ESE 2027

UPSC ENGINEERING SERVICES EXAMINATION

PRELIMINARY EXAMINATION

General Studies & Engineering Aptitude

Standards and Quality Practices in Production, Construction, Maintenance and Services

Comprehensive Theory with **Practice Questions** and **ESE Prelims Solved Questions**

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ESE 2027 Preliminary Examination
Standards and Quality Practices in Production, Construction, Maintenance and Services

EDITIONS

1st Edition : 2016
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3rd Edition: 2018
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Preface

B. Singh (Ex. IES)

The book **Standards and Quality Practices in Production, Construction, Maintenance and Services** has been compiled with the objective of providing a concise yet comprehensive resource for aspirants of the Engineering Services Examination (ESE). It is specifically designed to help students develop a clear understanding of the concepts covered under the General Studies and Engineering Aptitude section of ESE.

This textbook offers detailed and descriptive, step-by-step theoretical explanations presented in lucid and easy-to-understand language. It ensures thorough coverage of fundamental concepts along with well-structured objective-type questions. The concise and systematic presentation enables readers to grasp the subject with clarity and apply their knowledge effectively to solve objective questions with speed and accuracy.

The book covers the complete ESE syllabus in a holistic manner and is equally useful for other competitive examinations. Each topic has been given due emphasis so that a careful reading of the text itself is sufficient to build strong conceptual clarity.

Special effort has been made to include solved practice questions and previous years' solved questions from the General Studies and Engineering Aptitude (ESE Prelims) section. These solutions are explained in a clear, step-by-step manner to strengthen problem-solving skills. At the end of every chapter, practice question sets with answer keys and detailed explanations are provided to help readers assess their understanding and enhance their exam readiness.

We have made sincere efforts to ensure accuracy and eliminate errors. However, we would greatly appreciate it if readers bring to our notice any printing or conceptual errors.

Though it is not possible to acknowledge everyone individually, we extend our heartfelt gratitude to all the authors, editors, and reviewers whose valuable contributions made this publication possible.

With Best Wishes

B. Singh (Ex. IES)

CMD, MADE EASY Group

Standards and Quality Practices in Production, Construction, Maintenance and Services

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1 Quality

1.1 What is Quality?

Quality is a relative term and it is generally used with reference to the 'end use of product'. In other words, quality can also be defined as

1. Perfection
2. Fast delivery of product
3. Eliminating waste in product
4. Consistency in performance
5. Total customer service and satisfaction

1.1.1 Definition of Quality

The word quality has diverse definitions, ranging from the conventional to those that are strategic. Conventional definitions of quality usually describe a quality item as one that wears well, is well constructed and will last for a long time. Simply quality refers to one or more desirable characteristics that increases the value of product. It is inversely proportional to the variability.

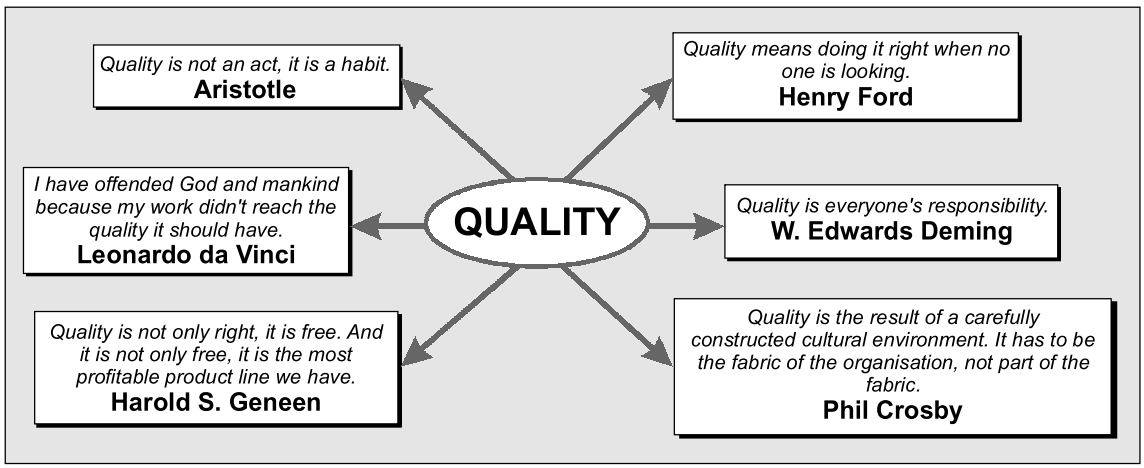


Fig. 1.1

1.1.2 Consequences of Poor Quality

Every manufacturing organisation is concerned with the quality of its product. While it is very important that quality requirements be satisfied and product schedules met, it is also equally important to consider the consequences of poor quality such as:

