SYLLABUS CSE- 403 F SOFTWARE PROJECT MANAGMENT

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam. : 4 Hrs.

Section-A

Introduction to Software Project Management (SPM): Definition of a Software Project (SP), SP Vs. other types of projects activities covered by SPM, categorizing SPs, project as a system, management control, requirement specification, information and control in organization.
Stepwise Project planning: Introduction, selecting a project, identifying project scope and objectives, identifying project infrastructure, analyzing project characteristics, identifying project products and activities, estimate efforts each activity, identifying activity risk, allocate resources, review/ publicize plan.

Section-B

Project Evaluation & Estimation: Cost benefit analysis, cash flow forecasting, cos t benefit evaluation techniques, risk evaluation. Selection of an appropriate project report; Choosing technologies, choice of process model, structured methods, rapid application development, water fall-, V-process-, spiralmodels. Prototyping, delivery. Albrecht function point analysis.
Activity planning & Risk Management: Objectives of activity planning, project schedule, projects and activities, sequencing and scheduling activities, network planning model, representation of l agged activities, adding the time dimension, backward and forward pass, identifying critical path, activity throat, shortening project , precedence networks.
Risk Management: Introduction, the nature of risk, managing risk, risk identification, risk analysis, reducing the risks, evaluating risks to the schedule, calculating the z values..

Section-C

Resource allocation &Monitoring the control: Introduction, the nature of resources, identifying resource requirements, scheduling resources creating critical paths, counting the cost, being specific, publishing the resource schedule, cost schedules, the scheduling sequence.
Monitoring the control: Introduction, creating the frame work, collecting the data, visualizing progress, cost monitoring, earned value, prioritizing monitoring, getting the project back to target, change control.
Managing contracts and people: Introduction, types of contract, stages in contract, placement, typical terms of a contract, contract management, acceptance, Managing people and organizing terms:Introduction, understanding behavior, organizational behavior: a back ground, selecting the right person for the job, instruction in the best methods, motivation, working in groups, becoming a team, decision making,leadership, organizational structures, conclusion, further exercises.

Section-D

Software quality: Introduction, the place of software quality in project planning, the importance of software quality, defining software quality, ISO 9126, Practical software quality measures, product versus process quality management, external standards, techniques to help enhance software quality.
Study of Any Software Project Management software: viz Project 2000 or equivalent

NOTE : Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsary and of short answer type. Each question carries equal mark (20marks). Students have to attempt 5 questions in total at least one question from each section.

SOFTWARE PROJECT MANAGEMENT

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Figures in the bracket indicate full marks.

Note : Attempt five questions in all. All question carry equal marks.

Q.1(a) Differentiate between software project with other types of projects. (4)

Ans. Difference between software project with other types of projects are as follows :

(i) Software project are based on logical work, while other are based on physical work.

(ii) We can't measure complexity of software project until we actually work on it.

(iii) There is invisibility of progress in software projects. Means customers of software project can't see the outcome in middle of project, because customers don't know about coding and other technical work.and as we know an incomplete project will not give an outcome. Consequently it becomes very difficult to satisfy customers of software project that actually their work is being done by team.

(iv) One good point of software projects is that, they are flexible. Customer only wants final result, so rest of things are in control of programmer, he can modify software at any stage. While this thing is not in other projects, as every thing is in front of customer he is aware about progress he can view what work is being done by project manager and team so it is not in the hands of project team to make changes at any stage of project development.

Q.1.(b) Briefly describe risk profile analysis. (4)

Ans. Risk analysis is the assessing of probability and seriousness of each risk. Probability may be very low, low, moderate, high or very high. Risk effects might be catastrophic, serious, tolerable or insignificant.

Risk	Probability	Effect
-Organisational financial problems force reductions in the project budget.	Low	Catastrophic
-It is impossible to recruit staff with the skills required for the project.	High	Catastrophic
-Key staff are ill at critical times in the project.	Moderate	Serious
-Software components that should be reused contain defects which limit their functionality.	Moderate	Serious
-Changes to requirements that require major design rework are proposed.	Moderate	Serious
-The organization is restructured so that different management are responsible for the project.	High	Serious

Q.1.(c) What is a Risk ? Name its categories.

Ans. Risk : A risk is a potential future harm that may arise from some present action such as, a schedule slip or a cost overrun. Risk management is a series of steps whose objectives are to identify, address, and eliminate software risk items before they become either threats to successful software operation or a major source of expensive rework.

