be asked about what is NOT mentioned in the passage or what is NOT true according to the passage. It means that three of the options are true and the other one is not. In this case, you should read the options first and then match the options against the information. Usually the options are related to a specific part of the passage otherwise you should skim whole the body of text to compare options against the regarding fact.

# Passage1

Economic decisions differ in a fundamental way from the types of decisions typically encountered in engineering design. In a design situation, the engineer uses known physical properties, the principles of chemistry and physics, engineering design correlations, and engineering judgment to arrive at a workable and optimal design. If the judgment is sound, the calculations are done correctly, and we ignore technological advances, the design is time invariant. In other words, if the engineering design to meet a particular need is done today, next year, or in five years time, the final design will not change significantly.

In considering economic decisions, the measurement of investment attractiveness is relatively straightforward. However, information required in such evaluations always involve predicting or

forecasting product sales, product selling price, and various costs over some future time frame- *5* years, 10 years, 25 years, etc.

All such forecasts have two things in common. First, they are never completely accurate when compared with the actual values realized at future times. Second, a prediction or forecast made today is likely to be different than one made at some point in the future. It is this ever-changing view of the future that can make it necessary to revisit and even change previous economic decisions. Thus, unlike engineering design outcomes, the conclusions reached through economic evaluation are not necessarily time invariant. Economic decisions have to be based on the best information available at the time of the decision and a thorough understanding of the uncertainties in the forecasted data.

In manufacturing, engineering is involved in every detail of producing goods, from conceptual design to shipping. In fact, engineering decisions account for the major (some say 85%) of product costs. Engineers must consider the effective use of capital assets such as buildings and machinery. One of the engineer's primary tasks is to plan for the acquisition of equipment (capital expenditure) that will enable the firm to design and produce products economically. With the purchase of any fixed asset, equipment for example, we need to estimate the profits (more precisely, the cash flows) that the asset will generate during its service period. In other words, we have to make capital-expenditure decisions based on predictions about the future. Suppose, for instance, that you are considering the purchase of a deburring machine to meet the anticipated demand for hubs and sleeves used in the production of gear couplings. You expect the machine to last 10 years. This purchase decision thus involves an implicit 10-year sales forecast for the gear couplings, which means that a long waiting period will be required before you will know whether the purchase was justified.

An inaccurate estimate of asset needs can have serious consequences. If you invest too much in assets, you incur unnecessarily heavy expenses. Spending too little on fixed assets is also harmful. For then your firm's equipment may be too obsolete to produce products competitively, and without an adequate capacity, you may lose a portion of your market share to rival firms. Regaining lost customers involves heavy marketing expenses and may even require price reductions or product improvements, both of which are costly.

**1- What is the main idea of the first paragraph?**

1. Fundamental of economic decision.
2. Fundamental of engineering design.
3. Time credit of engineering design.
4. Distinction of economic decision and industrial design.

**2- What is the main idea of the third paragraph?**

1. Economic decisions reached by economic evaluations are necessarily time invariant.
2. Economic evaluations are valid forever.
3. Conclusions obtained by economic evaluations are not necessarily time invariant.
4. Time has nothing to do with economic evaluations.

**3- What is the main idea of the last paragraph?**

1. Making precise estimation will help production.
2. Spending too little on fixed assets cannot have serious consequences.
3. Inaccurate estimations of asset needs can improve competitiveness.
4. All the options.

**4- Which one is the best title for the passage?**

1. Estimation in production.
2. Engineering economy.
3. Economic decision.
4. All the options.

**5- All the following are used in design situation EXCEPT….. .**

1. physical properties
2. principles of chemistry and physics
3. engineering design correlations
4. economic judgments to arrive at workable design

**6- According to the passage, all of statements are true EXCEPT….. .**

1. Design is time invariant
2. Economic decisions are not time invariant
3. Forecasts are accurate when compared with the actual values realized at future times
4. Forecast made today is likely to be different than one made at some point in the future

**7- According to the passage, it is NOT true that …. .**

1. engineers have to make capital-expenditure decisions based on predictions
2. economic decision is not an engineering task
3. engineer's primary tasks are to plan for the acquisition of equipment
4. an inaccurate estimate of asset needs can have serious consequences

**8- All of the following are reasons for importance of accurate estimate EXCEPT….. .**

1. investing too much in assets
2. incurring unnecessarily heavy expenses
3. defect in inventory
4. losing competitiveness

**9- "Sound" in line 4 means:**

1. clear 2. loud 3. voice 4. valid

## Passage 2(Industrial Engineering 89)

Operational Research is the science of planning and executing an operation to make the most economical use of the resources available. The operation can be as simple as making a cup of coffee or as complicated as scheduling the movements of a fleet of oil tankers around the world. It can be a project which will be undertaken only once, like the construction of a particular building, or a regularly repeated activity like the weekly ordering of stock in a shop. In each case the manager has to organize labor, equipment and materials in order to achieve a certain objective, usually the maximization of profit. Operational Research techniques attempt to model such real-world systems, either on paper or in a computer, so that their performance can be optimized with respect to an appropriate set of criteria.

The history of operational Research is not a long one although its origins can be traced back to the industrial Revolution. Most of the ideas were not developed until the Second World War when the British and American Armed Forces found themselves mounting large scale operations, many thousands of miles from their home bases. It because necessary to study the logistics of moving quantities of men, weaponry, vehicles and supplies over long distances in a coordinated fashion. Even in the fighting itself a mathematical approach was used to find the optimum military strategies.

**1. The passage does NOT imply that the manager:**

1) likes the construction of a particular building

2) tries to model real-world systems

3) organizes labor, equipment and materials.

4) uses a set of criteria.

**2. According to the passage, the word "optimum" means:**

1) maximinisation 2) minimization 3) maximization 4) most favorable

**3. The passage implies that:**

1) Operational Research is like the construction of a building

2) Operational Research developed in second World War

3) Operational Research related only to military activities

4) Operational Research always maximizing the profit

**4. According to the passage, "Scheduling" is:**

1) planning for raw material 2) planning for manpower

3) planning for equipment 4) planning for time

**5. What is the best title for this passage?**

1) Optimization Techniques 2) Operational Research

3) Industrial Revolution 4) Military strategies

*UNIT 6*

# Quality

Superset
Roughly
Stuff
Trivial
Verify
Weird
Continually
regular
interval
workload
periodically
side effect
stake
communicate
corporate
extend
disseminate
functionality
legitimacy
professionalism
evaluate
motivated
profitability
integrative
premise
capitalize
exceed
cross-functional
commit
Standardization

## Quality control

Quality control describes the directed use of testing to measure the achievement of a specified standard. Quality control is a formal use of testing. Quality control is a superset of testing, although it often used synonymously with testing. Roughly, you test to see if something is broken, and with quality control you set limits that say, in effect, if this particular stuff is broken then whatever you're testing *fails*.

Yet another way of looking at the difference between *testing* and *quality control* is to consider the difference between a test as an event and a test as a part of a system. For example, let's say our test is the measurement of your ability to assemble a jigsaw puzzle in one hour. We test you

today, and you complete the puzzle in fifty-eight minutes, so you pass. This seems pretty trivial, but says that there is some need in your life requiring you to solve puzzles quickly: we tested you once, but we must verify that you can meet this weird requirement continually over time. The solution is to test you at regular intervals, which will allow us to see if you can still be successful when under stress, when you haven't slept, when your workload is high — our quality control approach to this issue says "you must finish puzzle in one hour or less" and "we will test this requirement periodically over time". And as a side effect of this quality control testing, you might find that you are more likely to *improve* in your puzzle solving skills because of the repeated practice; this is the beginning of a shift to quality assurance.

A structured quality control program becomes necessary when the stakes rise: your site is supposed to make money, or communicate a corporate message, or extend a brand, or disseminate important information. Quality control also becomes necessary when the team grows, or you partner with more companies, or your site gets more visitors. You need quality control as soon as it becomes important to *prove*, through the appearance and functionality of your web site, that your site has the legitimacy and professionalism to stand behind its message.

## QFD

Quality Function Deployment (QFD**)** is a unique quality tool that allows businesses to plan and design products with the customers' needs in mind. QFD is a structured method for product or service planning. QFD lets a project team specify the customers' needs and then evaluate how the organization is meeting those needs. By using QFD, a business is motivated to focus on its customers and translate customer requirements into internal product specifications. With good initial requirements the customer obtains a higher quality product in a shorter time.

QFD is not a quality tool itself, but rather a visual-planning tool that helps to improve quality. When used to focus on the customer's needs early in the design, the team responsible for the development and introduction of the product finds that fewer changes are required after introduction into the market. When QFD is correctly utilized, it creates a closed loop that lowers costs and increases quality, timeliness, productivity, profitability, and market share.

# TQM

Total quality management or TQM is an integrative philosophy of management for continuously improving the quality of products and processes. It is used around the world.

TQM functions on the premise that the quality of products and processes is the responsibility of everyone who is involved with the creation or consumption of the products or services offered by an organization. In other words, TQM capitalizes on the involvement of management, workforce, suppliers, and even customers, in order to meet or exceed customer expectations. Considering the practices of TQM as discussed in six empirical studies, Cua, McKone, and Schroeder (2001) identified the nine common TQM practices as cross-functional product design, process management, supplier quality management, customer involvement, information and feedback, committed leadership, strategic planning, cross-functional training, and employee involvement.

# ISO

The ISO 9000 family of standards relate to quality management systems and are designed to help organizations ensure they meet the needs of customers and other stakeholders. The standards are published by ISO, the International Organization for Standardization and available through National standards bodies. ISO 9000 deals with the fundamentals of quality management systems, including the eight management principles on which the family of standards is based. ISO 9001 deals with the requirements that organizations wishing to meet the standard have to fulfill.

Third party certification bodies provide independent confirmation that organizations meet the requirements of ISO 9001. Over a million organizations worldwide are independently certified, making ISO 9001 one of the most widely used management tools in the world today.

**Question1.** Bias is a measure of systematic or …….. error. It may be a result of the method, itself, or the lab's use or interpretation of the method. Results that are …….. lower or higher than the true value reflect high bias.

1) inherent/ consistently
2) coherent/ continually
3) cohesive/exceptionally
4) precise/ unusually

**Question2.** Since variability can only be …….. in statistical items, statistical methods play a central role in quality improvement efforts. In the application of statistical methods to quality engineering, it is fairly typical to classify data on quality characteristics as either attributes or variables data.

1) prescribed 2) transcribed 3) described 4) scribed

**Question3.** Quality assurance is the set of activities that …….. the quality levels of products and services are properly ……. and that supplier and customer quality issues are properly resolved. Documentation of the quality system is an important component.

1) insures/preserved
2) determines/sustained
3) assures/protected
4) ensures/ maintained

**Question4.** One measure of the performance of the total quality system is the cost ……with it. Careful identification, measurement, and analysis of cost as a function of time …… in tracking the impact of an effective quality control system.

1) related /aimed
2) associated/aids
3) identified/ intervenes
4) decreased/affected

***Vocabulary***

*Concept:* idea, thought

*Somewhat:* slightly; to a certain extent; quite

*Variety:* diversity, multiplicity; assortment; kind, sort

*Commonality:* sharing of common features

*Endeavor:* effort, attempt

*Derive:* extract, take from a source

*Intend:* have in mind to do or accomplish, plan; mean

*Defective:* imperfect; deficient, lacking

*Temporarily:* lasting for only a limited period

*Haphazard:* random, irregular; lacking order or direction

***Strategies***
***Understanding vocabulary in context***
The context is the setting- the sentence and paragraph- in which a word or phrase appears. The meaning of a word or phrase in a context is its meaning in the particular sentence and paragraph in which it is used. A single word in English can have many different meanings. Its precise meaning always depends on the context in which it is used.
To understand the meaning of a word in context, you can use different types of context clues: your knowledge of structure, punctuation, and the meaning of the other words in the same sentence. In the reading you do, there may not always be context clue to help you. However, you can guess the probable meaning of an unfamiliar word by using your overall understanding of the ideas in the passage as well as your common sense and knowledge of the world.

***Structural clues*** are one type of context clues. Structural clues are certain words, phrases, and grammatical structures that point to the relationship among the various parts of the sentence. These clues help you to understand the meaning of an unfamiliar word by showing how the word relates to the other word and ideas in the sentence. The structural clues below can help you understand vocabulary in context.
***Clues:*** Be; Or; Appositive; Adjective Clause and Phrase; List or Series; Example; Contrast; Punctuation clues; Key words; Word parts

Quality is a much more complicated term than it appears. Dictionary definitions are usually inadequate in helping a quality professional understand the concept. It seems that every quality expert defines quality is a somewhat different way. There are a variety of perspectives that can be taken in defining quality (e.g. customer's perspective, specification-based perspective). Are there commonalities among these definitions? Is anyone definition "more correct" than the others? Is one quality expert "right" and the others "wrong"? Quality professionals constantly debate this question. The editors of Quality Digest say that defining the word "quality" is "no simple endeavor." They asked, in their December 1999 issue, for readers to send them their definitions of quality to be gathered and posted on Quality Digest Online.
A modern definition of quality derives from Juran's "fitness for intended use." This definition basically says that quality is "meeting or exceeding customer expectations." Deming states that the customer's definition of quality is the only one that matters. So, who is the customer? There is a difference between a symptom and a problem. Healthwise, a headache is usually a symptom. The cause of a headache (e.g. drinking too much alcohol, a brain tumor) is the

problem. In business, poor employee morale is usually a symptom (not a problem)--perhaps of poor supervision, inadequate working conditions, etc. High rates of scrap and rework are usually symptoms of a process problem (e.g. defective lot of material, a malfunctioning machine, an inadequately trained operator). In order to have any meaningful and lasting impact, the problem solving process must focus on the problem (root cause) rather than the symptom. Healthwise, an aspirin might temporarily relieve the headache, but the headache will recur because the root cause (tumor) has been ignored. Holding a company picnic will have little lasting impact on employee morale if the cause of poor morale (poor supervision) is ignored. Effective quality professionals use a structured approach to problem solving that is focused on root causes rather than a haphazard or seat-of-the-pants approach.

**1- The word "inadequate" in the passage is closet in meaning to ……. .**

1. defective 2. enough 3. competent 4. flawless

**2- The word "expert" in the passage means……. .**

1. specialist 2. master 3. magnificent 4. amateur

**3- Which one is NOT the synonym of "exceed"?**

1. transcend 2. excel 3. outstrip 4. nominate

**4- "symptom" means:**

1. indicator 2. solution 3. client 4. disease

**5- The word "morale" in the passage is closet in meaning to….. .**

1. disease 2. confidence 3. ethic 4. virtue

**6- The word "scrap" in the passage means……. .**

1. junk 2. scribble 3. scrawl 4. squiggle

**7- Select the synonym of "lasting" in the line 18:**

1. enduring 2. ephemeral 3. ceasing 4. temporary

**8- Which one is the best description of "malfunction"?**

1. Function in a defective manner
2. Fail to operate normally
3. Function in an unflawed manner
4. Both(1) and (2)

**9- What is Quality Digest?**

1. An especial method in QC
2. Concept of Quality
3. Important point of view
4. Kind of publication

**10- The phrase "seat-of-the-pants" in last line is closet in meaning to……. .**

1. "employing or based on personal experience"
2. "in a random manner"
3. "based on specified algorithms"
4. "scientifically"

**Industrial Engineering 86**

Statistical process control (SPC) is a method for achieving quality control in manufacturing processes. It is a set methods using statistical tools such as mean, variance, and others to detect whether the process observed is under control. Statistical process control was pioneered by Walter A. Shewhart and taken up by W. Edwards Deming with significant effect by Americans during World War II to improve industrial production. Deming was also instrumental in introducing SPC methods to Japanese industry after that war. Dr. Shewhart created the basis for the control chart and the concept of a state of statistical control by carefully designed experiments. While Dr. Shewhart drew from pure mathematical statistical theories, he understood that data from physical processes never produce a "normal distribution curve" (a Gaussian distribution, also commonly referred to as a "bell curve"). He discovered that observed

variation in manufacturing data did not always behave the same way as data in nature (Brownian motion of particles). Dr. Shewhart concluded that while every process displays variation, some processes display controlled variation that is natural to the process, while others display uncontrolled variation that is not present in the process causal system at all times.