- Product fails
- Delay in supplying of products
- Market value decreases
- Poor quality of product increases production and market costs
- Damage or injuries resulting from faulty design
- Loss of business because of defective products

1.1.3 Evolution of Quality

Years	Events
1700 - 1900	Quality was largely determined by the "How free from defects a purchased product".
1915 - 1919	W W I - British government began a supplier certification program.
1919	Technical inspection association, this later becomes "Institute of Quality Assurance".
1924	Concept of control charts by W.A. Shehwart.
1928	Acceptance sampling techniques.
1931 - 1933	British textile industry began use of statistical techniques for product/process development.
1944	Industrial quality control.
1954	E.S. Page introduced CUSUM control chart.
1960	The concept of quality control circle or quality circle was introduced in Japan by Ishikawa.
1960	The zero defect program was introduced in U.S. industries.
1975 - 1978	The concept of TQM was developed in the U.S.
1989	Quality engineering comes into picture.
1989	Motorola's six sigma initiative began.

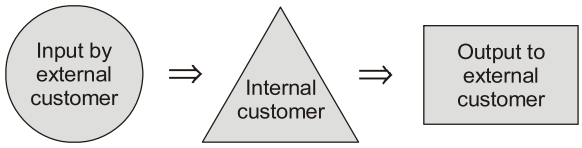
1.1.4 Who are the Customers?

Basically there are two types of customers such as:

- External customer
- Internal customer

External customer: An external customer may be the one who uses the end product or service, the one who purchases the end product or services or the one who influences the sale of product or services. An external customer exists outside the organisation.

Internal customer: Every function within organisation whether it is engineering, order processing or production has an internal customer. That means each functional team is the customer of other functional team.



Customer:

- "Anyone who is impacted by the product or service". There are several customers waiting down the line when a product is being processed through several stages in an organization before it reaches to the final customer. Thus we have people who are impacted within the organization and also people impacted outside the organization.

- Generally, there are two types of customers.

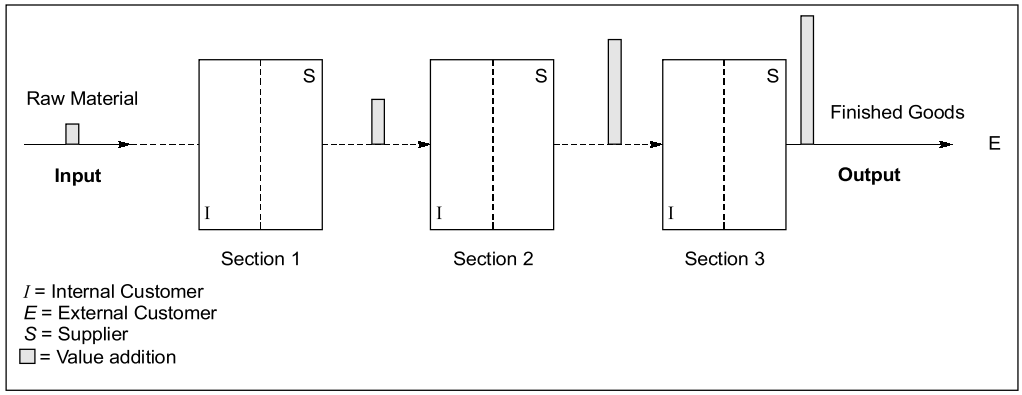


Fig. 1.2 : The Internal and External Customers

Internal Customer: Any individual who receives and uses what a group or organization provides. The person within the company who receives the work of another and adds his or her contribution to the product or service before passifying it on to someone else. Above figure shows that, should section 1 meet the needs of section 2? What happens to section 2 if the section 2 requirements (in terms of quality specifications) are not met by section 1? What if section 1 is not capable of meeting section 2 needs? Should the section 1 work in that case by outsourced? That would mean making section 1 redundant.

External Customer: One who purchases a commodity or service. External customers are the driving forces behind an organization's business.

1.1.5 Dimensions of Quality

As per David Garvin quality of a product can be judged by following eight quality criteria.

