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# **G.S. College of Commerce, Wardha**

## **Department Of B.Com Computer Application**

### **BCCA PART-III SEM-V**

### **System Analysis and Design**

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## UNIT-IV

**System Implementation- System Testing And Quality Assurance-** Introduction, Why System Testing?, What Do We Test For?, The Test Plan, Quality Assurance, Trends In Testing, Role Of Data Processing Auditor.

**Implementation And Software Maintenance-** Introduction, Conversion, Combating Resistance To Change, Post-Implementation Review, Software Maintenance.

**Hardware/ Software Selection -** Introduction, The Computer Industry, The Software Industry, A Procedure For Hardware/ Software Selection, Financial Considerations In Selection, The Used Computer, The Computer Contract.

## **Unit-IV**

### **System Implementation - System Testing and Quality Assurance**

#### **System Implementation- System Testing and Quality Assurance-**

- ☐ Introduction,
- ☐ Why System Testing?
- ☐ What Do We Test For?
- ☐ The Test Plan,
- ☐ Quality Assurance

## Testing (why system Testing?)

Testing is vital to the success of the system. System testing makes a logical assumption that if all the parts of the system of the system are correct, the goal will be successfully achieved. The time lag between the cause and the appearance of the problem. The effect of system errors on files and records within the system. A small system error can conceivably explode into a much larger problem. Effective testing early in the process translates directly into long-term cost savings from a reduced number of errors.

- ❖ Testing is the process or activity that checks the functionality and correctness of software according to specified user requirements in order to improve the quality and reliability of system. It is an expensive, time consuming, and critical approach in system development which requires proper planning of overall testing process.
- ❖ A successful test is one that finds the errors. It executes the program with explicit intention of finding error, i.e., making the program fail. It is a process of evaluating system with an intention of creating a strong system and mainly focuses on the weak areas of the system or software.

### **Characteristics of System Testing:**

System testing begins at the module level and proceeds towards the integration of the entire software system. Different testing techniques are used at different times while testing the system. It is conducted by the developer for small projects and by independent testing groups for large projects.

A successful test is one that finds the errors. It executes the program with explicit intention of finding error, i.e., making the program fail. It is a process of evaluating system with an intention of creating a strong system and mainly focuses on the weak areas of the system or software.

### **Why do we test for?**

The first test of a system is to see whether it produces the correct outputs. No other test can be more crucial.

**1. Online Response:** Online systems must have a response time that will not cause a hardship to the user. One way to test this is to input transactions on as many CRT screens as would normally be used in hours and time the response to each online function to establish a true performance level.

**2. Volume:** In this test, create as many records as would normally be produced to verify that the hardware and software will function correctly. The user is usually asked to provide test data for volume testing.

**3. Stress testing:** The purpose of stress testing is to prove that the candidate system does not malfunction under loads. Unlike volume testing, where time is not a factor, the system to a high volume of data over a short time period. This simulates an online environment where a high volume of activities occurs.

**4.Recovery and security:** A forced system failure is induced to test a backup recovery procedure for file integrity. Inaccurate data are entered to see how the system responds in terms of errors detection and protection. Related to file integrity is a test to demonstrate that data and programs are secure from unauthorized access.

**5.Usability documentation and procedure:** The usability test verifies the user-friendly nature of the system. This relates to normal operating and error-handling procedures. One aspect of user-friendliness is accurate and complete documentation.

## Why do we test for?

1. Software testing enables making objective assessments regarding the degree of conformance of the system to stated requirements and specifications.
2. Testing verifies that the system meets the different requirements including, functional, performance, reliability, security, usability and so on. This verification is done to ensure that we are building the system right.
3. In addition, testing validates that the system being developed is what the user needs. In essence, validation is performed to ensure that we are building the right system. Apart from helping make decisions, the information from software testing helps with risk management.



4. Software testing contributes to improving the quality of the product. You would notice that we have not mentioned anything about defects/bugs up until now.
5. While finding defects / bugs is one of the purposes of software testing, it is not the sole purpose. It is important for software testing to verify and validate that the product meets the stated requirements / specifications.
6. Quality improvements help the organization to reduce post release costs of support and service, while generating customer good will that could translate into greater revenue opportunities.
7. Also, in situations where products need to ensure compliance with regulatory requirements, software testing can safeguard the organization from legal liabilities by verifying compliance.

## Trends in system testing: (remaining)

### Role Of Data Processing Auditor:

- ❖ Testing should involve a thorough auditing to introduce control elements unique to a system.
- ❖ The Data Processing (DP) Auditor should be involved in testing.
- ❖ The role of the auditor is to judge the controls and make any recommendations to change or enhance the project.
- ❖ The user department also has to be involved in this process. For testing programs, test data that violate control procedures and test data that do not violate control procedures are to be included. At the time of testing all the required files are collected for testing.