Classical quality control was achieved by observing important properties of the finished product and accept/reject the finished product. As opposed to this, statistical process control uses statistical tools to observe the performance of the production line to predict significant deviations that may result in rejecting products. The underlying assumption in the SPC method is that my production process will produce products whose properties vary slightly from their designed values, even when the production line is running normally, and these variances can be analyzed statistically to control the process. For example, a breakfast cereal packaging line may be designed to fill each cereal box with 500 grams, but some boxes will have slightly more than 500 grams, and some will have slightly less, producing a distribution of net weights. If the production process itself changes (for example, the machines doing the manufacture begin to wear) this distribution can shift or spread out. For example, as its cams and pulleys wear out, the cereal filling machine may start putting more cereal into each box than it was designed to. If this change is allowed to continue unchecked, product may be produced that fall outside the tolerance of the manufacturer or consumer, causing product to be rejected. By using statistical tools, the operator of the production line can discover that a significant change has been made to the production line, by wear and tear or other means, and correct the problem- or even stop production- before producing product outside specification. An example would be the Shewhart control chart and the operator in the aforementioned example plotting the net weight in the Shewhart chart.

**1- The main purpose of the first paragraph is to explain ……. .**

1) The work of two SPC analysts

2) the historical development of SPC

3) Shewhart's contribution to statistics

4) a manufacturing process during the 2nd world war

**2- The Shewart control chart ……. .**

1) was purely theoretical

2) is a type of statistical tool

3) Can be considered as a production line

4) functions as a table of specifications

**3- The word "instrumental" in line 5 can best be replaced by…… .**

1) active 2) patient 3) interested 4) influential

**4- According the passage, SPC method…… .**

1) develops designed values
2) is a quantitative method of processing
3) is a concerned with variation in the weight of products
4) Employs both controlled and uncontrolled observation

**5-Statistical process control can contribute to quality control by …… .**

1) Statistically analyzing variances

2) packaging the finished product

3) Primarily changing the production process

4) increasing the tolerance of the manufacture

**6- The word "its" in line 25 refers to …… .**

1) machine 2) process 3) distribution 4) manufacture

**7-The statistical tools in SPC …… .**

1) form a set of methods

2) were first introduced by Deming

3) were developed to gather similar date in nature

4) help continue or discontinue production

**8- According to the passage, it is NOT true that…….. .**

1) variances fail into two categories

2) wear and tear is one source of variation in weight

3) net weights should be distributed across boxes

4) an increase in weight may dissatisfy the manufacture

# UNIT 7

# Management

| | |
|---|---|
| Accomplish | Appointee |
| Efficiently | Prioritization |
| Effectively | Deliberate |
| Comprise | Adversary |
| Staffing | Actuarial |
| Entity | Secure |
| Encompass | Endeavor |
| Manipulation | bring about |
| Primary | permanent |
| Satisfaction | preconceived |
| Reasonable | constraint |
| Faith | portfolio |
| Donor | investment |
| Constitute | asset |
| Administrator | |

Management in all business and organizational activities is the act of getting people together to accomplish desired goals and objectives using available resources efficiently and effectively. Management comprises planning, organizing, staffing, leading or directing, and controlling an organization (a group of one or more people or entities) or effort for the purpose of accomplishing a goal. Resourcing encompasses the deployment and manipulation of human resources, financial resources, technological resources, and natural resources.

Since organizations can be viewed as systems, management can also be defined as human action, including design, to facilitate the production of useful outcomes from a system. This view opens the opportunity to 'manage' oneself, a pre-requisite to attempting to manage others.

In for-profit work, management has as its primary function the satisfaction of a range of stakeholders. This typically involves making a profit (for the shareholders), creating valued products at a reasonable cost (for customers), and providing rewarding employment opportunities (for employees). In nonprofit management, add the importance of keeping the faith of donors. In most models of management/governance, shareholders vote for the board of directors, and the board then hires senior management. Some organizations have experimented with other methods (such as employee-voting models) of selecting or reviewing managers; but this occurs only very rarely.

In the public sector of countries constituted as representative democracies, voters elect politicians to public office. Such politicians hire many managers and administrators, and in some countries like the United States political appointees lose their jobs on the election of a new president/governor/mayor.

**Risk Management**

Risk management is the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities. Risks can come from uncertainty in financial markets, project failures (at any phase in development, production, or sustainment life-cycles), legal liabilities, credit risk, accidents, natural causes and disasters as well as deliberate attack from an adversary or events of uncertain root-cause. Several risk management standards have been developed including the Project Management Institute, the National Institute of Science and Technology, actuarial societies, and ISO standards. Methods, definitions and goals vary widely according to whether the risk management method is in the context of project management, security, engineering, industrial processes, financial portfolios, actuarial assessments, or public health and safety.

The strategies to manage risk include transferring the risk to another party, avoiding the risk, reducing the negative effect or probability of the risk, or even accepting some or all of the consequences of a particular risk.

Certain aspects of many of the risk management standards have come under criticism for having no measurable improvement on risk, whether the confidence in estimates and decisions seem to increase.

**Project management**

Project management is the discipline of planning, organizing, securing and managing resources to bring about the successful completion of specific project goals and objectives.

A project is a temporary endeavor, having a defined beginning and end (usually constrained by date, but can be by funding or deliverables), undertaken to meet unique goals and objectives, usually to bring about beneficial change or added value. The temporary nature of projects stands in contrast to business as usual (or operations), which are repetitive, permanent or semi-permanent functional work to produce products or services. In practice, the management of these two systems is often found to be quite different, and as such requires the development of distinct technical skills and the adoption of separate management.

The primary challenge of project management is to achieve all of the project goals and objectives while honoring the preconceived project constraints. Typical constraints are scope, time, and budget. The secondary—and more ambitious—challenge is to optimize the allocation and integration of inputs necessary to meet pre-defined objectives.

**Technology management**

**Question1.**Technology Management is set of management …….. that allow organizations to manage its technological fundamentals to create ……...advantage. Typical concepts used in technology management are technology strategy, technology forecasting, technology roadmapping, technology project portfolio and technology portfolio.

1) techniques/financial
2) disciplines/ competitive
3) planning/ non-commercial
4) experts/ commercial

**Question2.**Portfolio managers make decisions about …….. mix and policy, matching investments to objectives, asset allocation for individuals and institutions, and balancing risk against performance.

1) investment
2) strategic
3) managerial
4) functional

**Question3.**Product development (inbound-focused) and product marketing (outbound-focused) are different yet ……. efforts with the objective of maximizing sales revenues, market

share, and profit margins. The role of product management ……. many activities from strategic to tactical and varies based on the organizational structure of the company.

1) contrary/ mixes
2) opposing/ crosses
3) implementing/integrates
4) complementary/ spans

**Question4.**Staff management is the management of the …….. in an organization. In large organizations, many of these functions are performed by a specialist department such as …….. , but all line managers are still required to supervise and administer the activities and well-being of the staff that report to them.

1) subsidiaries/ Human Factor Engineering
2) subordinates/ Personnel or Human resources
3) employers/ Enterprise Resource Planning
4) acquisition/Staff Acquisition

***Vocabulary***

*Enterprise:* company, firm, business

*Acronym:* word formed from the first initials of several words

*Throwaway:* disposable

*Ambition:* aspiration, hope

*Finance:* raise money for; provide with funds, fund, pay for

*Warehouse:* storehouse, depot

*Combine:* unite, join; come together; become one

*Run off:* escape; print, make copies; produce quickly

*Share:* part; portion; quota, allocation

*Communicate:* share or exchange information or ideas

*Tremendous:* very great in numbers, huge, enormous, powerful

***Strategy***
***Making inferences***
An inference is a conclusion you can make from the information given in a passage. An inference is an idea that you can reasonably take to be true, based on what the author says. Some inferences can be made from a single sentence. Some inferences are based on a whole paragraph or on the entire passage.
An inference is a "hidden" idea. To make an inference, you must understand an idea that the author does not state directly. To do this you must interpret the information that is stated directly. What the author does not state directly and openly, he or she may ***imply*** and ***suggest*** by mentioning certain facts and details. When an author implies something, you must ***infer*** or ***conclude*** the meaning based on what author does say.

Enterprise resource planning software or ERP, Forget about planning—it doesn't do much of that—and forget about resource, a throwaway term. But remember the enterprise part. This is ERP's true ambition. It attempts to integrate all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs.
That is a tall order, building a single software program that serves the needs of people in finance as well as it does the people in human resources and in the warehouse. Each of those departments typically has its own computer system optimized for the particular ways that the department does its work. But ERP combines them all together into a single, integrated software program that runs off a single database so that the various departments can more easily share information and communicate with each other.
That integrated approach can have a tremendous payback if companies install the software correctly.

**1- It can be inferred from first paragraph that?**

1. Planning the enterprise is not that important.
2. Resource is an essential term in ERP.
3. ERP helps to be ambitious.
4. Enterprise resource planning doesn't live up to its acronym.

**2- The word "ambition" in the passage is closest in the meaning to….. .**

1. objective 2. recognition 3. identification 4. notion

**3- What can be inferred about ERP?**

1. It is kind of comprehensive software.
2. It is limited to each department.
3. ERP links all the databases.
4. None of the above mentioned.

**System Engineering (89)**

Over the years the relationship between employer and employee has changed from master and servant to one of employer and employee. Earlier it was a one-sided relationship will employer wielding absolute power to hire and fire employees.

Gradually government and unions intervened to prevent one-sided exploitation by the employer and to wield countervailing power over them. Today the relationship between employer and employee is contractual, reciprocal and mutual. The employee has certain rights and obligations and so does the employer. While the laws, courts and unions have, over the years, limited the rights of management, the rights of employees have been preserved and furthered by managerial indiscretions, laws, courts and unions.

The obligations of the employer are relatively precise and specific whereas those of the employees are imprecise and elastic. The substantive terms of the contract of employment prescribe wages, hours, holidays, etc. in definitive terms. But the obligations of the employee to provide an honest, efficient and faithful service and to obey orders are not easily measurable and therefore application of sanctions against workers for non-fulfillment of obligations often becomes difficult. Also managerial authority and power needs to be accepted by the subordinates. Tolerance to non acceptance of managerial arbitrariness in the exercise of managerial authority can cause further problems.

In any case, in the employment relationship employees expectations become employer's responsibilities and employer's expectations become employees' responsibilities. So, there is

bound to be certain area of friction or dissatisfaction where either party is not able to live up to the other's expectations.

**1- According to the passage, defining the obligations of the employee is not easy, because:**

1) They are not limited and contractual
2) They are employers' expectations
3) They are not accepted by employer
4) They are not measurable

**2- According to the passage, "obligations" means:**

1) duties 2) rules 3) laws 4) tasks

**3- The passage implies that:**

1) the relationship between employee and employer is like the servant and master yet
2) the obligations of the employees are flexible
3) the employee's expectations are the same as employer's expectations
4) one of the employer's rights is job security

**4- According to the passage, "Subordinates" related to:**

1) employers 2) courts 3) employees 4) laws

**5- What is the best title for the passage?**

1) The obligations of the employer and employee
2) Nature of the employment relationship
3) The rights of the employer and employee
4) The contract of employment

**Industrial Engineering (79)**

The public sector's provision of infrastructure has been a major contributor to East Asia's past success. But if rapid modernization is to be sustained, international engagement deepened, and the challenges to rising urbanization met, large infrastructure investments in power, transport,

water, and telecommunications are needed. In an increasingly competitive global economic environment, efficient infrastructure services become a more important ingredient to success; infrastructure bottlenecks not only stifle growth, raise costs, and hurt competitiveness but also reduce people's quality of life. East Asia's infrastructure needs are vast- an estimated $1.2 billion to $1.5 billion over the next decade. The needs far exceed the financial and managerial capacity of the public sector and can only be met if the private sector's role is increased significantly and infrastructure provision is commercialized. Private sector investment account for at most 10 percent of today's infrastructure investment in East Asia, yet there is growing recognition that private investment should increase to some 30 percent over the medium term. The binding constraint of reaching this goal is the lack of bankable projects. Creating a pool of bankable projects requires a combination of political will and aggressive policy and institutional reforms that will develop competitive market structures, sound regulatory regimes, price reforms, risk mitigation measures, competitive and transparent contracting procedures, and effective financial mechanisms.

**1- With large infrastructure investments in power, transport, water, and telecommunications can help …….. objectives.**

1) 3 2) 5 3) 2 4) 4

**2- The passage suggests that to provide for the infrastructure needs in East Asia …….**

1) The investment by the private sector must be raised to 10 recent of today's investments
2) a greater portion should be dedicated to the private sector than is today
3) the financial and managerial capacity of the public sector must be enhanced
4) none of the above

**3- The estimated quantity of investment on East Asia's infrastructure is ……**

1) less than the public sector's present capacity
2) for a period of ten years
3) all to be met by the private sector
4) both 2 and 3 above

**4- The underlined word "mitigation" in line 16 is closest in meaning to ……..**

1) reduction 2) increasing 3) estimation 4) eradication

**5- The lack of bankable projects is mentioned as a limitation which ……..**

1) creates infrastructure bottlenecks

2) encourages more investment by the private sector

3) will stifle growth, raise costs, and hurt competitiveness

4) prevent increased investment by the private sector

UNIT 8

# Manufacturing Engineering

| | |
|---|---|
| Convert | Command |
| Modification | Storage |
| Assure | Via |
| Determination | Cam |
| Specification | fed into |
| Flexibility | |
| Numerous | |
| Subcategories | |
| Absorb | |
| Effort | |
| Application | |
| Abstractly | |

Manufacturing engineering is engineering activities involved in the creation and operation of the technical and economic processes that convert raw materials, energy, and purchased items into components for sale to other manufacturers or into end products for sale to the public. Defined in this way, manufacturing engineering includes product design and manufacturing system design as well as operation of the factory. More specifically, manufacturing engineering involves the analysis and modification of product designs so as to assure manufacturability; the design, selection, specification, and optimization of the required equipment, tooling, processes, and operations; and the determination of other technical matters required to make a given product according to the desired volume, timetable, cost, quality level, and other specifications.

**Flexible Manufacturing Systems**

A flexible manufacturing system (FMS) is a manufacturing system in which there is some amount of flexibility that allows the system to react in the case of changes, whether predicted or

unpredicted. This flexibility is generally considered to fall into two categories, which both contain numerous subcategories. The first category, machine flexibility, covers the system's ability to be changed to produce new product types and the ability to change the order of operations executed on a part. The second category is called routing flexibility, which consists of the ability to use multiple machines to perform the same operation on a part, as well as the system's ability to absorb large-scale changes, such as in volume, capacity, or capability. Most FMS systems comprise three main systems. The work machines, which are often automated CNC machines, are connected by a material handling system to optimize parts flow and the central control computer, which controls material movements and machine flow. The main advantages of an FMS are its high flexibility in managing manufacturing resources like time and effort in order to manufacture a new product. The best application of an FMS is found in the production of small sets of products like those from a mass production.