(iii) Project execution: The project can now be executed. The execution of a project often contains design and implementation sub-phases. Students new to project planning often find that the boundary between design and planning can be hazy. Design is making decisions about the form of the products to be created. This could relate to the external apperance of the software, that is, the user interface, or the internal architecturre. The plan details the activities to be carried out to create these products. Planning and design can be confused because at the most detailed level, planning decisions are influenced by design decisions. Thus a software product with five major components is likely to require five sets of activities to create them.

Q.3.(a) Give an outline of stepwise planning activities. (10)

Ans. An outline of stepwise planning activities is as follows :

Step	Activities within step
0	Select project
1	Identify project scope and objectives.
	1.1 Identify objectives and measures of effectiveness in meeting them.
	1.2 Establish a project authority
	1.3 Identify all stakeholders in the project and their interest.
	1.4 Modify objectives in the light of stakeholder analysis
	1.5 Establish methods of communications with all parties
2.	Identify project infrastructure
	2.1 Establish relationship between project and strategic planning
	2.2 Identity installation standards and procedures
	2.3 Identity project team organization
3.	Analyse project characteristics
	3.1 Distinguish the project as either objective-or product-driven
	3.2 Analyse other project characteristics
	3.3 Identify high level project risks
	3.4 Take into account user requirements concerning implementation
	3.5 Select general lifecycle approach
	3.6 Review overall resource estimates.
4.	Identify project products and activities
	4.1 Identify and describe project products (or deleverables)
	4.2 Document generic product flows
	4.3 Recognize product instances
	4.4 Produce ideal activity network
	4.5 Modify ideal to take into account need for stages and checkpoints
5.	Estimate effort for each activity
	5.1 Carry out bottom-up estimates
	5.2 Revise plan to create controllable activities
6.	Identify activity risks
	6.1 Identify and quantify activity-based risks
	6.2 Plan risk reduction and contingency measure where appropriate
	6.3 Adjust plans and estimates to take account of risks

7.	Allocate resources
	7.1 Identify and allocate resources
	7.2 Revise plans and estimates to account for resource constraints
8.	Review/publicize plan
	8.1 Review quality aspects of project plan
	8.2 Document plans and obtain agreement
9.	Execute plan
10.	Lower levels of planning

Q.3.(b) Discuss in detail about project management characteristics & identifying activity risk. (10)

Ans. Characteristics of project management are as follows :

(i) Objectives oriented : Project management is focused on achieving specific project objectives with customer satisfaction. It is results-oriented.

(ii) Change oriented : Project management is a vehicle for planning and managing change in an organized manner. It adopts flexibility in doing things in a risky environment.

(iii) Single Responsibility Center : The project manager is the single responsibility center accountable for project outcomes. The role of project manager is crucial from inception to completion of the project. He is a project leader and champion. He motivates team members to excel.

(iv) Team-based : Project management consists of a multi-disciplinary project team with a wide range of skill and experiences.The team has project dedication.Each member has responsibility and accountability for a unit of work. Self-management is emphasized. So is member participation. The team membership is flexible and changes with project needs.

(v) Functional Coordination : Project management requires coordination along functional lines. The work flow is both vertical and horizontal in a matrix organization structure.

(vi) Planning and Control : Project management required integrated planning and control systems for continuous improvement.

(vii) Constraints : Project management achieves results within the constraints of time, cost and quality. It is a time and resources limited activity. It is focused on customer needs.

(viii) Body of Knowledge: Project management consists of a body of knowledge.

Identifying activity risk : Risk identification is an integrative process. The frequency of iteration and who participates in each cycle will vary from case to case. The project team should be involved in the process so that they can develop and maintain a sense of ownership of, and responsibility for, the risks and associated risk response actions. Stakeholders outside the project team may provide additional objective information. Especially important is the risk tolerance of the Stakeholders. This is invaluable information in Risk Planning.

The Risk Identification process usually leads to the Qualitative Risk Analysis process. Alternatively, it can lead directly to the Quantitative Risk Analysis process when conducted by an experienced risk manager. On some occasions, simply the identification of a risk may suggest its response, and these should be recorded for further analysis and implementation in the Risk Response Planning process.