## Audit trail:

One important function of control is to provide audit trail. Some of the problems encountered by the auditor are as follows

- ❖ Once the source documents are transferred into a machine-readable form, they are filed in areas that make it difficult to access.
- ❖ Files stored on tapes or disks require a computer to read it.
- ❖ Processing activities are difficult to observe since they are inside the system.
- ❖ To solve this a detailed file of the transactions can be kept and they can be used as an input for an audit program.
- ❖ The audit program then selects a transaction for selected accounts for the auditor to view.

**Three important steps are to be considered while evaluating the project**

1. Define the control objectives as separate design and test requirements.
2. Re-examine budget costs
3. Review specifications.

## **The Test Plan**

The first step in system testing is to prepare a plan that will test all aspects of the system in a way that promotes its credibility among potential users.

1. Programming usually do a better job in unit testing because they are expected to document and report on the method and extent of their testing.
2. Users are involved, which means communications is improved between users and the designer group.
3. Programmers are involved when they become aware of user problems and expectations. The user also becomes more aware of the complexity of programming and testing.

## **Activity Network for System Testing**

1. Prepare test plan.
2. Specify conditions for user acceptance testing.
3. prepare test data for program testing.
4. Prepare test data for transaction path testing.
5. Plan user training.
6. Compile/assemble programs.
7. Prepare job performance aids.
8. Prepare operational documents.

### **1.Prepare Test Plan :**

A workable test plan must be prepared in accordance with established a design specifications It includes the following items:

- 1.Outputs expected from the system.
- 2.Criteria for evaluating outputs.
- 3.A volume of test data.
- 4.Procedure for using test data.
- 5.Personnel and training requirements.

### **2.Specify conditions for User Acceptance Testing:**

Planning for user acceptance testing calls for the analyst and the user to agree on the conditions for the test. Many of these conditions may be derived from the test plan.

### **3.Preapre Test data for program Testing:**

As each program is coded, test data are prepared and documented to ensure that all aspects of the program are properly tested. After the testing the data are filed for future reference.

#### **4.Prepare Test Data for Transaction path testing:**

This activity develops the data required for testing every condition and transaction to be introduced into the system. The path of each transaction from origin to destination is carefully tested for reliable results.

#### **5.Plan user training:**

User training is designed to prepare the user for testing and converting the system. User involvement and training take place parallel with programming for three reasons:

- 1.The system group has time available to spend on training while the programs are being written.
- 2.Initiating a user-training program gives the systems group a clearer image of the user's interest in the new system.
- 3.A trained user participates more effectively in system testing.

For user training, preparation of a checklist is useful. Included are provisions for developing training materials and other documents to complete the training activity. The training plan is followed by preparation of the user training manual and other test materials. A common procedure is to train supervisors and department heads .

## **6.Compile/Assemble programs :**

All programs have to be compiled/assembled for testing. Before this however, a complete program description should be available. Included is the purpose of the program, its use, the programmers who prepared it and the amount of computer time it takes to run it. program and system flowcharts of the project should also be available for reference.

## **7.Prepare Job performance Aids:**

In this activity the materials to be used by personnel to run the system are specified and scheduled. This included a display of materials such as program codes, list of input codes attached to the CRT terminals and a posted instruction schedule to load the disk drive.

## **8.Prepare Operational Documents:**

During the test plan stage, all operational documents are finalized, including copies of the operational formats required by the candidate system. Related to operational documentation is a section on the experience, training and educational qualifications of personnel for the proper operation of the new system.

## Activity network of system testing: ( Stages of System Testing)

The following stages are involved in testing –

### **1) Test Strategy**

It is a statement that provides information about the various levels, methods, tools, and techniques used for testing the system. It should satisfy all the needs of an organization.

### **2) Test Plan**

It provides a plan for testing the system and verifies that the system under testing fulfils all the design and functional specifications. The test plan provides the following information –

Objectives of each test phase

- ❖ Approaches and tools used for testing
- ❖ Responsibilities and time required for each testing activity
- ❖ Availability of tools, facilities, and test libraries
- ❖ Procedures and standards required for planning and conducting the tests
- ❖ Factors responsible for successful completion of testing process



### 3) Test Case Design

- ❖ Test cases are used to uncover as many errors as possible in the system.
- ❖ A number of test cases are identified for each module of the system to be tested.
- ❖ Each test case will specify how the implementation of a particular requirement or design decision is to be tested and the criteria for the success of the test.
- ❖ The test cases along with the test plan are documented as a part of a system specification document or in a separate document called **test specification** or **test description**.

### 4) Test Procedures

- ❖ It consists of the steps that should be followed to execute each of the test cases. These procedures are specified in a separate document called test procedure specification.
- ❖ This document also specifies any special requirements and formats for reporting the result of testing.

### 5) Test Result Documentation

- ❖ Test result file contains brief information about the total number of test cases executed, the number of errors, and nature of errors.
- ❖ These results are then assessed against criteria in the test specification to determine the overall outcome of the test.

