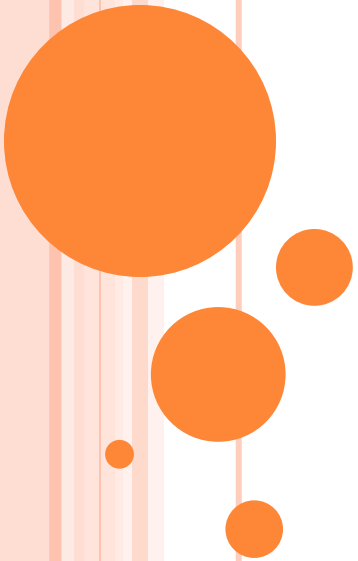
CHAPTER 14: ACCEPTANCE TESTING



TYPES OF ACCEPTANCE TESTING

- Acceptance testing is a formal testing conducted to determine whether a system satisfies its acceptance criteria—the criteria the system must satisfy to be accepted by the customer.
- It helps the customer to determine whether or not to accept the system.
- The customer generally reserves the right to refuse to take delivery of the product if the acceptance test cases do not pass.
- There are two categories of acceptance testing:
  - User acceptance testing.
  - Business acceptance testing.

TYPES OF ACCEPTANCE TESTING

- The UAT is conducted by the customer to ensure that system satisfies the contractual acceptance criteria before being signed off as meeting user needs.
- The BAT is undertaken within the development organization of the supplier to ensure that the system will eventually pass the UAT.
- The acceptance criteria must be defined and agreed upon between the supplier and the customer to avoid any kind of protracted arguments.

TYPES OF ACCEPTANCE TESTING

- Three major objectives of acceptance testing:
  - Confirm that the system meets the agreed-upon criteria.
  - Identify and resolve discrepancies, if there are any.
  - Determine the readiness of the system for cut-over to live operations. The final acceptance of a system for deployment is conditioned upon the outcome of the acceptance testing. The acceptance test team produces an acceptance test report which outlines the acceptance conditions.

ACCEPTANCE CRITERIA

- The basic principle of designing the acceptance criteria is to ensure that the quality of the system is acceptable.
- Even though different persons may have a different view about quality, it is the customer's opinion that prevails.
- The five views of quality are:
  1. The transcendental view sees quality as something that can be recognized but is difficult to describe or define.
  2. The user view sees quality as satisfying the purpose.
  3. The manufacturing view sees quality as conforming to the specification.
  4. The product view ties quality with the inherent characteristics of the product.
  5. The value-based view puts a cost figure on quality—the amount a customer is willing to pay for it.

QUALITY ATTRIBUTES

- ***Functional Correctness and Completeness***

- All the features which are described in the requirements specification must be present in the delivered system.
- It is important to show that the system works correctly under at least two to three conditions for each feature as a part of acceptance.
- Basically a traceability matrix tells us the test cases that are used to verify a requirement and all the requirements that are partially verified by a test case.
- Such a traceability matrix is a powerful tool in showing the customer about the functional correctness of the system.
- It is important to obtain an early feedback from the customer on the requirements traceability matrix.
- Question:

Does the system do what we want it to do?

Quality attributes

- ***Accuracy***

- Accuracy measures the extent to which a computed value stays close to the expected value.
- Accuracy is generally defined in terms of the magnitude of the error.
- A small gap—also called an error in numerical analysis, for example—between the actual value computed by a system and the expected value is generally tolerated in a continuous space.
- Question:

Does the system provide correct results?

Quality attributes

- ***Data Integrity***

- Data integrity refers to the preservation of the data while it is transmitted or stored such that the value of data remains unchanged when the corresponding receive or retrieve operations are executed at a later time.
- Thus, data must not be compromised by performing update, restore, retrieve, transmit, and receive operations.
- The requirement of data integrity is included in the acceptance test criteria to uncover design flaws that may result in data corruption.

Quality attributes

- ***Data Conversion***

- Data conversion is the conversion of one form of computer data to another.
- For example, conversion of a file from one version of Microsoft Word to an earlier version for the sake of those who do not have the latest version of Word installed.
- Data conversion testing is testing of programs or procedures that are used to convert data from existing systems for use in replacement systems.
- An acceptance criterion for data conversion measures and reports the capability of the software to convert existing application data to new formats.

Questions:

- How can we undo a conversion and roll back to the earlier database version(s) if necessary?
- How much human involvement is needed to validate the conversion results?
- How are the current data being used and how will the converted data be used?
- Will the data conversion software conduct integrity checking as well?

Quality attributes

- ***Backup and Recovery***

– Backup and recovery of data are default functionalities of large, complex systems.

- This is because, though systems are not expected to crash, in reality, a system crash is not uncommon.

- The backup and recovery acceptance criteria specify the durability and recoverability levels of the software in each hardware platform.

- The aim of the recovery acceptance test criteria is to outline the extent to which data can be recovered after a system crash.

- Questions:

• How much data can be recovered after a crash and how?