Section-B

Q.4. Write short notes on :
(a) Cost benefit analysis.
(b) Cash flow forecasting. (20)

Ans. (a) Cost benefit analysis : Cost benefit analysis (CBA) is a technique for assessing the monetary social costs and benefits of a capital investment project over a given time period. The principles of cost-benefit analysis (CBA) are as follows :

– Appraisal of a project : It is an economic technique for project appraisal, widely used in business as well as government spending projects (for example should a business invest in a new information system)

– Incorporates externalities into the equation: It can, if required, include wider social/-environmental impacts as well as 'private' economic costs and benefits so that externalities are incorporated into the decision process. In this way, CBA can be used to estimate the social welfare effects of an investment

– Time matters! CBA can take account of the economics of time – known as discounting. This is important when looking at environmental impacts of a project in the years ahead

Process : The following is a list of steps that comprise a generic cost–benefit analysis.

– List alternative projects/programs.
– List stakeholders.
– Select measurement(s) and measure all cost/benefit elements.
– Predict outcome of cost and benefits over relevant time period.
– Convert all costs and benefits into a common currency.
– Apply discount rate.
– Calculate net present value of project options.
– Perform sensitivity analysis.
– Adopt recommended choice.

Uses of CBA :

(i) CBA has traditionally been applied to big public sector projects such as new motorways, by-passes, dams, tunnels, bridges, flood relief schemes and new power stations.

(ii) The basic principles of CBA can be applied to many other projects or programmes. For example, - public health programmes (e.g. the mass immunization of children using new drugs), an investment in a new rail safety systems, or opening a new railway line.

(iii) Cost benefit analysis was also used during an inquiry into genetically modified foods.

(iv) Increasingly the principles of cost benefit analysis are being used to evaluate the returns from investment in environmental projects such as wind farms and the development of other sources of renewable energy, an area where the UK continues to lag behind.

(v) Because financial resources are scarce, CBA allows different projects to be ranked according to those that provide the highest expected net gains in social welfare - this is particularly important given the limitations of government spending.

Ans. (b) Cash flow forecasting : A cash flow forecast will indicate when expenditure and income will take place. It is the forecasting of the cash flows that will take place and their timing.

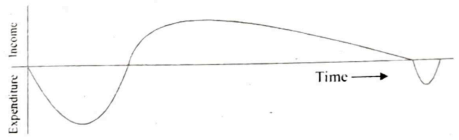


Fig. : Typical product life cycle cash flow

Accurate cash flow forecasting is not easy, as it is done early in the project's lifecycle. When estimating future cash flows, it is usual to ignore the effects of inflation. Forecast of inflation rate tends to be uncertain. Moreover, if expenditure is increased due to inflation it is likely that income will rise proportionately.

Q.5.(a) Explain Waterfall Model in detail. **(10)**

Ans. The Waterfall Model : The Waterfall Model was first Process Model to be introduced. It is a very common software development process model. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed fully before the next phase can begin. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In waterfall model phases do not overlap.

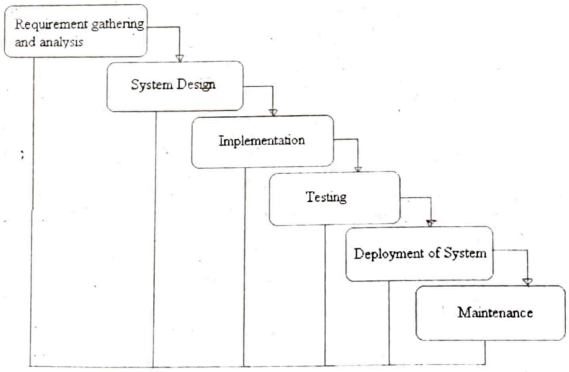


Fig. : Water Fall Model

Advantages :

(i) Simple and easy to understand and use.

(ii) Easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process.

(iii) Phases are processed and completed one at a time.

(iv) Works well for smaller projects where requirements are very well understood.

Disadvantages :

(i) Once an application is in the testing stage, it is very difficult to go back and change something that was not well-thought out in the concept stage.

(ii) No working software is produced until late during the life cycle.

(iii) High amounts of risk and uncertainty.

(iv) Not a good model for complex and object-oriented projects.

(v) Poor model for long and ongoing projects.

(vi) Not suitable for the projects where requirements are at a moderate to high risk of changing.

Q.5.(b) Differentiate between CPM & PERT. **(10)**

Ans. Differences between CPM and PERT are as follows :

PERT	CPM
(i) PERT is Programme Evaluation & Review Techinque.	(i) CPM is critical path method.
(ii) PERT is event oriented.	(ii) CPM is activity oriented.
(iii) PERT takes into account the uncertainities for calculating time.	(iii) CPM doesnot take into account the uncertainities, while calculating time for activities.
(iv) PERT is basically concerned with time only.	(iv) CPM is concerned with project cost as well as time.
(v) PERT is a technique where we use three time estimates namely optimistic, Pessimistic & most likely time.	(v) CPM is a single time estimate technique.