## System Testing:

The purpose of system testing is to identify and correct errors in the candidate system. As this phase is it is one that is frequently compromised. Typically, the project is behind schedule or the user to go directly to conversion.

In System testing, performance and acceptance standards are developed. Substandard performance or service interruptions that result in system failure are checked during the test. The following performance criteria are used for system testing:

1. Turnaround time is the elapsed time between the receipt of the input and the availability of the Output. In online systems, high-priority processing is handled during peak hours, while low-priority processing is done later in the day or during the night shift.
2. Backup relates to procedures to be used when the system is down. Backup plans might call for the use of another computer. The software for the candidate system must be tested for compatibility with a backup computer.
3. In case of a partial system breakdown, provisions must be made for dynamic reconfiguration of the system. For example, in an online environment, when the printer breaks down.
4. File protection pertains to storing files in a separate area for protection against fire, flood or natural disaster. Plans should also be established for reconstructing files damaged through a hardware malfunction.
5. The human factor applies to the personnel of the candidate system. During system testing, lighting, air conditioning, noise, chairs, CRTs, etc.

## Types of System Tests

After a test plan has been developed, system testing begins by testing program modules separately, followed by testing bundled modules as a unit. A program module may function perfectly in isolation but fail when interfaced with other modules. The approach is to test each entity with successively larger ones, up to the system test level.

System testing consists of the following steps:

1. Program testing
2. String testing
3. System testing
4. System documentation
5. User acceptance testing

### 1. Program Testing:

A program represents the logical elements of a system. For a program to run satisfactorily, it must compile and test data correctly and tie in properly with other programs. Achieving an error-free program is the responsibility of the programmer.

Program testing checks for two types of errors: Syntax and logic. A syntax error is a program statement that violates one or more rules of the language in which it is written. An improperly defined field dimension or omitted key words are common syntax errors.

A logic error, on the other hand, deals with incorrect data fields, out of range items, and invalid combinations.

**2.String Testing:** Programs are invariably related to one another and interact in a total system. Each program is tested to see whether it conforms to related programs in the system. Each portion of the system is tested against the entire module with both test and live data.

**3.System Testing:** System testing is designed to uncover weaknesses that were not found in earlier tests. This includes forced system failure and validation of the total system as it will be implemented by its user(s) in the operational environment. Generally, it begins with low volumes of transactions based on live data.

**4. System Documentation:** All design and tests documentation should be finalized and entered in the library for future reference. The library is the central location for maintenance of the new system. The format, organization and language of each documentation should be in line with system standards.

**6. User Acceptance Testing:** An acceptance test has the objective of selling the user on the validity and reliability of the system. It verifies that the system's procedures operate to system specifications and that the integrity of vital data is maintained. Performance of an acceptance test is actually the user's shows. User motivation and knowledge are critical for the successful performance of the system.

## Quality Assurance:

- ❖ The amount and complexity of software produced today stagger the imagination. Software development strategies have not kept pace, however, and software products fall short of meeting application objectives. Consequently, controls must be developed to ensure a quality product.
- ❖ It is the review of system or software products and its documentation for assurance that system meets the requirements and specifications.
- ❖ Purpose of QA is to provide confidence to the customers by constant delivery of product according to specification.
- ❖ Software quality Assurance (SQA) is a techniques that includes procedures and tools applied by the software professionals to ensure that software meet the specified standard for its intended use and performance.
- ❖ The main aim of SQA is to provide proper and accurate visibility of software project and its developed product to the administration.
- ❖ It reviews and audits the software product and its activities throughout the life cycle of system development.

## Quality Assurance Goals in the Systems Life Cycle

The software life cycle includes various stages of development and each stage has the goals of quality assurance.

### Quality Factors Specifications:

The goals of this stage is to define the factors that contribute to the quality of the candidate system. Seven factors determine the quality of a system:

- 1. Correctness:** The extent to which a program meets system specification and user objectives.
- 2. Reliability:** the degree to which the system performs its intended functions over a time.
- 3. Efficiency:** the amount of computer resources required by a program to perform a function.
- 4. Usability:** the effort required to learn and operate a system.
- 5. Maintainability:** the ease with which program errors are located and corrected.
- 6. Testability:** the effort required to test a program to ensure its correct performance.
- 7. Portability:** the ease of transporting a program from one hardware configuration to another.
- 8. Accuracy:** the required precision in input editing, computations and output.
- 9. Error tolerance-** error detection and correction versus error avoidance.
- 10. Expandability:** ease of adding or expanding the existing data base.
- 11. Access control and audit:** control of access to the system and the extent to which that access can be audited.
- 12. Communicativeness:** how descriptive or useful the outputs of the system are.