1. **Performance:** Basic characteristics of product/service
2. **Aesthetics:** Appearance: Appearance, feel, sound, smell, taste
3. **Special features:** Characteristics that supplement basic functioning
4. **Conformance:** Ability of product to meet customer expectations and standards
5. **Reliability:** Consistency of performance, probability product will operate over time
6. **Durability:** Expected product life
7. **Perceived quality:** Reputation and other indirect measure of quality
8. **Serviceability:** Speed, courtesy, competence and ease of repair

1.1.6 Quality Characteristics

There are number of elements that defines the quality of a product. These elements are called characteristics of quality. It may be:

Physical: length, weight, voltage, viscosity etc.
Sensory: taste, apprearance, colour
Time based: reliability, serviceability, durability

1.2 Traditional Approach vs. Modern Approach Towards Quality

Traditional concept	Modern concept
• Low quality is due to poor working people.	• Low quality is due to poor labour management.
• Quality depends only on production.	• Quality depends on all phases of the production process from the design till the delivery and after sales services.
• Some minor defects and deviations are acceptable.	• The goal is to have defects free product and services.
• The quality control department is a separate unit, checking the finished product.	• Quality is everyone's business. Its total control includes all production phases.

1.2.1 Benefit of Quality

1. Customer satisfaction therefore, customer loyalty and repeat business and referral.
2. Understanding and motivation of employees.
3. Confidence of interested parties in the effectiveness and efficiency of the company.

1.3 Types of Quality

In order to produce goods and services of consistent quality and costs, three types of quality are recognized as these are as follows:

(a) Quality of design
(b) Quality of conformance
(c) Quality of performance

- **Quality of design:** Quality of design is all about set conditions that the product or service must essentially have to satisfy the requirements of the customer. It is also concerned with the **tightness of specifications** for the manufacture of the product. e.g. a part with has a drawing tolerance of ±0.002 mm would be considered to have better quality of design than another with a tolerance of ±0.02 mm.
- **Quality of conformance:** The quality of conformance is concerned with how well the manufactured product conforms to the quality of design. It is basically meeting the standards define in the design phase after the product is manufactured or while the service is delivered.

  It deals with translating user-based characteristics into identifiable product attributes.
- **Quality of performance:** Quality of performance is concerned with how well the manufactured product gives its performance. Meeting customer expectation is the focus when we talk about quality of performance. Quality of performance studies focus on ascentaining how quality characteristics determined in quality of design, and improved and innovated through the quality of conformance studies, perform in market.

  It deals with organizing the manufacturing process to ensure that product quality stringently adheres to specifications.

Remember: 1. Higher quality of design usually costs more.
2. Higher quality of conformance usually costs less.

1.4 Quality Cost

Cost of quality measures the impact of quality in any business. Quality cost are defined as the those costs that are associated with the non-achievements of product or service quality standards and targets to meet customer expectations. Measurement and analysis of various cost aids in tracking the impact of an effective quality management system.

Cost of quality has following components:

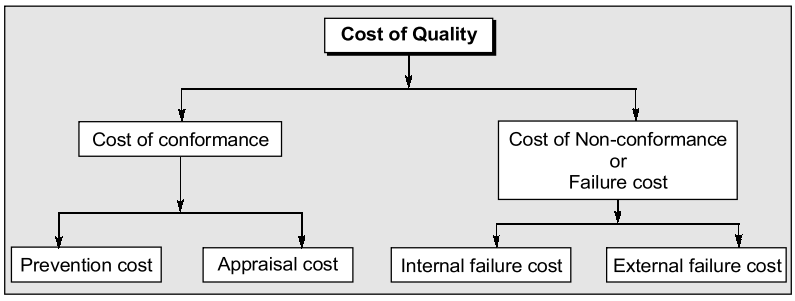


Fig. 1.3 : Cost of quality elements

- **Quality Assurance is the planned or systematic action necessary to provide enough confidence that a product or service will satisfy the given requirements of quality.**

  Quality assurance, on the other hand, is focused on providing confidence that quality requirements are fulfilled. As related to clinical trials, it includes all those planned and systemic actions that are established to ensure that the trial is performed and the data are generated, documented (recorded), and reported in compliance with GCP and the applicable regulatory requirements.
- **Quality Engineering refers to purposeful change of a process to improve the reliability of achieving an outcome.**

1.6.1 Quality Assurance vs. Quality Control

- Quality assurance is the planned or systematic action necessary to provide enough confidence that a product or service will satisfy the given requirement of quality.
- Quality control is the ongoing effort to maintain the integrity of a process to maintain the reliability of achieving an outcome.