**Question1.**Computer-aided design (CAD), also known as computer-aided design and ..... (CADD) is the use of computer technology for the process of design and design-documentation.

1) devastate
2) drafting
3) drawing
4) delivery

**Question2.** Numerical control (NC) refers to the …… of machine tools that are operated by abstractly programmed commands ……. on a storage medium, as opposed to manually controlled via handwheels or levers, or mechanically automated via cams alone.

1) discrimination/ translated
2) indiscrimination/transformed
3) automation/encoded
4) endue/ eradicated

**Question3.** Computer-aided ……..(CAM) is the use of computer software to control machine tools and related …….. in the manufacturing of workpieces.

1) automation/ system
2) machines/cams and pulleys
3) manufacturing/products
4) machine tools/ machinery

***Vocabulary***

*Capability:* ability, skill

*Limitation:* bound, restriction; act of limiting; state of being limited

*Maintain:* keep in existence, sustain; keep in good condition, preserve

*Constraint:* restriction; artificial manner, unnatural manner; force

*Comprehensive:* extensive, including much, large in scope

*Acquisition:* act of acquiring; purchase, something acquired or obtained

*Ensure:* make certain; guarantee; make secure

*Manpower:* power available from or supplied by human labor

*Throughout:* every part, at every point or moment

*Achieve:* obtain, attain; perform, accomplish; succeed

*Interactive:* acting reciprocally, acting mutually; communicating

*Environment:* surroundings; conditions in which someone or something lives

*Ease:* make easier; calm, soothe; free, release

*Aid:* help; assist

*Requirement:* necessity

*Eliminate:* remove, get rid of

*Cognitive:* aware, perceptive

*Sensory:* relating to sensation or the senses

*Excessive:* immoderate, exceeding normal bounds, extreme

*Workload:* amount of work to be done

*Frequent:* happening often; regular; common, usual

*Hazard:* danger, risk; game of chance

*Prior:* previous, earlier, preceding, former

*Refine:* purify, filter, distill; cultivate,

*Multidisciplinary:* applying to many different branches of education

*Compile:* collect, produce (a collection) by assembling material from other sources.

*Enhance:* increase; intensify; improve; raise the value of

*Baseline:* a minimum or starting point used for comparisons

***Strategies***
***Text unity***
One of the things which can be helpful in answering reading questions is the ability to predict what is going to come next after a give sentence or part in the passage. Recognition of the main idea will assist to guess what is going to represent next.
For instance, when the main idea of a paragraph is privileges of QC, you expect some items and applications to be continued.

The capabilities and limitations of the system operators and maintainers always place constraints on systems that must be considered during the development process. A comprehensive management and technical strategy for human systems integration must be initiated early in the acquisition process to ensure that human performance, safety, manpower, personnel and training issues be considered throughout the system design and development process. The objective of the human factors engineering critical process is to establish acceptable compatibility between the system and the people who operate, maintain, and support it. To insure system objectives are met and personnel safety is considered, human factors engineering must be integrated into all phases of system engineering: design, manufacture, test, and support.

Human System Integration (HSI) is the systematic use of knowledge to achieve compatibility in the design of interactive systems of people, machines, and environments to ensure their effectiveness, safety, and ease of performance. The term covers all biomedical and psychosocial considerations. It includes, but is not limited to, principles and applications in the areas of human factors engineering, personnel selection, training, life support, job performance aids, and human performance evaluation. Human factors engineering requirements are established to develop effective human-machine interfaces, and minimize or eliminate system characteristics that require extensive cognitive, physical, or sensory skills; require excessive training or workload for intensive tasks; or result in frequent or critical errors or safety/health hazards. The capabilities and limitations of the operator, maintainer, trainer, and other support personnel must be identified prior to program initiation and refined during the development process.

Human factors is a multidisciplinary effort to generate and compile information about human capabilities and limitations and apply that information to equipment, systems, software, facilities, procedures, jobs, environments, training, staffing, and personnel management to produce safe,

comfortable, and effective human performance. When human factors is applied early in the acquisition process, it enhances the probability of increased performance, safety, and productivity; decreased lifecycle staffing and training costs; and become well-integrated into the program's strategy, planning, cost and schedule baselines, and technical tradeoffs. Changes in operational, maintenance or design concepts during the later phases of a project are expensive and entail high-risk program adjustments. Identifying lifecycle costs and human performance components of system operation and maintenance during requirements definition decreases program risks and long-term operations costs.

**1- Which one is the main idea of first paragraph?**

1. Obstacles on systems
2. Barriers on staff acquisition
3. Introducing ERP
4. Introducing targets of human factor engineering

**2- According to the second paragraph…. .**

1. HSI is one of the most important sectors of human factors engineering literature.
2. HSI is not limited to the human factors engineering literature.
3. The capabilities of the staff must be identified posterior to program initiation
4. 2&3.

**3- According to third paragraph, all the statements are true EXCEPT…. .**

1. Applying human factors engineering enhance safety
2. Applying human factors engineering may increase bugs in the systems
3. Applying human factors engineering decreased lifecycle staffing and training costs
4. 1&2.

**System Engineering (86)**

Quite frequently manufactured products have unnecessary precision, production operation, or parts. Simple redesign can eliminate these, lowering costs and increasing manufacturability, reliability, and profits. For example, Russian liquid-fuel rocket motors are intentionally designed to permit ugly (though leak-free) welding, to eliminate grinding and finishing operations that do

not help the motor function better. Some Japanese disc brakes have parts tolerance to three millimeters, an easy-to-meet precision. When combined with crude statistical processes controls, this assures that less than one in a million parts will fail to fit. Many vehicle manufactures have active programs to reduce the numbers and types of fasteners in their product, to reduce inventory, tooling and assembly costs.

Another producibility technique is near net shape forming. Often a premium forming process can eliminate hundreds of low-precision machining or- drilling steps. Precision transfer stamping can quickly produce hundreds of high quality parts from generic rolls of steel and aluminum. Die casting is used to produce metal parts from aluminum or sturdy tin alloys (they are often about as strong as mild steels). Plastic injection molding is a powerful technique, especially if the special properties of the part are supplemented with inserts of brass or steel.

When a product incorporates a computer, it replaces many parts with software that fits into a single light-weight, low- power memory part or micro- controller. As computers grow faster, digital signal processing software is beginning to replace many analog electronic circuits for audio and sometimes radio frequency processing. On some printed circuit boards (itself a producibility technique), the conductors are intentionally sized to act as delay lines, resistors, and inductors to reduce the parts count. An important recent innovation was the use of "surface mounted" components. At one stroke, this eliminated the need to drill most holes in a printed circuit board, as well as clip off the leads after soldering. In Japan, it is a standard process to design printed circuit board. As well as clip off the leads after soldering. In Japan, it is a standard process to design printed circuit boards of inexpensive phenolic resin and paper, and reduce the number of copper layers to one or two to lower costs without harming specification.

It is becoming increasingly common to consider producibility in the initial stages of product design, a process referred to as design for manufacturability. It is much cheaper to consider these changes during the initial stages of design rather than redesign products after their initial design is complete.

**1- Redesign is criticized on the grounds that it ……. .**

1) may not be cost effective

2) may lead to only simple changes

3) eliminates many necessary elements

4) increases producibility rather than manufacturability

**2- The first producibility technique …….**

1) Was limited to rocket motors

2) was introduced by Russian engineers

3) included the issue of precision in products

4) led to only one instance of failure in Japan

**3- The word "eliminate" in line 2 means …….. .**

1) manage 2) remove 3) decrease 4) evaluate

**4- The example of Japanese disc brakes shows that ……. .**

1) unnecessary precision can be avoided

2) the failure of parts is most likely

3) precision is generally easy to meet

4) the best degree of tolerance is 3 millimeters

**5- According to the passage, the specifications of the product…….. .**

1) were printed on paper in Japan

2) showed the number of copper layers

3) explained the process of designing

4) did not change despite a decrease in costs

**6- The use of tin alloys was reasonable because they…… .**

1) increased the speed of die cast 2) were better than mild steels

3) resulted in a powerful technique 4) were strong enough to be used

**7- According to the passage, it is true that……. .**

1) a micro- controller can replace a computer

2) changes should be thought of before redesign

3) generic rolls are the result of high quality parts

4) most holes were eliminated because of soldering

*UNIT 9*

# Maintenance

| | |
|---|---|
| Satisfactory | Jurisdiction |
| Inspection | Whereas |
| Detection | Right(v) |
| Incipient | Adjunct |
| Adjustment | Buffer |
| Worthwhile | Interrupt |
| Overhaul | Uptime |
| Proactive | Deterioration |
| Legislation | Convenient |

**Preventive maintenance (PM)**

Preventive maintenance (PM) has the following meanings:

1. The care and servicing by personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects.
2. Maintenance, including tests, measurements, adjustments, and parts replacement, performed specifically to prevent faults from occurring

Preventive maintenance can be described as maintenance of equipment or systems before fault occurs. It can be divided into two subgroups: Planned maintenance and condition-based maintenance.

The main difference of subgroups is determination of maintenance time, or determination of moment when maintenance should be performed.

While preventive maintenance is generally considered to be worthwhile, there are risks such as equipment failure or human error involved when performing preventive maintenance, just as in

any maintenance operation. Preventive maintenance as scheduled overhaul or scheduled replacement provides two of the three proactive failure management policies available to the maintenance engineer. Common methods of determining what Preventive (or other) failure management policies should be applied are; OEM recommendations, requirements of codes and legislation within a jurisdiction, what an "expert" thinks ought to be done, or the maintenance that's already done to similar equipment, and most important measured values and performance indications.

**Total productive maintenance** (**TPM**)

Total productive maintenance (TPM) originated in Japan in 1971 as a method for improved machine availability through better utilization of maintenance and production resources.

Whereas in most production settings the operator is not viewed as a member of the maintenance team, in TPM the machine operator is trained to perform many of the day-to-day tasks of simple maintenance and fault-finding. Teams are created that include a technical expert (often an engineer or maintenance technician) as well as operators. In this setting the operators are enabled to understand the machinery and identify potential problems, righting them before they can impact production and by so doing, decrease downtime and reduce costs of production.

TPM is a critical adjunct to lean manufacturing. If machine uptime is not predictable and if process capability is not sustained, the process must keep extra stocks to buffer against this uncertainty and flow through the process will be interrupted. Unreliable uptime is caused by breakdowns or badly performed maintenance. Correct maintenance will allow uptime to improve and speed production through a given area allowing a machine to run at its designed capacity of production.

One way to think of TPM is "deterioration prevention": deterioration is what happens naturally to anything that is not "taken care of". For this reason many people refer to TPM as "total productive manufacturing" or "total process management". TPM is a proactive approach that essentially aims to identify issues as soon as possible and plan to prevent any issues before occurrence. One motto is "zero error, zero work-related accident, and zero loss".

**Predictive maintenance** (**PdM**)

Predictive maintenance (PdM) techniques help determine the condition of in-service equipment in order to predict when maintenance should be performed. This approach offers cost savings over routine or time-based preventive maintenance, because tasks are performed only when warranted.

The main value of Predicted Maintenance is to allow convenient scheduling of corrective maintenance, and to prevent unexpected equipment failures. The key is "the right information in the right time". By knowing which equipment that needs maintenance, the maintenance work can be better planned (spare parts, people etc.) and what would had been "unplanned stops" are transformed to shorter and less "planned stops" thus increasing plant availability. Other values are increased equipment life time, increased plant safety, less accidents with negative impact on environment, an optimized spare parts handling, etc.

**Question1.** Planned Maintenance (PM) is a scheduled service visit carried out by a competent and suitable agent, to ensure that …… is operating correctly and to therefore avoid any unscheduled breakdown and …….. .

1) an item of equipment/downtime
2) equipments/uptime
3) a number of equipment/downtime
4) the number of equipment/uptime

**Question2.**Corrective maintenance can be defined as a maintenance task performed to identify, isolate, and ……a fault so that the failed equipment, machine, or system can be …… to an operational condition within the tolerances or limits established for in-service operations.

1) avoid/repaired
2) rectify / restored
3) prevent/recovered
4) predict/transformed

**Question3.** Condition-based maintenance (CBM) is maintenance when ……. . This maintenance is performed after one or more indicators show that equipment is going to fail or that equipment performance is deteriorating.

1) equipment fails
2) something goes wrong
3) it is possible
4) need arises

**Question4.** PdM, or condition-based maintenance, attempts to evaluate the condition of equipment by performing periodic or continuous (online) equipment …… . The ultimate goal of PdM is to perform maintenance at a scheduled point in time when the maintenance activity is most cost-effective and before the equipment loses performance within a …… .

1) maintenance/life span
2) inspection/life cycle
3) condition monitoring/ threshold
4) adjustment/boundary

**Industrial Engineering (78, 90)**

Total preventive Maintenance (TPM) is a concept through which plant, machinery, and equipment operators are empowered to maintain continuous production on totally efficient lines. It is a tried and tested way of cutting waste, saving money, and making factories better places to work. It gives operators the knowledge and confidence to manage their own machines. Instead of waiting for a breakdown, then calling the investigate and then eliminate the root causes of machine errors. Also, they work in small teams to achieve continuous improvements to the production lines.

Doug Martin- TPM Manager at DuPont Said:

"We've set a goal to double the shareholder value by our 200th Anniversary in 2002. The only way we will achieve that goal is by improving equipment reliability through focus on the elements of TPM".

Today, within the European Union (EU) alone, over 2 million people are involved in maintenance, and visible costs are estimated at between 125 and 170 billion ECU (European Currency Units).

**Industrial Engineering 78:**

**1- According to the passage, TPM:**

1) Totally works on preventive maintenance activities.
2) Continuously operates the plants, machinery, and equipments.
3) Gives more power to plants, machinery and equipment.
4) Maintains production lines at high efficiency and little or interruptions.

**2- The TPM concept:**

1) Saves the money for the workers to work better.

2) Makes the production system more economical.

3) Is a tool for cutting the disposed material and waste into small pieces.

4) None of the above statements are true.

**3- Through TPM concept:**

1) Operators learn to find the main causes of machine failures.

2) Operators investigate about how they can eliminate their own operational errors.

3) The root causes of machine errors is due to the elimination of operators (introduction of automation)

4) All of the above statements are correct.

**4- The TPM Manager at Du-Pont is in the idea that:**

1) By the year 2002, Du-Pont will be 200 years old.

2) By the year 2002, there will be 200 shareholders in Du-point.

3) After 200 years, there will be 2002 shareholders in Du-point.

4) By the year 2002, the no. Of shareholders in Du-Pont will be twice as much as before.

**5- The TPM Manager at Du-Pont states that:**

1) Their equipment reliability is now very well improved.

2) Their equipment are not reliability at all now, and they need to be improved.

3) Real attention on elements of TPM will make them successful.

4) Focusing on equipment reliability is the same as focusing on elements of TPM.

**6- According to the passage:**

1) The E.U population is about 2 millions.

2) E.U alone spends 125 to 170 billion ECU for visitors to Europe.

3) There are 2 million people in Europe who can spend 124 to 170 billion ECU for maintenance cost.

4) There are 2 million people in E.U countries who work in some way on maintenance activities.

**7- According to the passage, TPM:**

1) Makes the operators to work on big maintenance problems.

2) Makes the operators confident to call the maintenance Engineer for any small problem.

3) Makes the maintenance engineers confident to deal directly with small problems.