## Objectives of Quality Assurance:

The objectives of conducting quality assurance are as follows –

- ❖ To monitor the software development process and the final software developed.
- ❖ To ensure whether the software project is implementing the standards and procedures set by the management.
- ❖ To notify groups and individuals about the SQA activities and results of these activities.
- ❖ To ensure that the issues, which are not solved within the software are addressed by the upper management.
- ❖ To identify deficiencies in the product, process, or the standards, and fix them.

## **Levels of Quality Assurance**

There are several levels of QA and testing that need to be performed in order to certify a software product.

### **Level 1 – Code Walk-through**

At this level, offline software is examined or checked for any violations of the official coding rules. In general, the emphasis is placed on examination of the documentation and level of in-code comments.

### **Level 2 – Compilation and Linking**

At this level, it is checked that the software can compile and link all official platforms and operating systems.

### **Level 3 – Routine Running**

At this level, it is checked that the software can run properly under a variety of conditions such as certain number of events and small and large event sizes etc.

### **Level 4 – Performance test**

At this final level, it is checked that the performance of the software satisfies the previously specified performance level.

Implementation is a process of ensuring that the information system is operational. It involves –Constructing a new system from scratch

Constructing a new system from the existing one.

Implementation allows the users to take over its operation for use and evaluation. It involves training the users to handle the system and plan for a smooth conversion.



### Trends in system testing:

In the future, it can expect unparalleled growth in the development and use of automated tools and software aids for testing. One such tool is the functional tester, which determines whether the hardware is operating up to a minimal standard. It is a computer program that controls the complete hardware configuration and verifies that it is functional. For example, it can test computer memory by performing read/write tests, and it tests each peripheral device individually.

The functional tester is of great value when minute hardware problems are disguised as software bugs. For example, hardware faults are usually repeatable, whereas software bugs are generally erratic. Problems arise when the delicate interaction between hardware and software cause a hardware problem to appear as an erratic software bug. A functional tester determines immediately that the problem is in the hardware. This saves considerable time during testing.

## Role Of Data Processing Auditor:

- ❖ The planned test of any system to include a thorough auditing technique and introduce control elements unique to the system. The data processing (DP) auditor should be involved in most phases of the system life cycle, especially system testing. In the past, auditors have audited systems after they have been installed. Then the cost is often too prohibitive to go back and modify the system to incorporate adequate control.
- ❖ Testing should involve a thorough auditing to introduce control elements unique to a system.
- ❖ The Data Processing (DP) Auditor should be involved in testing.
- ❖ The role of the auditor is to judge the controls and make any recommendations to change or enhance the project.
- ❖ The user department also has to be involved in this process. For testing programs, test data that violate control procedures and test data that do not violate control procedures are to be included. At the time of testing all the required files are collected for testing.

## Implementation and Software Maintenance-

Implementation is used here to mean the process of converting a new or a revised system design in to an operational one. Conversion is one aspect of implementation. The other aspects are the post implementation review and software maintenance.

There are three types of implementation:

1. Implementation of a computer system to replace a manual system. The problems encountered are converting files, training users, creating accurate files, and verifying printouts for integrity.
- 2.Implementation of a new computer system to replace an existing one. This is usually a difficult conversion. If not properly planned, there can be many problems.
- 3.Implementation of a modified application to replace an existing one using the same computer. This type of conversion is relatively easy to handle, provided there are no major changes in the files.

## **Conversion:**

Conversion means changing from one system to another. The objective is to put the tested system into operation while holding costs, risks, and personnel irritation to a minimum. It involves

1. creating computer compatible files.
2. Training the operating staff and
3. Installing terminals and hardware. A critical aspect of conversion is not disrupting the functioning of the organization.

Conversion should be exciting because it is the last step before the candidate system begins to show results.

### **Conversion: (Activity network for conversion)**

It is a process of migrating from the old system to the new one. It provides understandable and structured approach to improve the communication between management and project team.

Several procedures and documents are unique to the conversion phase.

1. Conversion begins with a review of the project plan, the system test documentation, and the implementation plan. The parties involved are the user, the project team, programmers and operators.
2. The conversion portion of the implementation plan is finalized and approved.
3. Files are converted.

- 4.Parallel processing between the existing and the new systems is initiated.
- 5.Results of computer runs and operations for the new system are logged on a special form.
- 6.Assuming no problems, parallel processing is discontinued. Implementation results are documented for reference.
- 7.Conversion is completed. Plans for the post-implementation review are prepared

## **Training:**

The personnel in the system must know in detail what their roles will be, how they can use the system, and what the system will or will not do. The success or failure of well-designed and technically elegant systems can depend on the way they are operated and used.

### **Training Systems Operators**

Systems operators must be trained properly such that they can handle all possible operations, both routine and extraordinary. The operators should be trained in what common malfunctions may occur, how to recognize them, and what steps to take when they come.

Training involves creating troubleshooting lists to identify possible problems and remedies for them, as well as the names and telephone numbers of individuals to contact when unexpected or unusual problems arise.

Training also involves familiarization with run procedures, which involves working through the sequence of activities needed to use a new system.