Section-C

Q.6.(a) What is a resource schedule ? Discuss in detail about scheduling sequence. **(10)**

Ans. Resource scheduling : Resource scheduling is done by representing the activity plan to assess the distribution of resources required over the duration of the project. It is done by representing the activity plan as a bar chart and using this to produce a resource histogram for each resource. A problem with uneven resource histogram is that it is more likely to call for levels of resources beyond those available.

Rectangles represent when an activity is scheduled and shaded rectangles represent the total float.

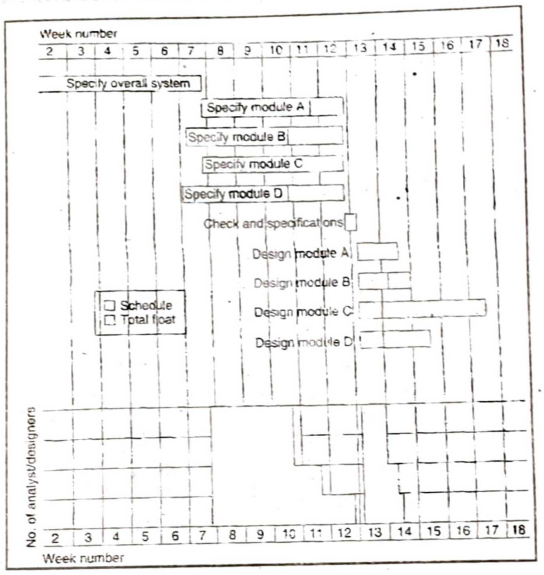


Fig. : Resource scheduling

Q.6.(b) Explain cost schedule in detail. **(10)**

Ans. Cost scheduling : A cost schedule is a schedule in which weekly or monthly costs over the life of the project are show. This will provide a more detailed and accurate estimate of costs and will serve as a plan against which project progress can be monitored.

Calculating cost is straightforward where the organization has standard cost figure for staff and other resources. Where this is not the case, then the project manager will have to calculate the costs.

In general, costs are catergorized as follows :

(i) *Staff costs :* There will include staff salaries as well as the other direct costs of employment such as the employer's contribution to social security funds, pension scheme contributions, holiday pay and sickness benefit. These are commonly charged to projects at hourly rates based on weekly work records completed by staff.

(ii) *Overheads :* Overheads represent expenditure that an organization incurs, which cannot be directly related to individual projects or jobs including space rental, interest charges and the costs of service departments (such as personnel). Overhead costs can be recovered by

making a fixed charge on development departments (in which case they usually appear as a weekly or monthly charge for a project), or by an additional percentage charge on direct staff employment costs.

(iii) *Usage charges :* In some organizations projects are charged directly for use of resources such as computer time (rather than thier cost being recovered as an overhead). This will normally be on as 'as used' basis.

Q.7.(a) What do you mean by prioritizing monitoring ? Explain. **(10)**

Ans. Prioritizing monitoring : Prioritizing monitoring is a significant part of project management. All project activities should be carefully monitored while the project is being accomplished. This helps project manager to keep informed of work progress, foresee possible problems and apply timely correctives. It is important that project monitoring is simple and not time-consuming. Project monitoring software may really help to simplify this process.

In this section we list the priorities we might apply in deciding levels of monitoring :

(i) *Critical path activities :* Any delay in an activity on the critical path will cause a delay in the completion date for the project. Critical path activities are therefore likely to have a very high priority for close monitoring.

(ii) *Activities with no free float :* A delay in any activity with no free float will delay at least some subsequent activities, even though, if the delay is less than the total float, it might not delay the project completion date. These subsequent delays can have serious effects on our resource schedule as a delay in a subsequent activity could mean that the resources for the activity will become unavailable before that activity is completed because they are committed elsewhere.

(iii) *Activities with less than a specified float :* If any activity has very little float, it might use up this float before the regular activity monitoring brings the problem to the project manager's attention.

(iv) *High risk activities :* A set of high risk activities should have been identified as part of the initial risk profiling exercise. These activities will be given close attention because they are most likely to overrun or overspend.

(v) *Activities using control risk :* Activities can be critical because they are very expensive. Staff or other resources might be available only for a limited period especially if they are controlled outside the project team. In any event, an activity that demands a critical resource requires a high level of monitoring.