Quality Assurance	Quality control
• It is process oriented. • It is a managerial tool. • It is a proactive quality process. • Quality assurance means planning done for doing a process. • The goal of quality assurance to prevent the occurance of defects.	• It is product oriented. • It is a corrective tool. • It is a reactive quality process. • Quality control means action has taken on the process on the process by execute them. • The goal of quality control is to identity and correct the defects in the finished product.

Previous ESE Prelims Questions

Q.1 Consider the following regarding quality circle:

1. It is a small group of people working in different areas of an organization with multiple expertise.
2. It consists of people who volunteer themselves.
3. It is a human resource development technique.
4. It is a problem solving forum.

Which of the above statements are correct?

(a) 2, 3 and 4 only (b) 1, 2 and 3 only
(c) 1, 3 and 4 only (d) 1, 2 and 4 only

[ESE Prelims : 2018]

Ans. (a)

Q.2 **Statement (I) :** The prevention costs increase with the introduction of a quality system and may be a significant proportion of the total quality costs.

Statement (II) : Costs associated with education and training are not included in prevention costs.

(a) Both Statement (I) and Statement (II) are individually true; and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true; but Statement (II) is NOT the correct explanation of Statement (I)
(c) Statement (I) is true; but Statement (II) is false
(d) Statement (I) is false; but Statement (II) is true

[ESE Prelims : 2019]

Ans. (c)

Q.3 Consider the following statements with reference to principal quality objectives:

1. The organization should achieve and sustain the quantity of the product so as to continually meet the purchaser's stated or implied needs.
2. The organization should provide confidence to it own management that the intended quality is being achieved and sustained.
3. The organization should provide confidence to the purchaser that the intended quality is being, or will be, achieved in the delivered product.

Which of the above statements are correct?

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3 **[ESE Prelims : 2022]**

Ans. (c)

Q.4 The quality characteristics can be categorized in which of the following groupings?

1. Sensory characteristics
2. Structural characteristics
3. Statistical characteristics
4. Time oriented characteristics

Select the correct answer using the code given below:

(a) 1, 2, 3 and 4 (b) 1 and 4 only
(c) 2 and 3 only (d) 1, 2 and 4 only **[ESE Prelims : 2022]**

Ans. (d)

Quality Characteristics:

1. Structural characteristics
2. Sensory characteristics
3. Time oriented characteristics
4. Ethical characteristics

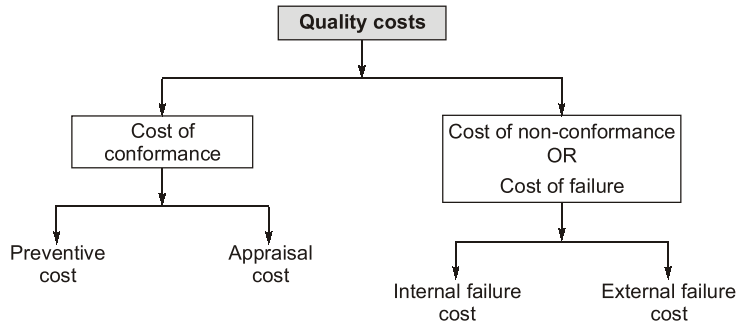
Q.5 What are the major categories for quality costs?

1. Prevention costs
2. Appraisal costs
3. Production costs
4. Internal failure costs

Select the correct answer using the code given below:

(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4 **[ESE Prelims : 2022]**

Ans. (b)



Q.6 Consider the following statements regarding production:

The major aspects of production that may lead to sickness are

1. Increase in the cost of production.
2. Decrease in the quantity of production.
3. Quality of product not meeting the standards/customer expectation.
4. Producing more quantity than can be sold, leading to accumulation of stock.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1, 2, 3 and 4
(c) 2 and 3 only (d) 1, 3 and 4 only **[ESE Prelims : 2022]**

Objective Brain Teasers

Q.1 The difference between internal and external customer is
(a) internal customer usually work in the business, external customer do not.
(b) external customer care about what they receive, internal customer do not.
(c) internal customer do not evaluate quality, external customer do.
(d) quality oriented business care only about external customer.

Q.2 Cost claimed by customer in guarantee period regarding defective product is
(a) Appraisal cost
(b) Cost of internal failure
(c) Prevention cost
(d) Cost of external failure

Q.3 Which of the following is considered as dimension of quality?
(a) Taste (b) Product life
(c) Easy to repair (d) All of the above

Q.4 Match the following:

List-I
A. Quality Control
B. Quality Assurance
C. Quality Engineering

List-II
1. Purposeful change of a process to improve the reliability of achieving an outcome
2. Maintaining the integrity of a process to maintain reliability of achieving an outcome
3. Providing confidence that quality requirements of product/service are fulfilled.