## **User Training:**

- ❖ End-user training is an important part of the computer-based information system development, which must be provided to employees to enable them to do their own problem solving.
- ❖ User training involves how to operate the equipment, troubleshooting the system problem, determining whether a problem that arose is caused by the equipment or software.
- ❖ Most user training deals with the operation of the system itself. The training courses must be designed to help the user with fast mobilization for the organization.

## **Training Guidelines**

- ❖ Establishing measurable objectives
- ❖ Using appropriate training methods
- ❖ Selecting suitable training sites
- ❖ Employing understandable training materials

## **Training Methods**

### **Instructor-led training**

It involves both trainers and trainees, who have to meet at the same time, but not necessarily at the same place. The training session could be one-on-one or collaborative. It is of two types

#### **Virtual Classroom**

In this training, trainers must meet the trainees at the same time, but are not required to be at the same place. The primary tools used here are: video conferencing, text-based Internet relay chat tools, or virtual reality packages, etc.

#### **Normal Classroom**

The trainers must meet the trainees at the same time and at the same place. Their primary tools used here are blackboard, overhead projectors, LCD projector, etc.



## **Self-Paced Training**

It involves both trainers and trainees, who do not need to meet at the same place or at the same time.

The trainees learn the skills themselves by accessing the courses at their own convenience. It is of two types –

## **Multimedia Training**

In this training, courses are presented in multimedia format and stored on CD-ROM. It minimizes the cost in developing an in-house training course without assistance from external programmers.

## **Web-based Training**

In this training, courses are often presented in hyper media format and developed to support internet and intranet. It provides just-in-time training for end users and allow organization to tailor training requirements.

## Combating Resistance to Change :

- ❖ Hazel Jones was 60 years old and had worked for Power House Athletics for 17 years. Her reputation among the employees is that there is right way, the company way, and Hazel's way. Hazel's job is to post customer and vendor accounts, keep track of the inventory, and balance the books before she leaves for home.
- ❖ Anxiety is produced when a person does not know the outcome of an induced change:
  - Change in job content.
- ❖ How to think along new lines.
- ❖ Change in personal relations patterns.
- ❖ Possible loss of self-esteem relative to the new job.
- ❖ Possible loss of one's job.
- ❖ Loss of control of job content.

Thus when people experience stress, part of their reaction is resistance to change. Here are examples of the ways they react:

- ❖ Hostility toward peers or others, communication barriers, or as in our example, refusing to sign the delivery notice.
- ❖ Withdrawal from the cause of stress – the supervisor going home sick.
- ❖ Rejection of the stressful situation -refusing to accept the computer.

### **Post Implementation Review:**

- ❖ Operational systems are quickly taken for granted. Every system requires periodic evaluation after implementation.
- ❖ A post implementation review measures the system's performance against predefined requirements. Unlike system testing, which determines where the system fails so that the necessary adjustments can be made, a post-implementation review determines how well the system continues to meet performances specifications.
- ❖ It is done after design and conversion are complete.
- ❖ It also provides information to determine whether major redesign is necessary.

#### **RequestforReview:**

The initiating study begins with the review team, which gathers and reviews requests for evaluation. It also files discrepancy notices after the system has been accepted.

- ❖ Unexpected change in the system that affects the user or system performance is a primary factor that prompts system review.
- ❖ Once a request is filled, the user is asked how well the system is functioning. Suggestions regarding changes and improvements are also sought. This phase sets the stage for a formal post-implementation review.

#### **AReviewPlan:**

This review team prepares a formal review plan around the objectives of the review, the type of evaluation to be carried out, and the time schedule required.

## **1.Administrativeplan:**

The review group probes the effect of the operational system on the administrative procedures of the user. The following activities are reviewed:

### **1. User objectives –**

This is an extremely critical area since it is possible that over time either the system fails to meet the user's initial objectives or the user objectives change as a reflection of changes in the organizational objectives.

We need to think in terms of problems and of further opportunities. The results of the evaluation are documented for future reference

### **2. Operating costs and benefits –**

Under the administrative plan, the cost structures of the system is closely reviewed.

This includes a review of all costs and savings, a review and update of the non-cost benefits of all the system and a current budget designed to manipulate the costs and savings of the system.

## 2. Personnel Requirement Plan:

This plan evaluates all activities involving system personnel and staff as they directly deal with the system. The emphasis is on productivity and job satisfaction. After the plan is developed, the review group evaluates the following:

**1. Personnel performance** objectives compared with current performance levels : Turnover, tardiness and absenteeism are also evaluated. The results are documented and made available to the maintenance group for follow-up.

**2. Training performance :** Through testing , interviews, and all other data gathering techniques, the review group attempts to answer questions about the adequacy of the training materials.

### **3.Hardware Plan:**

The hardware of the new system is also reviewed, including terminals, CRT screens, software programs, and the communication network. The primary target is a comparison of current performance specifications. The outcome of the evaluation indicates any differences between expectations and realized results. It also points to any necessary modifications to be made.