4) Makes the operators confident to deal with small problems and prevent them from becoming big ones.

**Industrial Engineering 90:**

**1- Through "Total Productive Maintenance" concept:**

1) Operators learn to find the main causes of machine failures.

2) The root causes of machine errors is due to the elimination of operators.

3) Operators investigate about how they can eliminate their own operational errors.

4) All of the above.

**2- Total Productive Maintenance:**

1) totally works on preventive maintenance activities.

2) gives more power to plants, machinery and equipment.

3) continuously operates the plants, machinery and equipment.

4) maintains production lines at high efficiency and little or no interruptions.

**3- According to the passage, what is the meaning of "eliminate"?**

1) remove 2) modify 3) polish 4) select

*UNIT 10*

# Simulation

Imitation
Entail
Lifelike
Insight
courses of action
engage
accessible
acquisition
approximation
assumption
fidelity
unification
loop
computational
rely (on)
suite
deterministic
derivative
securities
sophisticated

**Simulation** is the imitation of some real thing, state of affairs, or process. The act of simulating something generally entails representing certain key characteristics or behaviors of a selected physical or abstract system.

Simulation is used in many contexts, such as simulation of technology for performance optimization, safety engineering, testing, training, education, and video games. Training simulators include flight simulators for training aircraft pilots in order to provide them with a lifelike experience. Simulation is also used for scientific modeling of natural systems or human systems in order to gain insight into their functioning. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist.

Key issues in simulation include acquisition of valid source information about the relevant selection of key characteristics and behaviors, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes.

Historically, simulations used in different fields developed largely independently, but 20th century studies of Systems theory and Cybernetics combined with spreading use of computers across all those fields have led to some unification and a more systematic view of the concept.
Physical simulation refers to simulation in which physical objects are substituted for the real thing (some circles use the term for computer simulations modeling selected laws of physics, but this article doesn't). These physical objects are often chosen because they are smaller or cheaper than the actual object or system.
Interactive simulation is a special kind of physical simulation, often referred to as a human in the loop simulation, in which physical simulations include human operators, such as in a flight simulator or a driving simulator

**Question1.** Monte Carlo methods (or Monte Carlo experiments) are a class of computational algorithms that rely on repeated ……. sampling to compute their results. Monte Carlo methods are often used in simulating ……. and mathematical systems. These methods are most suited to calculation by a computer and tend to be used when it is infeasible to compute an exact result with a ……. algorithm.

1) deterministic / random/repetitive
2) deterministic / physical/ random
3) random / deterministic/complementary
4) random / physical/ deterministic

**Question2.** Monte Carlo methods are widely used in engineering for …….. and quantitative probabilistic analysis in process design. The need …… from the interactive, co-linear and non-linear behavior of typical process simulations

1) sensitivity analysis /rises
2) sensitivity analysis / arises
3) qualitative/arises
4) qualitative /raises

**Question3.** Simulation software is based on the process of modeling a real …….with a set of mathematical formulas. It is, essentially, a program that allows the user to observe an operation through simulation without actually ……..that operation.

1) phenomenon/ performing
2) phenomena/designing
3) phenomenon/abdicating
4) phenomena/complementing

**Question4.** …….. simulations are used to model statistical events such as customers arriving in queues at a bank. By properly ……. arrival probabilities with observed behavior, a model can determine optimal queue count to keep queue wait times at a specified level.

1) Discrete event / correlating
2) Discreet event/coordinating
3) Random numbers/ predicting
4) Uncertainty/determining

**Question5.** ……. are used to model a wide variety of physical phenomena like ballistic trajectories, human respiration, electric motor response, radio frequency data communication, steam turbine power generation etc.

1) Discrete events
2) Discrete simulators
3) Continuous simulators
4) simulators

**Industrial Engineering (88)**

Many problems in financial engineering require numerical evaluation of an integral. Several virtues make simulation popular among practitioners as a methodology for these computations.
First, it is easy to apply to many problems. For most derivative securities and financial models, even those that are complicated or high-dimensional, it takes relatively little work to create a simulation algorithm for pricing the derivative under the model. Also, pitfalls in numerical implementation of simulation algorithms are relatively rare. For the most part, a little knowledge and effort go a long way in financial simulations, with some expertise and investment of one's time, one can go further and faster.

The second virtue of simulation is its good performance on high-dimensional problems:
The rate of convergence of a Monte Carlo estimate does not depend on the dimension of the problem. While other numerical integration techniques may have advantage over simulation in various situations, their rates of convergence tend to degrade as the dimension increases. The dimension of the problem is high, for instance, when dealing with models of markets that contain many fundamental sources of risk or with derivative securities that depend in a nontrivial way on prices at many times.
This issue is becoming increasingly important as securities markets and financial risk management become more sophisticated.
A third attraction of simulation is the confidence interval that it provides for the Monte Carlo estimate. This information makes possible an assessment of the quality of the estimate, and of how much more computational effort might be needed in order to produce an estimate of acceptable quality.

**1- The passage mainly discusses ____.**

1) the range of effective application of simulation
2) the challenges specific to financial simulations
3) the advantages of financial simulation methodology
4) the use of simulation to handle financial engineering problems

**2- which of the following statements is NOT true according to the passage?**

1) Financial risk management can benefit from the implementation of simulation algorithms.
2) Financial simulations require extensive knowledge and expertise.
3) Simulation is well suited to high-dimensional problems.
4) Simulation is a valuable tool for pricing options.

**3- The word "pitfalls" is closest in meaning to ____.**

1) conflicts 2) procedures 3) features 4) difficulties

**4- Which of the following is NOT discussed as an advantage of simulation in the passage?**

1) The domain of problems to which simulation can be applied

2) The use of simulation to handle high-dimensional problems

3) the provision of the confidence interval for Monte Carlo methods

4) the application of simulation to a variety of financial problems

**5- The passage states that simulation makes it possible for the Monte Carlo estimate ____.**

1) to assess its quality and increase its acceptability

2) to assess the risk of more computational effort

3) to improve its performance when dealing with derivative securities

4) to compute the values of derivatives over a period of time

UNIT 11

# Safety Engineering

| | |
|---|---|
| Probabilistic | Severity |
| Proven | Likelihood |
| Perspective | Experience |
| Commercial | Expenditure |
| Collaboration | Consequence |
| Functionality | Accordance |
| Conducting | Priority |
| Mitigate | Evaluate |
| Mode | Vulnerability |

Safety engineering is an applied science strongly related to systems engineering and the subset System Safety Engineering. Safety engineering assures that a system behaves as needed even when components fail.

Ideally, safety-engineers take an early design of a system, analyze it to find what faults can occur, and then propose safety requirements in design specifications up front and changes to existing systems to make the system safer. In an early design stage, often a fail-safe system can be made acceptably safe with a few sensors and some software to read them. Probabilistic fault-tolerant systems can often be made by using more, but smaller and less-expensive pieces of equipment

Far too often, rather than actually influencing the design, safety engineers are assigned to prove that an existing, completed design is safe. If a safety engineer then discovers significant safety problems late in the design process, correcting them can be very expensive. This type of error has the potential to waste large sums of money.

The exception to this conventional approach is the way some large government agencies approach safety engineering from a more proactive and proven process perspective, known as "system safety". The system safety philosophy is to be applied to complex and critical systems,

such as commercial airliners, complex weapon systems, spacecraft, rail and transportation systems, air traffic control system and other complex and safety-critical industrial systems. The proven system safety methods and techniques are to prevent, eliminate and control hazards and risks through designed influences by a collaboration of key engineering disciplines and product teams. Software safety is a fast growing field since modern systems functionality are increasingly being put under control of software. The whole concept of system safety and software safety, as a subset of systems engineering, is to influence safety-critical systems designs by conducting several types of hazard analyses to identify risks and to specify design safety features and procedures to strategically mitigate risk to acceptable levels before the system is certified.

# Passage

A failure modes and effects analysis (FMEA) is a procedure in product development and operations management for analysis of potential failure modes within a system for classification by the severity and likelihood of the failures. A successful FMEA activity helps a team to identify potential failure modes based on past experience with similar products or processes, enabling the team to design those failures out of the system with the minimum of effort and resource expenditure, thereby reducing development time and costs. It is widely used in manufacturing industries in various phases of the product life cycle and is now increasingly finding use in the service industry. Failure modes are any errors or defects in a process, design, or item, especially those that affect the customer, and can be potential or actual. Effects analysis refers to studying the consequences of those failures.

**1- According to the passage, which statement is NOT true?**

1) FMEA is aimed to find faults in systems
2) FMEA helps to save costs and time
3) Records are very important in FMEA
4) Decreased development time is a result for FMEA

**2- The word " thereby" in the passage means:**

1) whereas 2) therefore 3) by means of that 4) in accordance with

**3- Author believes….**

1) FMEA is merely used in manufacturing industry
2) FMEA is specified to the service industry
3) FMEA is widely used in service industry
4) FMEA is growing in service industry

**4- According to the passage, which statement is true?**

1) Failure mode is the state of product failure
2) Effect analysis is related to customer feedbacks
3) Failure mode is detected in design phase
4) Effect analysis is sought in processing items

**Question1.** The outcomes of an FMEA development are actions to prevent or …… the severity or likelihood of failures, starting with the highest-priority ones. It may be used to evaluate risk management priorities for …… known threat vulnerabilities.

1) reduce/ mitigating
2) preserve/identifying
3) maintain/highlighting
4) decrease/decreasing

**Question2.** A Safety Management Systems (SMS) is intended to act as a framework to allow an organization, as a minimum, to meet its legal obligations under ……. health and safety law.

1) fundamental 2) manufacturer 3) environmental 4) occupational

**Question3.** …… is a phenomenon of a system or subsystem in which the system or subsystem does not perform its required or expected function

1) uptime 2) fault 3) failure 4) crackdown

**Question4.** FMEA is a team-based systematic and …….approach for identifying ways that a process or design can fail, why it might fail, and how it can be made safer.

1) statistical 2) proactive 3) discretionary 4) remedial

**System Engineering (90)**

Nowadays, industrial safety and environmental protection rank alongside that technically optimized manufacturing process. There is a wish to see harmonization of ecology and economy within economically viable production. For the metal working industry this means using cooling lubricant in technologically sound applications while, at the same time, implementing and refining maintenance and recycling concepts.

**1- The harmony of ecology and economy of production:**

1) is a wish
2) has no importance
3) cannot by- passed
4) is impossible to reach

**2-The technically optimized manufacturing process:**

1) is only for metal working industry.
2) stand in sharp contrast with safety and environmental issues.
3) is to be considered on equal rank with safety and environment.
4) must be reached considering safety and environment as equally important

**3- For the metal working industry the balance in sound application of cooling lubricants and implementation and recycling concepts.**

1) is a principle to observe in the entire metal industry.
2) is the harmony of ecology and economy of production.
3) is indicative of equal ranks for process versus safety and environment.
4) is special isolated case.

**4- According to the passage, “implementing" means:**

1) using
2) considering
3) marketing
4) protecting

**5- The best title for this passage is:**

1) maintenance
2) recycling concepts
3) ecology and economy
4) environmental pollution

**Industrial Engineering (82)**

Theoretically, if an item is to withstand a prescribed stress, making its strength strong enough to withstand three, four, or five times that stress would reduce the number of failures and accidents; that is a structure or container that had a safety factor of 4 would fail half as frequently as one that had a safety factor of 2. In practice, the inadequacies and uncertainties in use of safety led to a refinement known as margin of safety.

A safety factor is expressed as the ratio of strength to stress. Initially, strength was nominal ultimate strength of the part: the average or prescribed value at which it would fail completely. However it was found that the strength of a specific material was not constant but would differ from any of that kind. Difference will occur in the composition of the material involved, manufacturing and assembly, environment, or in usage. As a result, failure will occur when stress becomes greater than strength. Using nominal or prescribed strengths and stresses, normally S/L was made so large there was no failure. Now, minimum strength/ maximum stress may be stipulated. By this means which is not unusual in aerospace system, it is possible to have as safety factor of 1.0 or 1.25 such a safety factor as low as 1.25 would indicate a safety margin of 0.25.

Mark the best choice on your answer sheet:

**1- Safety factor may be defined as …… .**

1) strength divided by stress
2) prescribed strength multiplied by a factor of 2,3, or 4
3) the ratio of prescribed stress to strength.
4) nominal ultimate stress to half the prescribed strength

**2- We understand from the passage that if a part is to withstand a prescribed stress ……. .**

1) the safety factor must be at least equal to 1.
2) all the parts must be used under similar conditions.
3) The prescribed stress must be reduced by half the strength.
4) the composition of the material used in similar parts must be given variety.

**3- The variations observed in the strength of parts leading to total failure stem from ……. .**

1) constant usage conditions

2) discrepancies in production processes.

3) Variations in the composition of materials

4) both 1 and 2

**4- The underline "which" (in line 8 paragraph 2) refers to ……. .**

1) failure

2) maximum stress

3) minimum strength

4) stipulating a safety margin

**5- The difference between the concept of safety factor and safety margin lies in the fact that …….. .**

1) the latter cannot be used in aerospace technology while the former can.

2) The latter is the ratio of minimum strength to maximum stress while the former is the ratio of strength to stress

3) the former is the ratio of nominal strength to prescribed stress while the latter is the same ratio multiplied by a constant factor.

4) The former is usually made large enough to cancel any possibility of failure while the latter is reduced to a minimum by a factor of 0.25.

*UNIT 12*

# Inventory

Estate
Probate
Content
Furnish
Equivalent
Stock
Accounting
Accessibility
Oversupply
Safeguard
Fraud
Merchandise
Consumable
Transaction
Fulfillment
Prompt
Enhance
Merchant
Accountant
Taxation
Skew

**Inventory** means a list compiled for some formal purpose, such as the details of an estate going to probate, or the contents of a house let furnished. This remains the prime meaning in British English. In the USA and Canada the term has developed from a list of goods and materials to the goods and materials themselves, especially those held available in stock by a business; and this has become the primary meaning of the term in North American English, equivalent to the term "stock" in British English. In accounting, inventory or stock is considered an asset.

**Inventory control** is the supervision of supply, storage and accessibility of items in order to ensure an adequate supply without excessive oversupply.

It can also be referred as internal control - an accounting procedure or system designed to promote efficiency or assure the implementation of a policy or safeguard assets or avoid fraud and error etc.

An inventory control system is a process for managing and locating objects or materials. In common usage, the term may also refer to just the software components.

Modern inventory control systems often rely upon barcodes and RFID tags to provide automatic identification of inventory objects. In an academic study performed at Wal-Mart, RFID reduced Out of Stocks by 30 percent for products selling between 0.1 and 15 units a day. Inventory objects could include any kind of physical asset: merchandise, consumables, fixed assets, circulating tools, library books, or capital equipment. To record an inventory transaction, the system uses a barcode scanner or RFID reader to automatically identify the inventory object, and then collects additional information from the operators via fixed terminals (workstations), or mobile computers.

An **inventory control system** may be used to automate a sales order fulfillment process. Such a system contains a list of order to be filled, and then prompts workers to pick the necessary items, and provides them with packaging and shipping information. an inventory system also manages in and outwards material of hardware.

Real-time inventory control systems may use wireless, mobile terminals to record inventory transactions at the moment they occur. A wireless LAN transmits the transaction information to a central database.

Physical inventory counting and cycle counting are features of many inventory control systems which can enhance the organization.