Q.7.(b) Discuss the stages of contract management. **(10)**

Ans. Various **Stages in Contract** are as follows :

(i) Requirements analysis : The requirements document might typically have sections with the heading shown in Table.

Table : Main sections in a requirements document

(i)	Introduction
(ii)	A description of any existing systems and the current environment

(iiii)	The customer's future strategy or plans
(iv)	System requirements – mandotory – desirable
(v)	Deadlines
(vi)	Additional information required from potential suppliers

The requirements define carefully the functions of the new application and all the necessary inputs and outputs for these functions. They also state any standards that apply, and the existing systems with which the new' system should be compatible. There will also need to be operational and quality requirements, concerning such matters as the required response times, reliability, usability and maintainability of the new system.

(ii) Evaluation plan : Having drawn up a list of requirements, we need a plan of how the proposals are to be evaluated. The situation will be different if the contract is for a system that is to be specially written rather than an off-the-shelf package. In the latter case, it is the application itself that is being evaluated while in the former situation it is proposal for an application.

Ways of checking that the mandatory requirements are met need to be identified. The next consideration is how the desirable requirements can be evaluated.

(iii) Invitation to tender : Having produced the requirements and the evaluation plan, it is now possible to issue the invitation to tender to prospective suppliers. Essentially, this will be the requirement document with a supporting letter containing information about how responses to the invitation are to be lodged. A deadline will be specified and it is hoped that by then a number of proposals with price quotations will have been received.

(iv) Evaluation of Proposals : The process of evaluation may include :

– Scrutiny of the proposal documents;
– Interviewing supplier's representatives;
– demonstrations;
– site visits;
– practical tests.

Section-D

Q.8.(a) What is the importance of software quality ? Describe. **(10)**

Ans. Importance of software quality are as follows :

(i) *Increasing criticality of software :* The final customer or user is naturally anxious about the general quality of software, especially its reliability. This is increasingly the case as organizations become more dependent on their computer systems and software is used more and more in areas which are safety critical, for example to control aircraft.

(ii) *The intangibility of software :* This makes it difficult to know whether a particular task in a project has been completed satisfactorily. The results of these tasks can be made tangible by demanding that the developers produce 'deliverables' that can be examined for quality.

(iii) *Accumulating errors during software development :* As computer system development is made up a of a number of steps where the output from one step is the input to the next, the error in the earlier deliverables will be added to those in the later steps leading to an

accumulating detrimental effect, and generaly, the later in a project that an error is found the more expensive it will be to fix. In additoin, because the number of errors in the system is unknown the debugging phases of a project are particularly difficult to control.

Q.8.(b) Explain parameters used for software quality measures in detail. (10)

Ans. Different parameters for measuring the quality of software project are as follows :

(i) Reliability : This might be measured in terms of :

– *availability* : the percentage of a particular time interval that a system is usable;

– *mean time between failures* : the total service time divided by the number of failures;

– *failure on demand* : the probability that a system will not be available at the time required or the probability that a transaction will fail;

– *support activity* : the number of fault reports that are dealt with.

(ii) Maintainability : This is closely related to flexibility, the ease with which the software can be modified. The main difference is that before an amendment can be made, the fault has to be diagnosed. Maintainability can the therefore be seen as flexibility plus a new quality, diagnosability, which might be defined as the average amount of time needed to diagnose a fault.

(iii) Extendibility : This is a component of the more general quality of flexibility. It can be defined as the productivity needed to incorporate a new feature into an existing system expressed as a percentage of the normal productivity when developing the software from scratch.

Q.9. Explain, in detail, various techniques to enhance software quality. (20)

Ans. Techniques for **enhancing the quality of software project** are as follows :

– **Increasing visibility :** Weinberg encouraged the simple practice of software programmers looking at each other's code.

– **Procedural structure :** Every process in the software development cycle has carefully laid down steps.

– **Checking intermediate stages :** Emphasis on checking the correctness of work at its earlier conceptual stages.

– **Inspection :** The principle of inspection can be extended to any document that is produced at any stage in the development process. When a piece of work is completed, copies of the work are distributed to co-workers who then spend some time going through the work noting any defects.

– **Formal methods :** It uses techniques that are unambiguous, mathematically based and specification language. They are used to define pre and post conditions for each procedure. Pre-conditions define the allowable states before processing of the various items of data that a procedure is to work upon. Post conditions define the state of those data items after the procedure has been executed.