### **4.Documentation Review Plan:**

The reason for developing a documentation review plan is to evaluate the accuracy and completeness of the documentation compiled to date and its conformity with pre-established documentation standards. Irregularities prompt action where changes in documentation would improve the format and content.

## Software Maintenance:

### System Maintenance / Enhancement

- ❖ Maintenance means restoring something to its original conditions. Enhancement means adding, modifying the code to support the changes in the user specification. System maintenance conforms the system to its original requirements and enhancement adds to system capability by incorporating new requirements.
- ❖ Thus, maintenance changes the existing system, enhancement adds features to the existing system, and development replaces the existing system. It is an important part of system development that includes the activities which corrects errors in system design and implementation, updates the documents, and tests the data.

- ❖ Maintenance is the enigma of system development. It holds the software industry captive, tying up programming resources.
- ❖ Analysts and programmers spend far more time maintaining programs than they do writing them.
- ❖ Software maintenance is widely accepted part of SDLC now a days. It stands for all the modifications and updating done after the delivery of software product.
- ❖ There are number of reasons, why modifications are required, some of them are briefly mentioned below:



**Market Conditions** - Policies, which changes over the time, such as taxation and newly introduced constraints like, how to maintain bookkeeping, may trigger need for modification.

**Client Requirements** - Over the time, customer may ask for new features or functions in the software.

**Host Modifications** - If any of the hardware and/or platform (such as operating system) of the target host changes, software changes are needed to keep adaptability.

**Organization Changes** - If there is any business level change at client end, such as reduction of organization strength, acquiring another company, organization venturing into new business, need to modify in the original software may arise.

## Types of Maintenance

In a software lifetime, type of maintenance may vary based on its nature. It may be just a routine maintenance tasks as some bug discovered by some user or it may be a large event in itself based on maintenance size or nature. Following are some types of maintenance based on their characteristics:

**Corrective Maintenance** - This includes modifications and updating done in order to correct or fix problems, which are either discovered by user or concluded by user error reports.

**Adaptive Maintenance** - This includes modifications and updating applied to keep the software product up-to date and tuned to the ever-changing world of technology and business environment.

**Perfective Maintenance** - This includes modifications and updates done in order to keep the software usable over long period of time. It includes new features, new user requirements for refining the software and improve its reliability and performance.

**Preventive Maintenance** - This includes modifications and updations to prevent future problems of the software. It aims to attend problems, which are not significant at this moment but may cause serious issues in future.

## **Maintenance Activities**

**IEEE( Institute of Electrical and Electronics Engineers)** provides a framework for sequential maintenance process activities. It can be used in iterative manner and can be extended so that customized items and processes can be included.

These activities go hand-in-hand with each of the following phase:

### **❖Identification & Tracing -**

It involves activities pertaining to identification of requirement of modification or maintenance. It is generated by user or system may itself report via logs or error messages. Here, the maintenance type is classified also.

### **❖Analysis -**

The modification is analyzed for its impact on the system including safety and security implications. If probable impact is severe, alternative solution is looked for. A set of required modifications is then materialized into requirement specifications. The cost of modification/maintenance is analyzed and estimation is concluded.

- ❖ **Design** - New modules, which need to be replaced or modified, are designed against requirement specifications set in the previous stage. Test cases are created for validation and verification.
- ❖ **Implementation** - The new modules are coded with the help of structured design created in the design step. Every programmer is expected to do unit testing in parallel.
- ❖ **System Testing** - Integration testing is done among newly created modules. Integration testing is also carried out between new modules and the system. Finally the system is tested as a whole, following regressive testing procedures.
- ❖ **Acceptance Testing** - After testing the system internally, it is tested for acceptance with the help of users. If at this state, user complaints some issues they are addressed or noted to address in next iteration.

**Delivery** - After acceptance test, the system is deployed all over the organization either by small update package or fresh installation of the system. The final testing takes place at client end after the software is delivered.

Training facility is provided if required, in addition to the hard copy of user manual.

**Maintenance management** - Configuration management is an essential part of system maintenance. It is aided with version control tools to control versions, semi-version or patch management.

## Hardware/Software Selection and the Computer Contract

- ❖ The analyst must be familiar with the computer industry in general, what various computers can and cannot do, whether to purchase or lease a system, the vendors and their outlets, and their outlets, and the selection procedure.
- ❖ Hardware/software selection begins with requirements analysis, followed by a request for proposal and vendor evaluation.
- ❖ The final system selection initiates contract negotiations.
- ❖ It includes purchase price, maintenance agreements and the amount of updating or enhancements to be available by the vendor over the life of the system.