# Passage

When a merchant buys goods from inventory, the value of the inventory account is reduced by the cost of goods sold (COGS). This is simple where the CoG has not varied across those held in stock; but where it has, then an agreed method must be derived to evaluate it. For commodity items that one cannot track individually, accountants must choose a method that fits the nature of the sale. Two popular methods that normally exist are: FIFO and LIFO accounting (first in - first out, last in - first out). FIFO regards the first unit that arrived in inventory as the first one sold. LIFO considers the last unit arriving in inventory as the first one sold. Which method an accountant selects can have a significant effect on net income and book value and, in turn, on taxation. Using LIFO accounting for inventory, a company generally reports lower net income and lower book value, due to the effects of inflation. This generally results in lower taxation.

Due to LIFO's potential to skew inventory value, UK GAAP and IAS have effectively banned LIFO inventory accounting.

**1- What is the main idea of the passage?**

**1)** Inventory control

**2)** Inventory definition

**3)** Methods in accounting

**4)** FIFO vs. LIFO

**2- According to the passage, using proposed methods will affect……**

**1)** Inventory

**2)** Taxation

**3)** Production

**4)** Availability

**3- According to the passage, which statement is true?**

**1)** Choosing FIFO method will influence net income

**2)** LIFO can have a deviation in representing inventory value

**3)** LIFO leaves inflation out of the impression

**4)** FIFO is a better method in inventory accounting

**4- According to the passage, …….. is the determinant factor for choosing FIFO or LIFO method.**

**1-** Inflation

**2-** Net income

**3-** Book value

**4-** CoGs

**Question1.** Inventory management is primarily about specifying the …….. of stocked goods. It is required at different locations within a facility or within many locations of a supply network to proceed the regular and planned course of production and stock of materials.

**1-** shape and percentage
**2-** quantity and quality
**3-** inflow and outflow
**4-** number and value

**Question2.** Inventory appears as a/an……. on an organization's balance sheet because the organization can, in principle, turn it into cash by selling it.

**1-** long-term assets
**2-** current assets
**3-** accounts receivable
**4-** cash

**Question3.** …….. inventory is inventory whose potential to be sold at a normal cost has passed or will soon pass. In certain industries it could also mean that the stock is or will soon be …….. to sell.

**1-** safety/infeasible
**2-** out of order/hardly
**3-** expired/more likely
**4-** distressed/ impossible

**Question4.** EOQ applies only when demand for a product is ……. over the year and each new order is delivered …….. when inventory reaches zero. There is a fixed cost for each order placed, regardless of the number of units ordered.

**1-** alternative/selective
**2-** continuous/in phase
**3-** constant/ in full
**4-** fixed/ continuously

# UNIT 13

**Industrial Engineering (79)**

**1- In engineering degree courses, the coverage of …….. aspects include such areas as industrial engineering. Management information systems, and principles of economics.**

1) leadership 2) engineering 3) supervisory 4) management

**2- Social responsibility and …… knowledge are prerequisites for anyone working as a scientist.**

1) Clear 2) in time 3) up- to- date 4) unprofessional

**3- A manufacturing manager ……. his/her plant by separating engineering, accounting, manufacturing and purchasing specialists into different departments.**

1) Divide 2) program 3) organize 4) harmonize

**4- An alpha ray is a small, high-energy particle given off from the nuclei of creation radioactive atoms ……**

1) are disintegrating 2) as they disintegrate

3) they do disintegrate 4) before they are disintegrated.

**5- A man- machine system may consist of one man and one machine, in which the human error may be traced to …… equipment design, failure of operators, or the design engineer.**

1) Poor 2) sharp 3) costly 4) precise

**Industrial Engineering (80)**

**6- Unless dying products make some unique contribution to the firm's reputation or its product line or can be sold with an unusually high contribution, their production should be <u>terminated</u> .**

1) enforced 2) endorsed 3) enfolded 4) ended

**7- Quality robot design means that the product is designed so that small variations in production or assembly do not <u>adversely</u> affect the product.**

1) Adverbially 2) adventurously

3) unfavorably 4) umbilically

**8- The CAD system, through a library of symbols and details, helps to ensure <u>adherence</u> to the drafting standards.**

1) Fierceness 2) fidelity 3) faithfulness 4) faithlessness

**9- An assembly drawing shows an <u>exploded</u> view of the product.**

1) Parts designed 2) parts assembled 3) parts separated 4) parts integrated

**10- Product definition may be rigorous, as in the case of an insurance policy, or casual, as in the case of a haircut.**

1) Rigid 2) lag 3) right 4) lax

**Industrial Engineering (82)**

**11- If productivity were considered on the broader basis of getting maximum ……. from the energy, materials, capital, and human effort that go into producing a product, we would …….. for ever higher quality.**

1) usage/strive 2) losses/produce

3) assemblage/supply 4) requirements/need

**12- Group technology is a dynamic and evolutionary ……. Which continues to expand its influence on manufacturing system.**

1) product 2) development 3) consumption 4) manufacturing

**13- A free enterprise system depends upon the willingness of …… to accept the risks involved in …….. .**

1) the people, state
2) workers, unionization
3) politicians, elections
4) businesses, competitions

**Industrial Engineering (89)**

**14- Manufacturing Processes, deals with issues which lead to a better …….. of raw materials and energy, integration of design and manufacturing …….. which are requiring the invention of suitable new methods and techniques.**

1) consumption-activities 2) use-regulations
3) utilization-activities 4) fabrication-rules

**15- Decision making can be regarded as an outcome of mental & …….. processes leading to the selection of a course of action among several alternatives and provides the …….. to decide the optimized course of action to be taken.**

1) hypothetical-environment 2) rigorous-background
3) conventional-opportunity 4) cognitive-ability

**16- An operations researcher faced with a new problem is expected to determine which techniques are most …….. given the nature of the system, the goals for improvement, and …….. on time and computing power.**

1) appropriate-constraints 2) suitable-limitations
3) opportunity-experiences 4) promising-results

**17- Systems analysis is the interdisciplinary part of ……., dealing with analysis of sets of interacting ……., the systems, often prior to their automation as computer systems, and the interactions within those systems.**

1) technology-systems 2) science-entities

3) competency-parts 4) skill-tools

**18- Accrual adjustments, reconciling and correcting entries used to reconcile the ……. systems to the general ledger are not always immediately entered into other MIS ……. .**

1) mathematical-expectations 2) financial-systems

3) operational-cases 4) physical-issues

**Industrial Engineering (90)**

**19- In general, the systematic definition of……. can be defined as the ability of a person or system to perform and maintain its functions in routine ……., as well as hostile or unexpected circumstances.**

1) maintainability- analysis 2) flexibility- environments

3) reliability- circumstances 4) accountability- calculations

**20- They have considered the problem of ……. a nonlinear smooth objective function of several variables when the derivatives of the objective function are ……. and when no constraints are specified on the problem's variables.**

1) solving- fuzzy 2) handling- known

3) optimizing- noticeable 4) minimizing – unavailable

**21- Some of the promising directions for elaborating these ……. in the future may be viewed from a framework that links the ……. of artificial intelligence and operations research.**

1) issues- future 2) inventions- cases

3) problems- capability 4) innovations- perspectives

**22- There is also a need to inspect what has been delivered to organization by its …….. and what has already been produced by the organization.**

1) acceptance 2) suppliers

3) procedures 4) imperfection

**System Engineering(89)**

**23- The company insists that all their products are …….. in respect of their quality, specification and look.**

1) uniform 2) identity 3) typical 4) actual

**24- If for any reason customers do not like the item have bought, they always …….. and get a refund.**

1) give it back 2) take it back 3) keep it back 4) hold it back

**25- The advantages of working for this company is that all employees …….. themselves as a member of the team.**

1) hold 2) think 3) perceive 4) believe

**25- The primary …….. of project management is to achieve all of the project goals and objectives while honoring the preconceived project …….. . Typical constraints are scope, time, and budget.**

1) issue-aims 2) object-limitations

3) intention-goals 4) challenge-constraints

**26- Development plan document will contain a number of …….. to control the development and use of land, and will set out the design…….. and criteria against which planning applications will be considered.**

1) standards-issues 2) issues-affairs

3) policies-standards 4) cases-polices

**System Engineering(90)**

**27- …….. management is the application of knowledge, skills, tools, techniques and systems to define, visualize, measure, control, report and improve processes with the goal to meet customer requirements …….. .**

1) sale- environments 2) process- profitably

3) engineering- standards 4) maintenance- possibilities

**28- The basis of…….. is to reduce the errors produced during the manufacturing or service process, increase customer satisfaction, streamline supply chain ……., aim for modernization of equipment and ensure workers have the highest level of training.**

1) TPM- issues 2) PM- activities

3) EFQM- processes 4) TQM- management

**29- Strategic …….. is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this ……., including its capital and people.**

1) process- issue 2) case- arrangement

3) planning- strategy 4) management- strategy

**30- An organizational theorist should carefully consider level assumptions being made in ……., and is concerned to help …….. and administrators.**

1) action- managers 2) reality- individuals

3) theory- managers 4) practice- personnel

**31- Taylor is considered the father of …….. management and is credited in the development of the principles like scientific govern how much a worker can produce in a day, the function of management to discover and use these …….. in operation of productive systems.**

1) operations- laws 2) conventional- laws

3) production- regulations 4) traditional- regulations

| | |
|---|---|
| asset | دارایی |
| assets value | ارزش دارایی ها |
| assign | تخصیص دادن |
| Assignable | معین ، مشخص ، قابل تشخیص |
| assignable cause | انحرافات با دلیل |
| assignment | تخصیص ، گمارش ، ماموریت دادن |
| assurance | تضمین ، اطمینان ، تعهد ، اعتماد |
| attentive behavior | رفتار با دقت |
| attitude survey | بررسی رفتاری |
| attribute | مشخصه ،ویژگی ،نشان |
| audit | ممیزی ، بازبینی |
| Audit Client | متقاضی ممیزی |
| Audit criteria | معیار ممیزی |
| Auditee | ممیزی شونده |
| augment | تکمیل کردن ، زیاد کردن ، گسترده |
| automaticity | خودکاری، خودبخودی |
| automation | خودکار سازی ، اتوماسیون ، مجهز کردن به وسایل خودکار |
| avoidable delay | تأخیر قابل اجتناب |
| awareness stance | حالت آگاهی |
| axis | محور، قطب، محور تقارن |
| backlog | موجودی‌جنسی که بابت سفارشات درانبارموجوداست، |
| backorder cost | هزینه سفارش تاخیر شده |
| backward scheduling | زمانبندی برگشتی |
| balance | تراز، تعادل |
| balance sheet | ترازنامه |
| balanced line | خط (تولید) متوازن |
| balancing delay | تأخیر تعادلی |
| bankable | قابل نقل وانتقال بانکی |
| bar chart | نمودار میله‌ای |
| bar stock | ماده اولیه مصرفی |
| bar-coded document | سند بارکدگذاری شده |
| base wage rate | حداقل دستمزد، نرخ دستمزد پایه |
| basic division of work | تقسیم بندی پایه اس کار |
| basic element | عنصر پایه ای |
| basic motion | حرکت پایه ای |
| basic motion time study | مطالعه زمان حرکت پایه ای |
| batch processing | پردازش دسته ای |
| batch size | اندازه دسته |
| batch-type manufacturing | تولید دسته ای |
| behavioral management | مدیریت رفتاری |
| behavioral patterns | الگوهای رفتاری |
| bell curve | نمودار زنگوله ای |
| benchmarking | ارزیابی مقایسه ای ، الگو گیری |

| | |
|---|---|
| absenteeism | غیبت |
| accident rate | نرخ تصادف،نرخ وقوع تصادف |
| accommodate | وفق دادن ، اصلاح کردن ، تطبیق نمودن |
| account for | گزارش دادن، مسئول بودن |
| accounting books | دفاتر حسابداری |
| accounting period | دوره های حسابداری |
| accounts receivable | حساب های دریافتنی |
| accrue | افزوده شدن، منتج گردیدن، تعلق گرفتن |
| accuracy | صحت ،درستی |
| activity | فعالیت ،کار |
| Activity Relationship | رابطه فعالیت ها |
| Activity Network Diagram | نمودار شبکه فعالیت ها |
| activity network | شبکه فعالیت ها |
| administration | اداره، کل، مدیریت |
| aerospace system | سیستم های هوافضا |
| after-the-fact-information | اطلاعات بعد از فعالیت |
| airborne aircraft | فضا پیمای هوابرد(انتقال بوسیله هوا) |
| aisle | راهرو |
| Aisle Arrangement | چیدمان راهرو |
| algorithm | الگوریتم |
| allocation | تخصیص |
| allowance | بیکاری مجاز |
| alloy | الیاژ |
| alphanumeric character | الفبا عددی |
| amenable | تابع، رام شدنی، |
| amortization cost | هزینه استهلاک (سرمایه و غیره) |
| analytical techniques | تکنیک های تحلیلی |
| annual depreciation | استهلاک سالیانه |
| anthropometric | وابسته به مبحث اندازه گیری بدن انسان |
| anthropomorphic | شبیه انسان، دارای شکل انسان |
| antithesis | پادگذاره، ضد و نقیض، تضاد، تناقض |
| approach | نزدیک شدن ، نظر کردن ،نظر گاه ، رویکرد ، نگرش |
| arithmetic procedure | رویه حسابی |
| articulate | مفصل بندی |
| Articulated Mechanical System (AMS) | مجموعه اندام های مکانیکی (روبات) |
| artisan | صنعتگر، صنعتکار، افزارمند |
| assemblage | عمل سوار کردن (ماشین یاموتور)، جمع اوری، |
| assemble | مونتاژ ، سوار کردن ، همگذاری |
| assembly | مونتاژ ، سر هم کردن ، بستن |
| Assembly Chart | نمودار مونتاژ |
| assembly line | خط مونتاژ |
| assessor | ارزیاب |

| | |
|---|---|
| benefit-cost ratio | نسبت هزینه و فایده |
| bill of material(BOM) | سیاهه مواد، فهرست مواد |
| binary value | مقدار دودویی |
| binding constraint | محدودیت الزام آور |
| bind | متعهدوملزم ساختن، بند، قید |
| binomial distribution | توزیع بینم ، توزیع دو جمله ای |
| bit | یک رقم دودویی، سر مته |
| black box | جعبه سیاه |
| blending stage | مرحله آمیزش |
| block diagram | نمودار کنده ای ، نمایش کلی مدار |
| bodily discomfort | ناراحتی جسمی |
| bonds | اوراق بهادار |
| bonus | پاداش |
| book value | ارزش دفتری |
| boost | ترقی، بالارفتن |
| boring machine | ماشین سوراخ کاری |
| boring mill | ماشین سوراخ کاری |
| bottleneck | گلوگاه |
| Bottleneck Engineering (BE) | مهندسی گلوگاه |
| bottom-line | دلیل اصلی |
| bottom-up decision-making | تصمیم گیری از پائین به بالا |
| boundary | مرز، خط سرحدی |
| brass | برنج الیاژ،برنج( فلز) |
| brawn | نیروی عضلانی |
| break away | گسیختگی |
| break even chart | نمودار نقطه سر به سر |
| break point | نقطه شکست |
| breakdown | خرابی، شکست ، تفکیک ، تقسیم بندی |
| breakeven | سر به سر شدن ، یر به یر شدن |
| break-even point | نقطه سر به سر |
| budget | بودجه |
| budget appropriation | تخصیص‌بودجه، منظورکردن بودجه |
| budgetary constraint | محدودیت های بودجه ای |
| buffer | میانگیر ، واسطه ،ذخیره ساز ، بافر |
| buffer inventory | موجودی ایمنی |
| Buffer Stock | ذخیره ایمنی |
| bulk loading | بارگیری مخزن به طور یک جا |
| burden | بار، بالاسری |
| business process reengineering(BRP) | مهندسی مجدد فرآیند کسب و کار |
| calibration | تنظیم کردن، کالیبره کردن |
| capacity | گنجایش، ظرفیت |
| capacity bottleneck | گلوگاه ظرفیت (ماشین یا ایستگاه کاری که ظرفیت کل سیستم را محدود می کند) |