Codes:

	A	B	C
(a)	1	2	3
(b)	1	3	2
(c)	2	3	1
(d)	2	1	3

Q.5 How can be quality be computes?
(a) $\text{Quality} = \frac{\text{Expectation}}{\text{Performance}}$
(b) $\text{Quality} = \frac{\text{Performance}}{\text{Expectation}}$
(c) Quality = Performance + Expectation
(d) Quality = Performance – Expectation

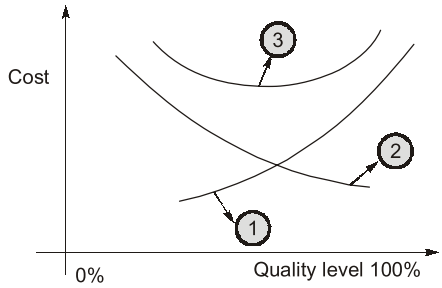
Q.6 Identify the example of external failure costs
(a) quality planning
(b) re-inspection
(c) material review
(d) customer returns

Q.7 Which one of the following depicts aesthetics, which is dimension of quality?
(a) Exterior finish (b) Quality of work
(c) Ranking first (d) Ease of repair

Q.8 Type of waste are
(i) Waiting time (ii) Transport
(iii) Processing waste
The correct answer is
(a) (i) only (b) (i) and (ii)
(c) (ii) and (iii) (d) (i), (ii) and (iii)

Q.9 Which of the following would be considered an appraisal cost of quality?
(a) Training workers to perform their job
(b) Purchasing better tool for workers to perform their job
(c) Repairing an item under the warranty
(d) Running a functional test on each item before it is boxed for the shipment

Q.10 Identify the following curves.



(a) 1-cost of failure, 2-cost of conformance, 3-total quality cost
(b) 1-cost of conformance, 2-cost of non-conformance, 3-preventive cost
(c) 1-cost of conformance, 2-cost of non-conformance, 3-total quality cost
(d) 1-preventive cost, 2-appraisal cost, 3-internal failure

Q.11 Cost of failure includes
(a) Monitoring and control
(b) Quality planning
(c) Rejection and rework
(d) All of the above

Q.12 Which one of these reflects an internal failure cost?
(a) Inspection
(b) Rework
(c) Customer complaint
(d) Replacement of defective product

Q.13 Which of the following includes in cost of quality?
(a) cost of appraisal (b) cost of prevention
(c) cost of failure (d) All of the above

Q.14 Cost incurred to correct an identification defect before the customer receives the product.
(a) Appraisal cost
(b) Internal failure cost
(c) External failure cost
(d) None

Q.15 Cost related to training process capabilities studies, surveys of vendors/suppliers/contractor.
(a) Prevention cost
(b) Appraisal cost
(c) Internal failure cost
(d) External failure cost

Q.16 Which of the following is/are correct?
1. An external customer exists outside the organization and generally falls into three categories; current, prospective & lost.
2. Every person in a process is considered a customer of the preceding operation.

(a) 1 only (b) 1 and 2
(c) 2 only (d) None

Q.17 Which of the following is correct?

(a) $\text{Value} = \dfrac{\text{Quality} \times \text{Service}}{\text{Cost} \times \text{Cycle time}}$

(b) $\text{Value} = \dfrac{\text{Quality} \times \text{Cost}}{\text{Service} \times \text{Cycle time}}$

(c) $\text{Value} = \dfrac{\text{Cost} \times \text{Cycle time}}{\text{Quality} \times \text{Service}}$

(d) $\text{Value} = \dfrac{\text{Service} \times \text{Cycle time}}{\text{Quality} \times \text{Cost}}$

Q.18 Which one of the following is/are correct regarding cost of quality?
1. **Internal failure costs:** Cost generates before a product is shipped as a result of nonconformance to requirements.
2. **External failure costs:** Cost generates after a product is shipped as a result of nonconformance to requirements.

(a) 1 only (b) 2 only
(c) 1 and 2 (d) None

Answers

1. (a)	**2.** (d)	**3.** (d)	**4.** (c)	**5.** (b)
6. (d)	**7.** (a)	**8.** (d)	**9.** (d)	**10.** (c)
11. (c)	**12.** (b)	**13.** (d)	**14.** (b)	**15.** (a)
16. (b)	**17.** (a)	**18.** (c)		

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