## **The Computer Industry**

They can be classified into three groups

1. Hardware suppliers
2. Software suppliers
3. Service suppliers

### **1. Hardware Suppliers**

This group includes mainframe manufacturers, peripheral vendors, supplies vendors, computer leasing firms and used systems dealers. Peripheral manufacturers supply tape drives, disk and diskette drives, printers, and other components. Vendors of supplies provide consumable supplies such as diskettes and printer forms and non consumable supplies such as disk packs, tape reels, tape library shelves and fireproof vaults.

## 2. Software Suppliers

- ❖ In today's market, 17000 firms offer more than 5000 systems and applications. In the microcomputer area, over 30000 software packages are available.
- ❖ Computers users can acquire programs from either the vendor or the software house for virtually every application imaginable.
- ❖ Price vary from a basic payroll program stored on cassette for mainframe-based inventory control.



### 3.Service suppliers:

Outside computer services are commonly used by small firms or first-time users. Also called servicers they include the following:

- 1.Computer manufacturers supply services such as system design, programming, education and training and hardware maintenance.
- 2.Service bureaus run applications for small firms. Large firms contract for specialized application or for running jobs during peak volume periods. The primary services are programming file and system conversion, system design and user training.
- 3.facilities management furnishes specialists to manage a user installed computer on the user's premises. In some case, service is limited to developing application programs. The user runs the system but calls on the service organization for developmental work and maintenance

## **The Software industry:**

### **Introduction:**

Software industry encompasses all the activities and businesses involved with development, maintenance and distribution of computer software. Software industry started its operation during mid-70's. In this modern era of technology, software industry can be regarded as the most booming industry in the world. Software industry also covers the activities like software servicing, training and consultancy.

The software industry is the largest and most booming industry in the world. For the last couple of years this industry is dominated by the software industry giant Microsoft corporation. One of the reports of Microsoft software magazine shows that in 2005, the total amount of revenues earned by software companies were highest.

## Present tendencies of software industry

- The economy of the leading companies are mostly dependent on the development of proprietary software products. Although some major companies like IBM, Sun Microsystems are also taking part in developing open-source software to take the advantage of getting some portion of market share.
- **Some aspects of software industry**
- **Packaged applications:** Made for business purposes and are written for mass distribution
- **Enterprise software:** This type of software is basically made for big corporations for their production or selling purposes.
- **Systems software:** Specifically made for system(computer) related functions, like Operation system software. Some other categories are utility software, application software, etc.

## Two types of software companies:

### Systems Software

- ❖ Systems software includes the programs that are dedicated to managing the computer itself, such as the operating system, file management utilities, and disk operating system (or DOS).
- ❖ The operating system manages the computer hardware resources in addition to applications and data.

Without systems software installed in our computers we would have to type the instructions for everything we wanted the computer to do!

## Applications Software

- ❖ Application software, or simply applications, are often called productivity programs or end-user programs because they enable the user to complete tasks, such as creating documents, spreadsheets, databases and publications, doing online research, sending email, designing graphics, running businesses, and even playing games!
- ❖ Application software is specific to the task it is designed for and can be as simple as a calculator application or as complex as a word processing application.
- ❖ When you begin creating a document, the word processing software has already set the margins, font style and size, and the line spacing for you.
- ❖ But you can change these settings, and you have many more formatting options available.
- ❖ For example, the word processor application makes it easy to add color, headings, and pictures or delete, copy, move, and change the document's appearance to suit your needs

## **Procedure for Hardware/software selection:**

Today, selecting a system is a serious and time-consuming business. Unfortunately, many systems are still selected based on vendor reputation only or other subjective factors. The time spend on the selection process is a function of the applications and whether the system is a basic microcomputer or a mainframe.

There are several factors to consider prior to system selection.

1. Define system capabilities that make sense for business. Computers have proven valuable to business in the following areas.

- a. Cost reduction includes reduction of inventory, savings on space, and improved ability to predict business trends.
- b. Cost avoidance includes early detection of problems and ability to expand operations without adding clerical help.
- c. Improved service quick availability of information to customers, improved accuracy and fast turnaround.
- d. Improved profit reflects the business and its ability to keep receivables within reason.

2. Specify the magnitude of the problem, that is, clarify whether selection entails a few peripherals or a major decision concerning the mainframe.
3. Assess the competence of the in-house staff. This involves determining the expertise needed in areas such as telecommunications and data base design.
4. Consider hardware and software as a package. This approach ensures compatibility. Infact, software should be considered first, because often the user secures the hardware and then wonders what software is available for it.
5. Develop a schedule for the selection process. Maintaining a schedule helps keep the project under control.
6. Provide user indoctrination. This is crucial, especially for first-time users. Selling the system to the user staff, providing adequate training and preparing an environment.

## **Major Phases in Selection**

The selection process should be viewed as a project, and a project team should be organized with management support. In larger projects the team includes one or more user representatives, an analyst and a consultant.