| | |
|---|---|
| capacity constraints | محدودیت ظرفیت (عامل محدودکننده در گلوگاه ظرفیت) |
| capital | سرمایه |
| capital budgeting | بودجه بندی سرمایه |
| cell | سلول |
| cell layout | چیدمان سلول |
| cellular manufacturing | تولید سلولی |
| changeover | انتقال |
| chart | نمودار |
| check study | مطالعه بازنگری(باز مطالعه) |
| chronological time order | ترتیب زمانی داری تسلسل تاریخی |
| circumvent | پیش دستی کردن،میانبر زدن |
| closed-loop MRP | برنامه ریزی نیازمندیهای مواد با حلقه بسته |
| coarse | ضخیم، زبر، خشن |
| coding system | سیستم کدگذاری |
| coin tossing | سکه انداختن |
| commercial | تجاری |
| commodity | کالا ، متاع ، جنس |
| commonalities | اشتراکات |
| competitiveness | رقابت پذیری، رقابتی بودن |
| competitor | رقیب |
| complex whole | کل پیچیده |
| compliance | قبول، اجابت، بر اوردن |
| component | اجزاء ، سازه |
| Computer Aided Design(CAD) | طراحی به کمک کامپیوتر |
| Computer-Aided Manufacturing(CAM) | تولید به کمک کامپیوتر |
| computerized program control | کنترل برنامه کامپیوتری |
| conceptual design | طراحی مفهومی |
| concise visualization | تصور موجز |
| concurrent | همزمان |
| concurring engineering | مهندسی همزمان (CE) |
| configuration management | مدیریت پیکربندی |
| constant element | جزء ثابت |
| constrained optimization problem | مسئله بهینه سازی با محدودیت |
| consumption | مصرف، سوختن |
| contingency | احتمال ، شانس ، احتمال وقوع |
| continuous stopwatch method | روش زمانگیری متوالی/پیوسته |
| contract | قرار داد ، پیمان ، مقاطعه کاری |
| contractor | پیمان کار، مقاطعه کار |
| contractual | قراردادی ،مقاطعه ای ،ماهده ای ،پیمانی |
| control chart | نمودار کنترل |
| control system | سیستم کنترل |

| | |
|---|---|
| decision variable | متغیر تصمیم |
| decline | نزول ، کاهش ، کاسته شدن |
| decoder | رمز گشا، رمز شناس |
| dedicate | اهدا کردن، اختصاص دادن، وقف کردن |
| dedicated FMS | FMSاختصاصی |
| dedication | اهداء، تخصیص، فداکاری |
| deductive reasoning | استدلال قیاسی |
| defective unit | واحد معیوب |
| deficiency | نقص، کمی، کمبود، کسر، ناکارایی |
| degree of flexibility | درجه انعطاف پذیری |
| degrees of freedom | درجات آزادی |
| delay | تاخیر ، به تاخیر افتادن |
| delay allowance | تاخیر مجاز |
| demand | تقاضا ، مطالبه ، خواسته |
| demarcate | تعیین حدود کردن، نشان گذاردن |
| departure mechanism | مکانیزم انحراف |
| deplete | تهی کردن، خالی کردن، به ته رسانیدن |
| deployment | موضع گیری استراتژیک( نظامیان) |
| depreciation | استهلاک ، کاهش بها |
| derivatives | اوراق مشتقه |
| detailed layout | چیدمان تفصیلی |
| determinant | تعیین کننده، تصمیم گیرنده، عاجز، جازم |
| deterministic | قطعی ، غیر احتمالی |
| deviate | منحرف شدن |
| deviation | انحراف |
| dice throwing | پرتاب تاس |
| Die casting | ریختن فلزات تحت فشار |
| diesel propulsion | نیروی محرکه دیزلی |
| differential piecework | کارمزد قطعه اضافی |
| diffuse | پخش کردن |
| direct costing | هزینه یابی مستقیم |
| direct labor | نیروی کار مستقیم |
| direct material | مواد اولیه مستقیم |
| direct search methods | روش های جستجوی مستقیم |
| disassemble | دمونتاژ، پیاده کردن |
| discernment | تشخیص، تمیز |
| disciplined process | فرآیند منظم |
| discrepancy | اختلاف، تفاوت، مورداختلاف |
| discrete | گسسته ، جدا ، مجزا |
| discrete event | پیشامد گسسته |
| dispatch list | لیست ارسال |
| disposal | ضایعات |
| dispose | دور ریز(ضایع کردن) |
| distribution | توزیع ، توزیع کردن ، پخش کردن |

| | |
|---|---|
| conventional turning | تراشکاری معمولی |
| convex programming | برنامه ریزی محدب( زیر شاخه ای از ریاضیات که مسائل بهینه سازی با توابع محدب را بررسی می کند) |
| cooperative affairs | کارهای تعاونی |
| coordinate | هماهنگ کردن ، تعدیل کردن ، مختصاتی |
| coordinated body | جزء هما هنگ |
| coordination | هماهنگی، همکاری |
| corporation | شرکت، گروهی از مردم (شرکت یا بنگاه) که دارای‌شخصیت حقوقی باشند |
| cost center | مرکز هزینه |
| cost control | کنترل هزینه |
| cost of goods sold | هزینه کالاهای فروخته شده |
| cost reduction report | گزارش کاهش هزینه |
| cost tradeoff | تهاتر هزینه |
| costly | گران، گزاف |
| coverage | پوشش، شمول |
| criteria | شرایط ، معیارها ، ضوابط |
| criterion | ضابطه، معیار |
| critical | حرانی |
| critical path | مسیر بحرانی |
| critical path method(CPM) | روش مسیر بحرانی |
| critical program analysis | تحلیل برنامه بحرانی |
| cross member | عضو یک ساختار برای اتصال قطعات طولی |
| cross-functional team | تیم میان کارکردی |
| cube like | شبیه مکعب |
| cumulative lead time | ان تدارک تجمعی |
| customer dissatisfaction | ارضایتی مشتری |
| cutting speed | سرعت برش |
| cycle time | زمان سیکل |
| cycle timing | زمان سنجی سیکل گردش کاری |
| cylindrical | استوانه‌ای |
| data acquisition | اکتساب داده ها |
| data processing | داده پردازی، پردازش داده ها |
| Data mining | داده کاوی |
| day rate | نرخ مزد روزانه |
| day work | کار روز مزد |
| dead ends | بی پایان |
| debug | اشکال زدایی کردن |
| decimal hour stopwatch | ساعت زمانسنجی دهدهی( بر حسب ساعت) |
| decimal minute stopwatch | ساعت زمانسنجی دهدهی( بر حسب دقیقه) |
| decision analysis | آنالیز تصمیم گیری |
| decision theory | تئوری تصمیم گیری |

| | |
|---|---|
| ergonomic | مربوط به مهندسی انسانی ، ارگونومیک ، فاکتورهای انسانی |
| erosion | فرسایش، سایش، فساد تدریجی، تحلیل |
| erroneous assumption | فرض نادرست |
| error-free | بی خطا |
| evaluated base rate | نرخ پایه ای تخمینی(برآوردی) |
| even analysis | |
| ever-increasing | دائم در حال افزایش |
| examine | امتحان کردن، بازرسی کردن |
| excess stock | موجودی مازاد |
| excessive cost | هزینه بیش از حد |
| execution | اجرا |
| executive | مدیر اجرایی |
| expenditure | برامد، هزینه، خرج |
| Exploded Assembly Drawing | نقشه مونتاژ گسترده |
| exploit | بهره برداری‌کردن از، |
| external element | جزء خارجی |
| extrusion line | خط عملیات فشار کاری |
| facilities planning | طراحی تسهیلات |
| factor comparison | مقایسه فاکتور |
| failure | شکست ، خرابی ، عیب |
| Failure Mode And Effect Analysis ( FMEA) | آنالیز حالات بالقوه خرابی(روشی سیستماتیک برای شناسایی و پیشگیری از وقوع مشکل در محصول و فرآیند آن) |
| failure rate | نرخ شکست |
| fair day's work | کار روزانه عادلانه |
| fatigue | خستگی ، فرسودگی |
| fatigue allowance | مرخصی خستگی |
| feasible | عملی ، موجه ، امکان پذیر |
| feasible alternative | گزینه موجه |
| Feasible Region | منطقه موجه |
| field | میدان، رشته |
| film analysis | تحلیل فیلم( بررسی فیلم فریم به فریم عملیات ...) |
| financial engineering | مهندسی مالی |
| finish goods inventory | موجودی کالاهای تمام شده |
| firm | شرکت ، موسسه |
| firm horizon | افق برنامه ریزی شرکت |
| First In, First Out(FIFO) | (سیستم صفِ) اولین ورودی، اولین خروجی |
| First -pass yield | (نرخ) خروجی اولین تأیید |
| Five S(5S) | پنج S ، پنج اصطلاح که با حرف S شروع می شوند و هدف از کاربرد آن ایجاد محیط کاری مناسب برای کنترل دیداری است. |
| fixed asset | دارائی ثابت |
| fixed cost | هزینه ثابت |

| | |
|---|---|
| dividing line | مرز جداکننده |
| dock | بار انداز ، سکو |
| document | سند ، مدرک ، ملاک |
| documentation | مستند سازی |
| dovetail | جفت کردن |
| downtime | زمان توقف ، مدت زمانی که کارخانه کار نمی کند |
| draftsman | نقشه کش، طراح، تهیه‌کننده لوایح قانونی |
| drill | مته زدن |
| driving force | نیروی محرکه |
| drop delivery | ارسال(جابه جایی) نزولی |
| due dates | سر رسید، موعد مقرر |
| Earliest Due Date (EDD) | زودترین موعد تحویل |
| duplex style | سبک مضاعف |
| duplicating machine | ماشین نسخه برداری |
| dynamic | پویا |
| earn | کسب معاش کردن، ،درامد داشتن |
| earned hour | ساعت بدست آمده |
| economic justification | توجیه اقتصادی |
| Economic Order Quantity(EOQ) | مقدار اقتصادی سفارش |
| economical | اقتصادی، مقرون به صرفه |
| effectiveness | اثر بخشی |
| efficiency | کارایی |
| effort | تقلا، تلاش، کوشش، سعی |
| effort rating | رتبه بندی تلاش |
| elapsed time | زمان سپری شده |
| element | عنصر |
| elongation | کشیدگی، دراز شدگی |
| embellished | رایش کردن، ارایش دادن،پیراستن |
| emit | ساتع کردن |
| empathy | انتقال فکر، تلقین |
| employ | به کار گرفتن ، استخدام کردن |
| employee | کارمند ، کارگر ، استخدام شده ، مستخدم |
| employer | کارفرما، استخدام کننده |
| empowerment | تقویت |
| encoded data | داده های رمزی شده |
| encoding | رمز گذاری |
| encompass | دورگرفتن، احاطه کردن |
| endorsement | صحه‌گذاردن |
| enterprise | بنگاه اقتصادی |
| entity | موجودیت |
| Entity Relationship Diagram (ERD) | نمودار ارتباط موجودیت ها |
| equipment | تجهیزات،موارد ضروری |

| | |
|---|---|
| growth | رشد، نمود، روش، افزایش |
| guaranteed annual wage | دستمزد تضمینی سالیانه |
| hierarchical level | سطح سلسله مراتبی |
| high-speed manipulation | کار کردن( با مهارت) سریع السیر |
| horizontal axis | محور افقی |
| human factor | عوامل انسانی |
| human factors engineering | مهندسی عوامل انسانی |
| human sensory capability | قابلیت حسی انسان |
| idle time | زمان بیکاری |
| impetus | نیروی جنبش، عزم، انگیزه |
| incentive | انگیزه |
| incentive earning | درآمدهای انگیزشی |
| incentive environment | محیط های انگیزشی |
| incentive opportunity | فرصت های انگیزشی |
| incentive pace | سرعت ( عملکرد) انگیزشی |
| incentive performance | عملکرد انگیزشی |
| incentive rate | نرخ دستمزد انگیزشی |
| income statement | اظهارنامه درآمد |
| incorporate | یکی کردن، بهم پیوستن، متحد کردن |
| incremental analysis | آنالیز اضافی |
| incur | موجب زیاد شدن،متحمل شدن |
| indexing | شاخص گذاری |
| indexing mechanism | مکانیزم شاخص گذاری |
| indirect labor | نیروی کار غیر مستقیم |
| indirect material | مواد اولیه غیر مستقیم |
| Indoor Air Quality(IAQ) | کیفیت هوای داخل ساختمان |
| Industrial Engineer | مهندس صنایع |
| industrial Engineering | مهندسی صنایع |
| infant mortality period | دوره مرگ و میر کودکان (دوره ابتدایی شروع سیستم که تلفات بالایی دارد و به آن اصطلاحاً دوره «عیب زدایی» هم می گویند) |
| infinitesimal | بی اندازه خرد، بینهایت کوچک |
| inflation | تورم |
| information processing system(IPS) | سیستم پردازش اطلاعات |
| Information Technology(IT) | فن آوری اطلاعات |
| infrastructure | پیدایش، شالوده، سازمان، زیر سازی، زیربنا |
| ingredient | جزء، جزء ترکیبی |
| initial cost | هزینه اولیه |
| inoperative | غیر عملی، غیر موثر |
| in-process goods | کالاهای در دست اقدام(در حال پردازش) |
| input | ورودی |
| inspect | بازرسی کردن، رسیدگی کردن |
| inspection | بازرسی ، بازدید |

| | |
|---|---|
| fixed-order system | سیستم سفارش ثابت |
| fixture | قید ، فیکسچر |
| fleet | ناوگان |
| flexibility of manufacturing | انعطاف پذیری ساخت وتولید |
| Flexible Manufacturing Systems(FMS) | سیستم تولید انعطاف پذیر |
| flexible workforce | نیروی کار منعطف |
| flow diagram | دیاگرام جریان(دیاگرامی که جریان اطلاعات، مواد و غیره در یک فرآیند را نشان می دهد.) |
| flow line configuration | پیکر بندی مسیر جریان |
| Flow Process Chart(FPC) | نمودار فرایند جریان |
| fluctuation | نوسان، تغییر |
| forecast | پیش بینی ، پیش بینی کردن |
| foreign element | عنصر بیگانه |
| foremen | سردسته |
| forming | فرم کاری، شکل دهی |
| forum | میدان، بازار، محل اجتماع عموم |
| forward scheduling | زمانبندی روبه جلو |
| foundry enterprise | کارخانه گداز فلز |
| framework | استخوان بندی، چارچوب |
| free enterprise system | نظام اقتصاد ازاد |
| freight cost | هزینه کرایه |
| frequency | بسامد ، فرکانس |
| friction | سایش، اصطکاک |
| frustration | محروم سازی ،نا امیدی |
| full-blown reality | واقعیت کامل |
| function description | شرح وظایف |
| futuristic | مربوط به اینده، پیشرو |
| gagging equipment | تجهیزات اندازه گیری |
| gain sharing | تسهیم دست آورد |
| game theory | نظریه بازی ها |
| Gantt chart | گانت چارت(نموداری برای برنامه ریزی و پیگیری پروژه ها که در آن محور افقی نشان دهنده عامل زمان و محور عمودی نشانگر فعالیت های لازم در اجرای پروژه است) |
| Gaussian distribution | توزیع نرمال |
| generic role | نقش کلی |
| Gilberth basic element | عنصر پایه ای گیلبرت |
| gradient-based methods | روشهای مبتنی بر گرادیان |
| graph theory | تئوری گراف |
| grind | کوبیدن، عمل خرد کردن یا اسیاب کردن |
| gripper | دارنده، نگاه دارنده |
| Group Technology(GT) | تکنولوژی گروهی |
| group-tooling device | وسیله شکل دهی گروهی |