• Is the recovered data expected to be consistent?

• How frequently is the backup process initiated?

• How long does the backup process take?

Quality attributes

- ***Competitive Edge***

- The system must provide a distinct advantage over existing methods and competing products through innovative features.
- An analysis of the competitiveness of the product is provided to the buyer.
- This document contains a comparative study of the system with products available in the market from other vendors.
- Questions:

• What are the nearest direct competitors of the product?
• What are the indirect competitors of the product?
• Who are the potential competitors?

Quality attributes

- ***Usability***

- The goal of usability acceptance criteria is to ensure that the system is flexible, it is easy to configure and customize the system, on-line help is available, work-around is available, and user-interface is friendly.

- Questions:

- How will the system help the user in the day-to-day job?
- Will the productivity, customer satisfaction, reliability, and quality of work life of the user improve by using the system?
- Are the menus, commands, screens, and on-line help clear to a typical user?
- Are the user procedures simple, logical, and clear to the typical user?

Quality attributes

- ***Performance***

- The desired performance characteristics of the system must be defined for the measured data to be useful.
- Questions:

• What types of performance characteristics of the system need to be measured?

• What is the acceptable value for each performance parameter?

• With what external data source or system does the application interact?

Quality attributes

- ***Start-Up Time***

- The system start-up time reflects the time taken to boot up to become operational.
- Questions:

- How is the start-up time defined?
- Does the start-up time include the power-on self-test of all the system hardware?
- What is the longest acceptable start-up time?

Quality attributes

- ***Stress***

- The system should be capable of handling extremely high or stressful load.
- It is necessary to identify the system limitations and then stress the system to find the results when the system is pushed to the border and beyond.
- The system limitation must be identified in the acceptance criteria.
- Questions:

• What are the design limits of the system?

• What is the expected and acceptable behavior of the recovery mechanism?

• What test environment, close to customer deployment architecture, is needed in order to force the system to be stressed?

Quality attributes

- ***Reliability and Availability***

- Software reliability is defined as the probability that the software executes without failure for a specified amount of time in a specified environment.

- The longer a system runs without failure, the more reliable it is.

- A large number of reliability models are available to predict the reliability of software.

- Questions:

• What is the current failure rate of the software?

• What will be the failure rate if the customer continues acceptance testing for a long time?

• How many defects are likely to be in the software?

Quality attributes

- ***Maintainability and Serviceability***

- The maintainability of a system is its ability to undergo repair and evolution.
- One way to characterize maintainability is to measure the MTTR, which reflects the time it takes to analyze a *corrective defect,* design a modification, implement the change, test it, and distribute it.
- - Questions:

• The customer is the final arbiter of setting the severity of a system problem. If the customer calls a problem critical, it must be fixed immediately.

• If a system problem is assessed as critical by the customer, then staff must be assigned to work on resolving the problem immediately with utmost priority.

Quality attributes

- ***Robustness***

- The robustness of a system is defined as its ability to recover from errors, continue to operate under worst conditions, and operate reliably for an extended period of time.

- Questions:

- What are the types of errors from which the system is expected to recover?
- What are the causes, or sources, of the errors so that these can be simulated in a test environment?
- How are the errors initiated, or triggered, in the real world?

Quality attributes

- ***Confidentiality and Availability***

- The confidentiality acceptance criteria refer to the requirement that the data must be protected from unauthorized disclosure and the availability acceptance criteria to the requirement that the data must be protected from a denial of service (DoS) to authorized users.
- Different types of possible confidentiality and availability acceptance criteria are as follows:

• No unauthorized access to the system is permitted, that is, user authentication is performed.
• Files and other data are protected from unauthorized access.
• The system is protected against virus, worm, and bot attacks.

Quality attributes

- ***Compatibility and Interoperability***

- The compatibility of a system is defined as the ability to operate in the same way across different platforms and network configurations and in the *presence of different mixes of other applications*.
- On the other hand, the interoperability of a system is defined as the ability to *interface* with other network elements and work correctly as expected.
- - Questions:

- What are the platforms, or configurations, on which the system must operate?
- Does the system have to work exactly the same way across different configurations? If not, what are the acceptable variations?
- What are the applications that must coexist with the system?

Quality attributes

- ***Compliance***

- The system should comply with the relevant technical standards, such as the IEEE standards, operating system interface standards, and the IP standards.

- Questions:

- With what technical standards should the system comply? Are there any exceptions to these standards? If yes, specify the exceptions.
- Identify the regulatory bodies that must certify the system?

Quality attributes

- ***Installability and Upgradability***

- The purpose of system installability and upgradability is to ensure that the system can be correctly installed and upgraded in the customer environment.
- If for some reason the customer wants to uninstall or downgrade the system software, it is required to be done smoothly.
- Installation and upgradation of a system is planned by identifying the major milestones and contingency steps.
- Questions:

• The document must identify the person to install the system, for example, the end user or a trained technician from the supplier side.

• Can the installation or upgradation process change the user's existing environment? If yes, the risks of this change should be clearly documented.