– **Software quality circles :** A quality circle is a group of four to ten volunteers working in the same area to identify, analyse and solve their work related problems.

– **The GQM approach :** A number of metrics will need to be identified as needing collection in order to answer the question.

SOFTWARE PROJECT MANAGEMENT

Dec - 2014

Paper Code:-CSE-403-F

Note : ***Question No. 1 is compulsory. Attempt five questions and one question from each Section.***

Q.1.(a) Explain the project as a system. (5)

Ans. The project as a system : A project is concerned with creating a new system and/or transforming an old one and is itself a system.

Systems, subsystem and environments :

A simple definition of the term system is 'a set of interrelated parts'. A system will normally be part of a larger system and will itself comprise *subsystems*.

Outside the system there will be the system's *environment*. This will be made up of things that can affect the system but over which the system has no direct control.

Open versus closed systems : Open systems are those that interact with the environment. Nearly all systems are open. One reason that engineered systems and the projects to construct them often fail is that the technical staff involved do not appreciate the extent to which system are open and are liable to be affected by outside changes.

Sub-optimization : This is where a subsystem is working at its optimum but is having a detrimental effect on the overall system. An example of this might be where software developers deliver to the users a system that is very efficient in its use of machine resources, but is also very difficult to modify.

Sociotechnical systems : Software projects belong to this category of systems. Any software project requires both technological organization and also the organization of people. Software project managers therefore need to have both technical competence and the ability to interact persuasively with other people.

Q.1.(b) How Albrecht function point analysis is done ? (5)

Ans. Alan Albrecht while working for IBM, recognized the problem in size measurement in the 19 ·s, and developed a technique (while he called *Function Point Analysis*), which appeared to be a solution to the size measurement problem [ALBR79. ALBR83]. It measure functionality from the users point of view, that is, on the basis of what the user requests and receives in return. Therefore, it deals with the functionality being delivered, and not with the lines of code, source modules, files, etc. Measuring size in this way has the advantage that size measure is independent of the technology used to deliver the functions. In other words, two identical counting systems, one written in 4 GL and the other in assembler, would have the same function count. This makes sense to the user, because the object is to buy an accounting system, not lines of assembler and it makes snese to the IT department, because they can measure the performance differences between the assembler and 4GL environments (STEP95).

Function point measures functionally from the users point of view, that is, on the basis of what the user requests and receives in return from the system. The principle of Albrecht's function point analysis (FPA) is that a system is decomposed into functional units.

- Inputs : information entering the system.
- Outputs : information leaving the system.
- Enquiries : requests for instant access to information.
- Internal logical files : information held within the system.
- External interface files : information held by other systems that is used by the system being analyzed.

Q.1.(c) Explain Risk Management cycle. **(5)**

Ans. The risk management cycle : Every project is subject to constant change in its business and wider environment. The risk environment is constantly changing too. The project's priorities and relative importance of risks will shift and change. Assumptions about risk have to be regularly revisited and reconsidered, for example at each end stage assessment.

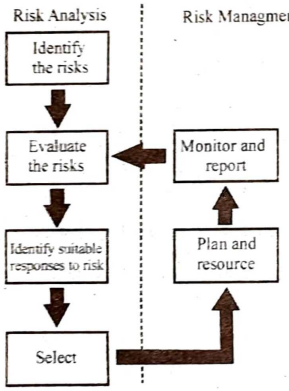


Fig. : The risk managment cycle

Fig. shows the main steps through the risk management cycle.

Q.1.(d) What is contract ? **(5)**

Ans. Contract is a voluntary, deliberate, and legally binding agreement between two or more competent parties. Contracts are usually written but may be spoken or implied, and generally have to do with employment, sale or lease, or tenancy.

A contractual relationship is evidenced by (1) an offer, (2) acceptance of the offer, and a (3) valid (legal and valuable) consideration. Each party to a contract acquires rights and duties relative to the rights and duties of the other parties. However, while all parties may expect a fair benefit from the contract (otherwise courts may set it aside as

inequitable) it does not follow that each party will benefit to an equal extent. Existence of contractual-relationship does not necessarily mean the contract is enforceable, or that it is not void (see void contract) or voidable (see voidable Contract). Contracts are normally enforceable whether or not in a written form, although a written contract protects all parties to it. Some contracts, (such as for sale of real property installment plans, or insurance policies) must be in writing to be legally binding and enforceable. Other contracts (see implied in fact contract and implied in law contract) are assumed in, and enforced by, law whether or not the involved parties desired to enter into a contract.