| | |
|---|---|
| | ژاپنی که معتقد به نگهداری موجودی در انبار نمی باشد) |
| Kaizen | کایزن (واژه ژاپنی)، بهبود پیوسته و فزاینده یک فعالیت به منظور آفرینش ارزش بیشتر و مودا ( تلفات ) کمتر .در محیط کار به معنی بهبود پیوسته با مشارکت همگانی کارکنان اعم از کارگران و مدیران است. |
| kanban | سیگنال (واژه ژاپنی) |
| key milestone | مرحله برجسته ای در یک پروژه |
| keypunch | ماشین پانچ |
| labor | نیروی کار |
| labor cost | هزینه نیروی کار |
| labor environment | محیط کار |
| labor productivity | بهره دهی نیروی کار |
| labor-hour | نفر ساعت نیروی کار |
| Last In First Out(LIFO) | (سیستم صفِ) آخرین ورودی، اولین خروجی |
| layout | چیدمان ، طرح بندی ، نقشه |
| lead time(LT) | زمان تدارک ،زمان انتظار تا رسیدن محمله سفارش داده شده |
| leadership | رهبری |
| lean | ناب |
| lean manufacturing | روش تولیدی است که مزایای تولید دستی و تولید انبوه را با یکدیگر تلفیق کرده و ازقیمت بالای اولی و انعطاف ناپذیری دومی اجتناب می کند و از ماشین آلاتی استفاده می کند که هم خودکار و هم انعطاف پذیرند |
| learning curve | منحنی یادگیری؛ نموداری که به عنوان شاخصی برای توانایی یادگیری در یک دوره زمانی می باشد. |
| leveled time | زمان متوازن شده |
| leveling | تسطیح ، هم سطح کردن ، همتراز کردن |
| lexicographic | الفبایی |
| liability | استعداد ، شایستگی ، مسئولیت نیازمندی |
| limiting process | فرآیند محدودکننده |
| line balance | توازن خط؛خط متوازن |
| line production | تولید خطی |
| loading ramps | سطح شیب دار بارگذاری |
| logic | منطقی |
| logistic | تهیه و توزیع ، حمل و نقل |
| logistical subsystems | لجستیکی ،مربوط به لجستیک |
| long run | دراز مدت |
| long-term | دراز مدت، طویل المدت |
| long-term growth | رشد دراز مدت |
| loose standards | استاندارد آزاد |
| lost time | زمان از دست رفته |
| lot | انباشته، موجودی |

| | |
|---|---|
| inspection probe | کاوشگر بازرسی |
| installation | نصب، راه اندازی |
| instruction card | کارت دستورالعمل |
| instrumentation | تجهیزات ،دستگاهها |
| insurance | بیمه، حق بیمه، پول بیمه |
| integer linear program | برنامه ریزی خطی اعداد صحیح |
| integer programming | برنامه ریزی اعداد صحیح |
| integrate shop floor system | سیستم سطح یکپارچه کارگاهی |
| integrated system | سیستم یکپارچه |
| interaction | تعامل ، فعل و انفعال |
| interdependent subsystems | زیر سیستم های وابسته |
| interface | واصل ، واسطه ، ارتباط |
| interference time | زمان تداخل |
| internal elements | عناصر داخلی |
| internal recycling | بازیافت داخلی |
| intersect | از وسط قطع کردن، تقسیم کردن، تقاطع کردن |
| introduction | معرفی( اولین مرحله چرخه عمر محصول) |
| intuitive process | شهودی |
| inventory | موجودی ، دارایی |
| inventory as a percent of sales | موجودی به عنوان درصد فروش |
| inventory control | کنترل موجودی |
| inventory turns | گردش موجودی |
| invest | سرمایه گذاری کردن |
| investor | سرمایه گذار |
| irrigation system | شبکه ابیاری |
| iteration | تکرار |
| iterative model building | ساخت مدل تکرار شونده |
| Jig | هدایت کننده (جیگ) |
| job | کار، امر، سمت، شغل، ایوب، مقاطعه کاری کردن، دلالی‌کردن |
| job analysis | تجزیه کار، تحلیل شغل |
| job classification | تقسیم بندی مشاغل |
| job description | شرح وظایف شغلی |
| job enrichment | غنی سازی شغل |
| job evaluation | ارزش گذاری شغل |
| job lot | ته مانده انبار |
| job rotation | گردش شغلی |
| job shop | تولید کارگاهی |
| job specification | مشخصات شغلی |
| job-based pay system | سیستم پرداخت بر مبنای شغل |
| joints | اتصالات |
| jurisdictional | اداری و قضایی( مربوط به حل اختلافات کارگری) |
| Just-In-Time(JIT) | درست به موقع (یک سیستم موجودی |

| | |
|---|---|
| lot size | اندازه انباشته |
| lumber | الوار |
| machine attention time | زمان مراقبت ماشین |
| machine idle time | زمان بیکاری ماشین |
| machine interference | دخالت ماشین |
| machine utilization | بکارگیری ماشین |
| machine-controlled time | زمان کنترل شده ماشین |
| Machine downtime | زمان خرابی ماشین |
| machine-hour | ساعت-ماشین |
| machinery | ماشین الات |
| maintainability | نگهداشت پذیری |
| make to order | تولید سفارشی |
| make to stock | تولید انبارشی |
| makeup pay | پرداخت جبرانی |
| malfunction | بدعمل کردن، خرابی |
| management | مدیریت |
| management analyst | تحلیلگر مدیریت |
| management audit | ممیزی مدیریت |
| management consultant | مشاور مدیریت |
| management engineering | مهندی مدیریت |
| management information systems(MIS) | سیستم های اطلاعات مدیریت |
| man-machine system | سیستم انسان-ماشین |
| man-made | ساخت بشر |
| manpower | نیروی انسانی |
| manual element | عنصر دستی |
| manual motion | حرکت دستی |
| manufacturing floor | کف کارگاه |
| manufacturing lead time | زمان سر رسید ساخت تولید |
| manufacturing organization | سازمان ساخت تولید |
| manufacturing systems | سیستم های ساخت و تولید |
| marginal | حاشیه ای ، مرزی |
| marketing | بازار یابی |
| marketing forecast | پیش بینی بازار |
| mass production | تولید انبوه |
| Master Production Schedule(MPS) | زمانبندی اصلی تولید |
| master schedule | زمانبندی اصلی |
| material flow | جریان مواد |
| material handling | جابجایی مواد |
| Material Requirement Planning(MRP) | برنامه ریزی نیازمندیهای مواد |
| maturity | بلوغ(مرحله سوم از چرخه عمر محصول) |
| Maynard Operation Sequence Technique(MOST) | تکنیک توالی عملیات مانیارد |
| Mean Time Between Failure(MTBF) | زمان متوسط بین خرابی ها |
| Mean Time To Failure(MTTF) | زمان متوسط تا اولین خرابی |
| measured day work | کار روزانه انجام شده(اندازه گیری شده) |
| memory | حافظه |
| memotion study | مطالعه حرکت آهسته |
| merit rating | رتبه بندی شایستگی |
| method | روش |
| methodology | روش شناسائی ،متدلوژی ،علم اصول ،روش شناسی |
| methods engineering | مهندسی روشها |
| methods study | مطالعه روش ها |
| Methods Time Measurement(MTM) | زمانسنجی روش ها |
| methods training | آموزش روش ها |
| micromotion study | مطالعه ریز حرکت ها |
| mild steel | فولاد نرم |
| milling machine | ماشین تراش |
| minimum time | حداقل زمان |
| miscalculate | اشتباه حساب کردن، پیش بینی غلط کردن |
| model | نمونه، مدل، مدل سازی |
| modeler | مدلساز |
| monitor | دیده بانی کردن |
| monograph | تک نگاری |
| monotony | یکنواختی |
| Monte Carlo method | روش مونت کارلو |
| Motion study | مطالعه ی حرکت |
| multifunction | چند وظیفه ای، چند کاره |
| multiple activity process chart | نمودار فعالیت-فرآیند چندگانه |
| multiple piece rate plan | طرح نرخ دستمزد چند قطعه ای |
| mutual | متقابل، دو جانبه |
| mutual fund | شرکتی که بکار خرید سهام شرکتهای دیگر مبادرت کند(صندوق سرمایه گذاری) |
| net revenue | درآمد خالص |
| nominal ultimate | نهایی اسمی |
| nomination | نام گذاری، کاندید، تعیین، نامزدی (در انتخابات) |
| nonintegrated shop floor system | سیستم سطح کارگاهی غیر یکپارچه |
| nonlinear | غیر خطی |
| nonlinear programming | برنامه ریزی غیر خطی |
| nonprofit organization | سازمان غیرانتفاعی |
| Non-proliferation | منع گسترش |
| nonrepetitive | غیر تکرارشونده |
| nonrepetitive production | تولید غیر تکرارشونده |
| Non-value-added | بدون ارزش افزوده |

| | |
|---|---|
| normal element time | زمان شاخص نرمال |
| normal place | محیط عادی |
| normal time | زمان عادی |
| Numerical Control(NC) | کنترل عددی |
| objective function | تابع هدف |
| observation | مشاهده، ملاحظه، نظر |
| observation form | فرم مشاهدات |
| obsolescence | کهنگی ،اسقاط |
| off-specification | خارج از محدوده مشخصات(محصول که الزامات را برآورده نمی کند) |
| off-the-shelf | مواد در دسترس<br>**کامپیوتر** : محصول سخت افزار یا نرم افزار با تولید انبوه |
| one-for-one kanaban | کانبان یک به یک |
| one-of-a-kind | بی نظیر |
| on-the-job | مشغول به کار؛ ضمن خدمت |
| operation | عمل ، عملکرد |
| operation analysis | تحلیل عملکرد، عمل کاوی |
| operation analysis chart | نمودار تحلیل عملکرد |
| Operation Process Chart(OPC) | نمودار فرآیند عملیات |
| Operations Research(OR) | تحقیق در عملیات |
| operations sheet | برگه عملیات |
| operator process chart | نمودار پردازش اپراتور |
| opportunity cost | هزینه فرصت |
| optimal | بهین |
| optimization | بهینه‌سازی |
| optimize | بهینه‌ساختن |
| optimum | بهینه ، مطلوب |
| optimum product slat | |
| order point system | سیستم نقطه سفارش |
| organization | سازمان ، تشکیلات ، سازماندهی |
| organization chart | نمودار سازمانی |
| Organizational Breakdown Structure (OBS) | ساختار شکست سازمانی |
| outline process chart | طرح کلی نقشه عملیات |
| output | خروجی، برونداد، محصول |
| overhaul | برای تعمیر پیاده کردن و مجددا "سوار کردن |
| overhead | سرجمع ، بالاسری |
| overhead cost | هزینه بالاسری |
| overtime | اضافه کار |
| pace rating | رتبه بندی سرعت |
| packaging sacks | کیسه بسته بندی |
| pallet fixture | نگهدارنده پالت(چرخ دستی حمل بار) |
| palletize | روی سکوب بلند قراردادن ،بوسیله سکوب متحرک(کامیون و غیره)چیزی را حمل |

| | |
|---|---|
| | کردن |
| paperwork flow chart | نمودار جریان تشریفات اداری |
| Pareto's law | قانون پارتو |
| Pareto Chart | نمودار پارتو<br>یک توزیع فراوانی(هیستوگرام) برای داده های وصفی است که بر اساس گروه دسته بندی شده اند |
| part and parcel | جزء لاینفک |
| part replacement | جایگزینی قطعات |
| Parts Per Million(PPM) | قسمت در میلیون قسمت |
| patent department | سازمان ثبت اختراعات |
| patronize | تشویق کردن، نگهداری کردن،مشتری شدن |
| pedant programming | |
| percent defective | درصد نقص (خرابی) |
| performance | عملکرد، اجرا |
| performance rating | رتبه بندی عملکرد |
| performance rating factor | فاکتور رتبه بندی عملکرد |
| performance rating scale | مقیاس رتبه بندی عملکرد |
| performance standard | استاندارد عملکرد |
| perpetual | دائمی ، همیشگی ، ابدی |
| personal allowance | زمان خستگی مجاز فردی |
| personal time | زمان شخصی |
| Project Evaluation & Review Technique (PERT) | **روش ارزیابی و بازنگری پروژه ها**<br>یک تکنیک است که در آن پروژه به صورت شبکه ای از وقایع و وظایف سازماندهی می شود که برای نشان دادن وقایع ، فعالیتها و ارتباط آنها از گره و پیکان استفاده می شود . |
| pharmaceutical | دارویی، وابسته به داروسازی، دارو |
| piece rate | نرخ دستمزد به ازای هر قطعه |
| piece rate wage plan | طرح نرخ دستمزد به ازای قطعه |
| pitch | نصب، استقرار |
| plan | برنامه |
| planning horizon | افق برنامه ریزی |
| plant | کارخانه ، ماشین آلات ، ماشین |
| plant layout | طراحی کارخانه |
| pneumatic | بادی، با فشار هوا |
| point system | سیستم امتیازدهی |
| poke-yoke | ضد خطا( واژه ژاپنی) |
| polymer plant | کارخانه پلیمر |
| position | جایگاه، موقعیت، پست سازمانی |
| postural combination | ترکیب کیفیتی |
| power loom | کارگاه بافندگی برقی |
| power plants | نیروگاه تولید برق |
| predetermined motion study | سیستم زمانسنجی حرکتی از پیش تعیین شده |
| premium | جایزه، حق‌العمل |

| | |
|---|---|
| prototype | نمونه اولیه ، نمونه اصلی |
| psychomotor | روانی- حرکتی |
| purchase | خریدن ، خریداری کردن |
| purchase order | دستور خرید، سفارش خرید |
| quadratic function | تابع درجه دوم |
| quadratic programming | برنامه ریزی غیرخطی |
| qualified operator | اپراتور واجد شرایط |
| quality assurance(QA) | تضمین کیفیت |
| quality control(QC) | کنترل کیفیت |
| quality defect | نقص کیفی |
| quality function employment | استقرار کیفی عملکردی |
| Quality Function Deployment (QFD) | گسترش کارکرد کیفیت |
| quality in process | کیفیت درون فرآیندی |
| quantifiable | قابل سنجش یا تعیین |
| queue | صف |
| queuing system | سیستم صف |
| queuing theory | تئوری صف |
| quick changeover | تغییر سریع (انطباق) |
| Quick Response Manufacturing(QRM) | ساخت و تولید واکنش سریع |
| rack | قفسه ، طاقچه |
| random access | دسترسی تصادفی |
| random element | عنصر تصادفی |
| range of time | دامنه زمانی |
| ranking methods | روش های رتبه بندی |
| rate | نرخ |
| rate cutting | کاهش نرخ (تولید) |
| rate setting | تثبیت نرخ |
| rated average elemental time | میانگین موزون زمان پایه |
| rating study | رتبه بندی، نرخ گذاری |
| ratio delay study | مطالعه تاخیر- نسبت |
| raw material inventory | موجودی مواد خام |
| reaming | برقو زدن |
| recipient | گیرنده، دریافت کننده، وصول کننده |
| reciprocal | متقابل، عمل متقابل، دوجانبه، دو طرفه |
| recruiter | کارمند تازه، نو اموز استخدام کردن،نیروی تازه گرفتن |
| recurrent | برگردنده، عود کننده |
| redistributing | باز توزیع |
| redundant | افزونه ، زاید |
| Redundant Constrain | محدودیت زائد |
| regulator | تنظیم کننده |
| relayout | چیدمان مجدد |
| reliability | اعتبار ، قابلیت اطمینان ، قابلیت اعتماد ، پایایی ، اعتماد پذیری |