Several steps make up a selection process:

- 1.Requirements analysis:
- 2.System Specification:
- 3.Request for proposal [REP]
- 4.Evaluation and Validation
- 5.Vendor Selection
- 6.Post-installation review

### **1.Requirements Analysis:**

The first step in selection is understanding the user's requirements within the framework of the organization's objectives and the environment in which the system is being installed. In selecting

Software, the user must decide whether to develop it in house, hire a service company or a contract programmer to create it, or simply acquire it from a software house.



## **2.System specification:**

Failure to specify system requirements before the final selection almost always results in a faculty acquisition. They must reflect the actual applications to be handled by the system and include system objectives, flowcharts, input-output requirements, file structure and cost.

## **3.Request for proposal:**

After the requirements analysis and system specification have been determined, request for proposal [REP] is drafted and sent to selected vendors for bidding.

## **4.Evaluation and Validation**

The evaluation phase ranks vendor proposals and determines the one best suited to the user's needs. It looks into items such as price, availability and technical support.

## **5. Vendor Selection:**

This step determines the winner-the vendor with the best combination of reputation, reliability, service record, training delivery time, lease finance terms and conversion schedule.

## **6. Post-Installation Review:**

Sometime after the package is installed, a system evaluation is made to determine how closely the new system conforms to plan.

## **Financial Consideration in selection:**

When the decision to go ahead with the acquisition has been made, the next question is whether to purchase or lease. There are three methods of acquisition

- 1.Rental directly from the manufacturer
- 2.Leasing through a third party
- 3.Outright purchase

### **The Rental Option**

Rent is a form of lease directly by the manufacturer. The user agrees to monthly payment, usually for one year or less. The contract can be terminated without penalty by a 90 day advance notice. Rental charges are based on 176 usage hours. Additional usage means higher total charges per month. Computer users favor renting a system for three reasons:

- 1.Insurance, maintenance and the other expenses are included in the rental charge.
- 2.There is financial leverage for the user.
- 3.Rental makes it easier to change to other systems, thereby reducing the risk of technological obsolescence.

### **The Lease Option:**

A leased system is acquired through a third party or from the vendor. A third-party purchase ranges from six months with month-to-month renewals to seven years. Longer running leases have more favorable terms but entail a higher risk as the user is strapped with the system.

From the user's view, leasing has several advantages

- 1.No financing is required. The risk of system is shifted to the lessor.
- 2.Lease charges are lower than rental charges for the same period and are also tax deductible.
- 3.Leases may be written to show higher payments in early years to reflect the decline in value of the system.

### **The Purchase Option:**

Purchasing a computer has benefits and drawbacks. Purchasing means assuming all the risks of ownership including taxes, insurance and technological obsolescence. However, the owner obtains all the services and support that are available under the lease or rental agreement. Compared with renting or leasing,

- 1.The flexibility of modifying the system at will.
- 2.Lower continuing cash outlays than those for leased system due to cash savings from depreciation and investment tax credit.

## The Used Computer:

- ❖ Most organizations outgrow their computers long before they become obsolete, however. This means that users are forced to uphold equipment at a loss in order to acquire new systems.
- ❖ Availability is a major advantage to buying used computers. The demand for some system is so high that promised six-week deliveries can stretch up to six months.
- ❖ For certain highly sought microcomputers, delivery may as long as four months used computer dealers have been known to deliver the same day.
- ❖ For standalone systems, used computers are ideal for users with inhouse expertise who are assured of vendor support.
- ❖ Although the biggest drawback to used computers is maintenance, this is readily available from the vendor or independent service firms.

- ❖ Used computers are acquired dealers or end users. Most dealers are knowledgeable about the system they sell.
- ❖ The best bargain, however, is buying directly from the end user, provided there is a log that verifies the maintenance record of the system
- ❖ In conclusion, there are saving from acquiring used systems, and more and more organizations are going that route. Furthermore, it is an excellent way to extend the useful life of the computer.

## **The Computer Contract**

- ❖ After a decision has been made about the equipment or software, the final step in system acquisition is to negotiate a contract. Unfortunately, the typical user does not negotiate.
- ❖ The assumption is that a contract drafted by a reputable firm is a standard instrument and is not subject to change.
- ❖ The primary law governing contracts is the law of contracts, although contracts can be influenced by other laws, such as the uniform commercial code (UCC).
- ❖ Performance of a contract is the fulfilling of the duties created by it.

## **The Art of Negotiation**

- ❖ Many users enter in to contract negotiations at the mercy of the vendor, with little preparation. Negotiating is an art. Timing is critical.
- ❖ Strategies must be planned and rehearsed. The leverage enjoyed by either party can change during the course of the negotiations.
- ❖ Part A represent the poorly prepared user, outmaneuvered completely throughout the negotiations. Part B shows a relatively informed user, but one who has a sense of urgency.

## Strategies and Tactics

Various strategies and tactics are used to control the negotiation process. A key strategy is to control the environment. the user's "home field advantage" allow the user's representative to concentrate on the negotiation process in a familiar setting.