Section-A

Q.2. It is said that spiral model combines the best features of earlier models. Justify your answer. **(20)**

Ans. One of the most popular life cycle models for software projects is the Spiral model. There are several variants of this model in the literature. In the discussion below, we have tried to abstract the features common to the various forms of the spiral model. These features are :

(1) The entire software life cycle is visualised in terms of various phases represented by different *sectors* hatched with lines in different angles in Fig. The phases are the ones that a project goes through in a chronological order in any one *iteration*. The number and nature of the sectors varies with the size and complexity of the product.

(2) The project starts off from the center of the diagram and *spirals up* (clock-wise) in *iterations*. Each iteration starts from a particular sector and returns to that sector at a higher level than its starting point.

(3) Each iteration can be taken as a particular level of the product or the completion of a particular part of the product (e.g., requirements, design etc.). Obviously, the incurred costs are higher as we go farther from the center of the spiral. Hence each iteration strives to identify and correct any errors at that iteration itself.

(4) Each iteration takes off from where the previous iteration left and moves on an outward spiral. Each iteration builds the next level of the product, building upon the level from the previous iteration.

(5) The more distant the current point from the center, the closer is the project to its completion. The overall *radius* of the spiral (i.e., distance from the start/center of the spiral) denotes the length and complexity of the project/product. If a product/project is an incremental version, then the spiral will be of a shorter radius than that of a revolutionary new product.

There are various names given to the sectors or phases in the literature. In the original description in [BOEH-88], there are four sectors (actually quadrants) that are roughly labelled "Determine objectives; identify constraints', "Evaluate alternatives/identify risks", "Develop, verify next level product" and "plan next release". [GRAD-97] combines the vanilla spiral model with Deming's Plan-Do-Check-Act and names the four quadrants as "Plan", "Do", "Check" and "Act". As can be seen from the discussion above, the essence of the model is an evolutionary approach to building the product; the product; the product basically evolving in a series of levels; each level satisfying the following three criteria :

(i) Each level is an indication of the stage of evolution of the product.

(ii) Each level builds on the previous level

(iii) Each level tries to isolate and correct errors at that level without passing them on to the next level. That is why one of the sectors is usually called the "Risk Analysis", "Evaluate Alternatives" or the "Customer Evaluation" sector.

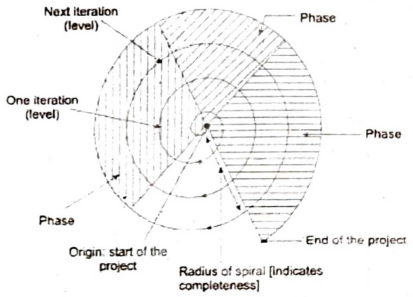


Fig. : Spiral Model

Key Advantages and Disadvantages of the Model : The main advantages of the Spiral model are :

(i) It is realistic and typifies most software development products/projects. Most software is evolutionary in nature and this model captures that nature.

(ii) It combines the best features of most of the eariler models: A typical application of the spiral model can use prototyping as a means of eliciting feedback (and ensuring that the requirements are properly captured) within each iteration. The diferent phases resemble the Waterfall Model.

(iii) It strikes a good balance mechanism for early problem identification and correction while not missing out proactive problem prevention. Each iteration has a Risk Analysis sector that evaluates alternatives for proactive problem avoidance. Also, each iteration has a "testing" or "customer acceptance" sector that takes care of error correction at that level.

The key to the successful application of this model lies in effective management oversight in ensuring that the evolutionary approach does not get out of hand. While starting the overall product/project, there should be a clear definition of goals and objectives; at each level, while building upon the previous levels, it is important not to change drastically what is expected of the previous levels and make the previous levels go back to the drawing board often.

Applicability of the Model : There are significant similarities in the nature and applicability of this model as compared to the RAD model. This model-like RAD - is most applicable when the product can be evolved in a series of steps or levels, each one building on top of the previous ones. This model also requires some amount of customer participation and input but is more suited to building of general purpose software. Also, the spiral model tends to be more useful for the development of systems software than RAD.

Conclusion : *It should be noted that in real life situations, the actual "life cycle model" could be a combination of the features of one or more of the above models.* These models are intended to be the guidelines rather than be prescriptive. At the end of the day, it is important not to twist the natural and most appropriate way of working on a product / project to suit any one theoretical model.