| | |
|---|---|
| preposition | استقرار در محل پیش بینی شده استقرار در محل معین شده |
| preventive maintenance program | برنامه نگهداری پیشگیرانه |
| principle of motion economy | اصول اقتصادی حرکت |
| prismatic part | جزء منشوری ( خطی ، انتقالی ، شیاری) |
| probability of survival | احتمال بقاء |
| probability theory | نظریه احتمالات |
| procedural elements | عناصر مرتبط به رویه |
| procedure | رویه |
| process | فرآیند ، پروسه |
| process chart | نمودار فرآیند |
| process chart symbols<br>1. Operation<br>2. Inspection<br>3. Transportation<br>4. Delay<br>5. Storage | نمادهای نمودار فرآیند<br>۱. عملیات<br>۲. بازرسی<br>۳. حمل و نقل<br>۴. تاخیر<br>۵. ذخیره سازی |
| process engineer | مهندس فرآیند |
| process layout | چیدمان فرآیند |
| process oriented | فرآیند گرا |
| process razing | پیرایش فرآیند |
| process time | زمان پردازش |
| processing | پردازش |
| product | محصول ، فرآورده ، تولید |
| product life cycle | چرخه عمر محصول |
| product mix | ترکیب محصول |
| product packaging | بسته بندی محصول |
| production | تولید |
| production control | کنترل تولید |
| production Control System(PCS) | سیستم کنترل تولید |
| production engineering | مهندسی تولید |
| production planning | برنامه ریزی تولید |
| production report | گزارش تولید |
| production response time | زمان پاسخ تولید |
| productive time | زمان بهره ور |
| productivity | بهره وری ، فراورش ، سودمندی |
| Program Evaluation and Review Technique | روش ارزیابی و بازنگری برنامه |
| project management | مدیریت پروژه<br>فرآیند هدایت فعالیت های یک پروژه با حداقل هزینه ( بودجه مشخص ) و در چهارچوب مدت زمان مشخص |
| projection | طرح، نقشه کشی |
| proliferation | گسترش |
| proposal | طرح پیشنهادی |
| propulsion | نیروی محرکه، خروج، دفع، پیش راندن |

| | |
|---|---|
| semi-flow-line | شبه خط جریان |
| senior executive | مدیر ارشد |
| sensitivity analysis | تحلیل حساسیت |
| sequence | توالی ، ترتیب |
| sequential relationship | رابطه ترتیبی |
| sequential test | آزمایش مداوم |
| service capacity | ظرفیت خدمت |
| setup | راه اندازی |
| setup method | روش راه اندازی |
| setup reduction | کاهش(زمان) راه اندازی |
| setup time | زمان راه اندازی |
| severity | سختی، شدت، سخت گیری، دقت |
| shared resource | منابع مشاع |
| shared resource work flow | جریان کار بر اساس منابع مشاع |
| shareholder | سهم دار، صاحب سهم |
| Shewhart chart | نمودار شیبوهارت |
| shop floor control | کنترل سطح کارگاه |
| shop supervisors | ناظر فروش |
| short run | کوتاه مدت |
| short-cycle | با چرخه کوتاه |
| shorten | کوتاه کردن، مختصر کردن، کاستن |
| short-term | کوتاه مدت، مختصر |
| shutdown | خاموش کردن |
| simulation | شبیه سازی ، تشبیه |
| simultaneous engineering | مهندسی همزمان |
| simultaneous motion (simo) chart | نمودار حرکت همزمان |
| single delivery | زمان ارسال واحد |
| Single Minute Change of Die(SMED) | تعویق غالب یک دقیقه ای |
| six sigma | شش سیگما یعنی رسیدن به سطحی از کیفیت تولیدات و ارایه ی خدمات که خطای فرآیندهای کاری به میزان ۴/۳ در یک میلیون موقعیت کاهش یابد. |
| skill | مهارت |
| skill-based pay system | سیستم پرداخت بر اساس مهارت |
| slag | تفاله، اشغال، تفاله گرفتن از |
| snapback method | روش زمان سنجی بازگشت به اول |
| sneak-circuit analysis | تحلیل مدار پنهان<br>تحلیل مدار پنهان یک ابزار تحلیل نسبتاً جدید برای طراحان است که به‌طور فزاینده‌ای در سازمان‌های تکنولوژیک پیشرفته به‌کار گرفته می‌شود. مدار پنهان در واقع یک جریان منطقی (لاجیک) در مسیر پیش‌بینی‌نشده درون سیستم است که تحت شرایط خاصی می‌تواند یک عمل نامطلوب را سبب شده یا از یک عمل مطلوب جلوگیری کند |

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|---|---|
| remuneration system | سیستم پرداخت حق الزحمه |
| repetitive | تکراری، مکرر |
| requirement | نیازمندی ،الزام، نیاز ، احتیاج |
| requisition | درخواست، تقاضا |
| resource capacity planning | برنامه ریزی ظرفیت منابع |
| Resource Leveling | تسطیح منابع |
| rest | باقیمانده، تجدید قوا کردن، |
| restudy | بازنگری، مطالع مجدد |
| retail sale | خرده فروشی |
| retime | زمانسنجی مجدد |
| retrieval of information | بازیابی اطلاعات |
| retrofit | بروز در اوردن یا اضافه نمودن به یک سیستم موجود به منظور بهبود ان |
| revenue | عایدی ، بازده ، سود |
| reverse | معکوس، پشت، معکوس کردن، برگشتن |
| rework | دوباره کاری |
| reworkable | قابل دوباره کاری |
| risk analysis | تحلیل ریسک |
| risk mitigation | کاهش ریسک |
| root cause | علت ریشه ای |
| route | مسیر |
| route sheet | برگ مسیر(ساخت ) |
| routing | مسیرگزینی، مسیریابی |
| run time | زمان کار |
| safety engineering | مهندسی ایمنی |
| safety factor | فاکتور ایمنی |
| safety margin | حاشیه امن |
| salary | حقوق ، دستمزد |
| sales commission | کمیسیون حقوق |
| sales lead time | زمان تدارک فروش |
| satisfactory performance | عملکرد رضایت بخش |
| scale model | مدل مقیاسی |
| scanning | پویش، مرور اجمالی |
| schedule attainment | دستیابی به (برنامه) زمانبدی |
| scheduling | زمانبندی |
| schematic model | مدل قیاسی |
| schematically | بطور طرح یا خلاصه |
| scope | حوزه |
| scrap | ضایعات ، قراضه |
| screening | سرندزنی ،سرند کردن ،سرند،نمایش بر روی پرده تلویزیون ،ازمایش |
| scrutiny | موشکافی، بررسی |
| segmenting | قطعه قطعه کردن |
| select | انتخاب کردن |
| self-imposed | بر خود تحمیل شده |

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|---|---|
| straight-line depreciation | روش استهلاک خط مستقیم |
| strategy | استراتژی، راهبرد |
| stratify | چینه چینه کردن، طبقه طبقه کردن |
| streamline | ساده‌و موثر کردن |
| stretch out | کش آوردن زمان (کار) |
| stuffing | انباشتن |
| subassembly | قسمت فرعی دستگاه |
| subordinate | مادون، وابسته، فرعی، پایین تر، زیردست |
| subsidiary | شرکت تابعه، تابعه ،تقویتی |
| suggestion system | سیستم پیشنهادات |
| sundry function | کارکرد مختلف |
| supervision | نظارت، سرپرستی |
| supplier | تامین کننده ، تولید کننده |
| supply | عرضه داشتن،تدارک دیدن، |
| supply chain management(SCM) | مدیریت زنجیره تامین |
| support effectiveness | اثر بخشی حمایتی |
| survey | پیمایش، زمینه یابی، بازدید کردن، ممیزی کردن، |
| synthesize | ترکیب کردن، امیختن، ترکیب شدن، هم گذاری کردن |
| system dynamic | پویایی سیستم |
| system parameter | پارامتر سیستم |
| take-home pay | پرداخت کار در منزل |
| takt (tact) time | زمان دقیق |
| tall gates | |
| tapping | ضربه زدن |
| tax | مالیات |
| telecommunication | ارتباطات |
| template | الگو، قالب |
| temporary rate | نرخ(پرداخت) موقتی |
| temporary standard | استاندارد موقتی |
| theory of constraints | تئوری محدودیت ها |
| threbling | نام واحد( بخش پایه ای) کار |
| throughput | توان عملیاتی ، بازده |
| throwing dice | تاس ریختن |
| tight standard | استاندارد محکم |
| time allowance | زمان بیکاری مجاز |
| time scale | مقیاس زمان |
| time span | محدوده زمان |
| timekeeping | ثبت وقت، نگهداشت وقت |
| timing | زمانبندی |
| tolerance | تلرانس ، حد قابل قبول خطا ، تحمل |
| tool design | طراحی ابزار |
| toolset | جعبه بزار |
| top down | تلرانس ، حد قابل قبول خطا ، تحمل |

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|---|---|
| soil salinity | میزان شوری خاک |
| soldering | لحیم کاری |
| sophistication | مهارت |
| source inspection technique | تکنیک بازرسی منبع |
| space utilization | بهره گیری از فضا |
| span | محدوده، گستردگی، پوشش |
| spatial configuration | پیکره بندیی فضایی |
| spatial order | |
| specification | تصریح، تشخیص، ذکر خصوصیات، مشخصات |
| speed rating | رتبه بندی سرعت |
| spindle | محور |
| spinning frame | چهارچوب یا دستگاه نخ تابی |
| spiral | حلزونی، مارپیچ |
| spotlight | نورافکن |
| spreadsheet | صفحه گسترده |
| staff | کارمندان، کارکنان |
| staffing | قابل دسترس ساختن افراد برای سازمانها |
| standard | استاندارد |
| standard allowance | زمان خستگی استاندارد |
| standard cost | هزینه استاندارد |
| standard performance | عملکرد استاندارد |
| standard practice | کارکرد استاندارد |
| standard time | زمان استاندارد |
| standardization | متعارف سازی، همگونی |
| starting rate | نرخ شروع |
| static work | کار ایستا |
| station dwell time | زمان توقف در ایستگاه(کاری) |
| statistical process control(SPC) | کنترل فرآیند آماری |
| statistical quality control | کنترل کیفیت آماری |
| statistics | امار، ارقام |
| statistic | آماره |
| steel | فولاد ، فولادی ، استیل |
| steelworker | کارگر صنعت فولاد |
| step bonus | پاداش مضاعف |
| steward | وکیل خرج، پیشکار، مباشر، ناظر، مباشرت کردن |
| stifle | خاموش کردن، فرونشاندن |
| stipulate | خاموش کردن، فرونشاندن |
| stochastic model | الگوی تصادفی |
| stock out cost | هزینه کمبود در موجودی |
| stooping position | |
| stopwatch | کرونومتر، گام شمار، قدم شمار |
| storage mode | طرز ذخیره سازی |

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|---|---|
| torso | پیچ یا تاب خوردن، تاب گشت، خاصیت تاب گشت |
| total inventory by product | موجودی کل بر اساس محصول |
| Total Productive Maintenance(TPM) | نگهداری فنی با بهره وری کامل |
| Total Quality Control (TQC) | کنترل کیفیت جامع |
| Total Quality Management (TQM) | مدیریت کیفیت جامع |
| total revenue | درآمد کل |
| transportation | ترابری ، حمل و نقل |
| travel element | نمودار های سفر |
| TRIZ | واژه TRIZ برگرفته شده از حروف اول کلمات در عبارت روسی زیر می‌باشد: Teoriya Resheniya Izobrototelskikh Zadatch که برابر انگلیسی آن عبارت Theory of Inventive Problem Solving با مخفف (TIPS است که به معنای نظریه حل ابداعانه مساله می‌باشد. این دانش در سراسر جهان تحت عنوان TRIZ شناخته می‌شود. |
| troubleshooting | رفع عیب ، عیب زدایی ، میانجی گری |
| true optimum | |
| turret | برج متحرک ، برج گردان |
| two-bin system | سیستم سفارش دهی دو ظرفی |
| ultimate user | کاربر نهایی |
| unavoidable delay | تأخیر غیر قابل اجتناب پذیر |
| unavoidable delay allowance | زمان مجاز تأخیر غیر قابل اجتناب پذیر |
| unconstrained problem | مسئله بدون محدودیت |
| undulation | نوسان، حرکت |
| union | اجتماع ، اتحاد |
| unitary whole | کل یکپارچه |
| unpacking | باز کردن، بسته بندی را گشودن |
| upgrading | ارتقأ دادن |
| upstream work center | مرکز کار بالادستی |
| useful life | عمر مفید |
| utility analysis | آنالیز سودمندی |
| utilization | سودمندی، استفاده، مصرف، بکاربری |
| valid | معتبر، صحیح |
| validate | معتبر ساختن، تایید اعتبار |
| validation | اعتبار بخشی ، اعتبار سنجی ، اعتبار ، تصدیق |
| value added | ارزش افزوده |
| value analysis | آنالیز ارزش |
| value stream | جریان ارزش |
| value-added ratio | نسبت ارزش افزوده |
| variable cost | هزینه متغیر |
| variable element | عنصر متغیر |
| variable expense | هزینه متغیر |

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|---|---|
| variance | واریانس |
| varnish | صیقلی کردن |
| verification | بررسی ، تحقیق ، شناسایی،تصدیق |
| vertical spindle | محور عمودی |
| visual review system | سیستم مرور بصری |
| wage | مزد، دستمزد، اجرت، |
| wage and salary administration | سازمان حقوق و دستمزد |
| wage curve | منحنی دستمزد |
| wage differential | تفاوت دستمزد |
| wage incentive plan | طرح انگیزشی دستمزد |
| wage rate | نرخ دستمزد |
| waiting line | صف در حال انتظار |
| warrant | تضمین‌کردن، گواهی |
| wear(v) | فرسوده شدن ، مستهلک شدن ، ساییده شدن |
| wear-out | کهنه و فرسوده شدن(در اثر استعمال) |
| welding | جوشکاری |
| white collar | کارمند دفتری |
| wholesale | عمده فروشی |
| wizard | فرآیندی برای هدایت کاربران از بین مجموعه ای از سوالات |
| work cycle | سیکل کاری |
| work force | نیروی کار |
| Work In Process(WIP) | کار در حال پردازش |
| work measurement | اندازه گیری کار |
| work rotation | گردش شغلی |
| work simplification | ساده سازی کار |
| working capital | سرمایه درگیر در کار |
| working condition | شرایط کاری |
| workplace | مجیط کار |
| workstation | ایستگاه کاری |
| workstation layout | چیدمان ایستگاه کاری |
| worn-out part | قطعی فرسوده |
| worst-circuit analysis | تحلیل بدترین مدار |
| yaw | حرکت راست به چپ ،انحراف |
| yield | ثمر دادن، حاصل |
| zero-based budgeting | بودجه بندی بر مبنای صفر |