Quality attributes

- ***Scalability***

- The scalability of a system is defined as its ability to effectively provide acceptable performance as the following quantities increase: (i) geographic area of coverage of a system, (ii) system size in terms of the number of elements in the system, (iii) number of users, and (iv) volume of workload per unit time.
- Questions:

- How many concurrent users is the system expected to handle?
- How many transactions per unit time is the system expected to process?
- How many database records is the system expected to support?

Quality attributes

- ***Documentation***

- The quality of the system user's guide must be high.
- All the user documents should be reviewed and approved by the software quality assurance group for correctness, accuracy, readability, and usefulness.
- The on-line help should be reviewed and signed off by the software quality assurance group.

SELECTION OF ACCEPTANCE CRITERIA

- The customer needs to select a subset of the quality attributes and prioritize them to suit their specific situation.
- Next, the customer identifies the acceptance criteria for each of the selected quality attributes.
- When the customer and the software vendor reach an agreement on the acceptance criteria, both parties must keep in mind that satisfaction of the acceptance criteria is a trade-off between time, cost, and quality.
- For example, IBM used the quality attribute list CUPRIMDS—capability, usability, performance, reliability, installation, maintenance, Documentation, and service—for its products

SELECTION OF ACCEPTANCE CRITERIA

- For web-based applications, a set of quality attributes are identified in decreasing order of priority: reliability, usability, security, availability, scalability, maintainability, and time to market.
- Such a prioritization scheme is often used in specific application domains.
- For example, usability and maintainability take precedence over performance and reliability for a word processor software.
- On the other hand, it might be the other way around for a real-time operating system or telecommunication software.

ACCEPTANCE TEST PLAN

- The purpose of an ATP is to develop a detailed outline of the process to test the system prior to making a transition to the actual business use of the system.
- Often, the ATP is delivered by the vendor as a contractual agreement, so that the business acceptance testing can be undertaken within the vendor's development organization to ensure that the system eventually passes the acceptance test.
- An ATP needs to be written and executed by the customer's special user group. The user group consists of people from different backgrounds, such as software quality assurance engineers, business associates, and customer support engineers.

ACCEPTANCE TEST PLAN

- An overall test plan for acceptance testing and description of specific tests are documented in the ATP.
- The introduction section of the ATP describes the structure of the test plan and what we intend to accomplish with this test plan. This section typically includes (i) test project name, (ii) revision history, (iii) terminology and definitions, (iv) names of the approvers and the date of approval, (v) an overview of them plan, and (vi) references.

TABLE 14.1 Outline of ATP

1. Introduction
2. Acceptance test category. For each category of acceptance criteria:
   - (a) Operational environment
   - (b) Test case specification
     - (i) Test case ID number
     - (ii) Test title
     - (iii) Test objective
     - (iv) Test procedure
3. Schedule
4. Human resources

ACCEPTANCE TEST EXECUTION

- The acceptance test cases are divided into two subgroups. The first subgroup consists of basic test cases, and the second consists of test cases that are more complex to execute.
- The acceptance tests are executed in two phases:
- In the first phase, the test cases from the basic test group are executed.
- If the test results are satisfactory, then the second phase, in which the complex test cases are executed, is taken up.
- In addition to the basic test cases, a subset of the system-level test cases are executed by the acceptance test engineers to independently confirm the test results.

ACCEPTANCE TEST EXECUTION

- Acceptance test execution is an important activity performed by the customer with much support from the developers. The activity includes the following detailed actions:
- The developers train the customer on the usage of the system.
- The developers and the customer coordinate the fixing of any problem discovered during acceptance testing.
- The developers and the customer resolve the issues arising out of any acceptance criteria discrepancy.

ACCEPTANCE TEST REPORT

- Acceptance test activities are designed to reach one of three conclusions:
  - Accept the system as delivered,
  - Accept the system after the requested modifications have been made, or
  - Do not accept the system.
- Usually some useful intermediate decisions are made before making the final decision:
  - A decision is made about the continuation of acceptance testing if the results of the first phase of acceptance testing are not promising. One may recall that the basic tests are executed in the first phase.
  - If the test results are unsatisfactory, changes will be made to the system before acceptance testing can proceed to the next phase.

ACCEPTANCE TEST REPORT

TABLE 14.3 Structure of Acceptance Test Status Report

1. Date	Acceptance report date
2. Test case execution status	Number of test cases executed today
	Number of test cases passing
	Number of test cases failing
3. Defect identifier	Submitted defect number
	Brief description of issue
4. ACC number(s)	Acceptance criteria change document number(s), if any
5. Cumulative test execution status	Total number of test cases executed
	Total number of test cases passing
	Total number of test cases failing
	Total number of test cases not executed yet

ACCEPTANCE TEST REPORT

TABLE 14.4 Structure of Acceptance Test Summary Report

1. Report identifier
2. Summary
3. Variances
4. Summary of results
5. Evaluation
6. Recommendations
7. Summary of activities
8. Approval