Q.3. Discuss various types of software projects and also focus on different project team structures. (20)

Ans. Various **types of software projects** are as follows :

(i) Desktop project management software gives individual users the most responsive and highly-graphical interface. Desktop applications normally store their data in a local file, although some allow collaboration between users or store their data in a central database. A simple file-based project plan can be shared between users if it is stored on a networked drive, and only one user accesses it at any given time.

(ii) Web-based project management software can be accessed through an intranet or extranet using a web browser and has all the usual advantages and disadvantages of web applications:

- Can be accessed from any type of computer without installing software
- Ease of access-control
- Provides multi-user facilities
- Only one software version and installation needs to be maintained
- Typically slower to respond than desktop applications
- Limited graphical capability compared to desktop applications
- Project information is not available offline.

(iii) Single-user project management systems work on the basis that only one person will need to edit the project plan at any time. This may be used in small organisations, or only a few people are involved in project planning. Desktop applications usually come into this category.

(iv) Collaborative project management systems are designed to support multiple users modifying different sections of the plan at once, ex. updating the areas they are personally responsible for so that those estimates get integrated into the overall plan. Web-based tools often fall into this category, but they can only be used when the user is online. Some client-server-based software tools replicate project and task information through a central server when users connect to the network.

(v) Integrated systems combine project management or project planning, with many other aspects of company operations, ex. bug tracking issues can be assigned to each project, the list of project customers becomes a customer relationship management module, and each person on the project plan has their own task lists, calendars, messaging associated with their projects.

Different **project team structures** are as follows :

(i) Chief programmer team : In this team organization, a senior engineer provides the technical leadership and is designated as the chief programmer. The chief programmer partitions the task into small activities and assigns them to the team members. He also verifies and integrates the products developed by different team members. The chief programmer provides an

authority; and this structure is arguably more efficient than the democratic team for well-understood problems. However, the chief programmer team leads to lower team morale, since team-members work under the constant supervision of the chief programmer. This also inhibits their original thinking. The chief programmer team is subject to single point failure since too much responsibility and authority is assigned to the chief programmer.

(ii) Democratic Team : The democratic team structure does not enforce any formal team hierarchy. Typically, a manager provides the administrative leadership. At different times, different members of the group provide technical leadership.

The democratic organization leads to higher morale and job satisfaction. Consequently, it suffers from less man-power turnover. Also, democratic team structure is appropriate for less understood problems. A democratic team structure is suitable for projects requiring less than five or six engineers and for research-oriented projects. For large sized projects, a pure democratic organization tends to become chaotic. The democratic team organization encourages egoless programming as programmers can share and review one another's work.

(iii) Mixed Control Team Organization : The mixed team organization draws upon the ideas from both the democratic organization and the chief-programmer organization. This team organization incorporates both hierarchical reporting and democratic set up. The mixed control team organization is suitable for large team sizes. The democratic arrangement at the senior engineers level is used to decompose the problem into small parts. Each democratic setup at the programmer level attempts solution to a single part. Thus, this team organization is eminently suited to handle large and complex programs. This team structure is extremely popular and is being used in many software development companies.

Section-B

Q.4. What are the objectives of activity planning ? Also discuss the responsibilities taken by a software project manager. **(20)**

Ans. The objectives of activity planning : In addition to providing project and resource schedules, activity planning aims to achieve a number of other objectives which may be summarized as follows:

(1) Feasibility assessment. Is the project possible within required timescales and resource constraints? It is not until we have constructed a detailed plan that we can forecast a completion date with any reasonable knowledge of its achievability. The fact that a project may have been estimated as requiring two work-years effort might not mean that it would be feasible to complete it within, say, three months were eight people to work on it - that will depend upon the availability of staff and the degree to which activities may be undertaken in parallel.

(2) Resource allocation. What are the most effective ways of allocating resources to the project and when should they be available? The project plan allows us to investigate the relationship between timescales and resource availability (in general, allocating additional resources to a project shortens its duration) and the efficacy of additional spending on resource procurement.

(3) Detailed costing. How much will the project cost and when is that expenditure likely to take place ? After producting an activity plan and allocating specific resources, we can obtain more detailed estimates of costs and their timing.

(4) Motivation. Providing targets and being seen to monitor achievement against targets is an effective way of motivating staff, particularly where they have been involved in setting those targets in the first place.

(5) Co-ordination. When do the staff in different departments need to be available to work on a particular projct and when do staff need to be transferred between projects? The projects plan, particularly with large projects involving more than a single project team, provides an effective vehicle for communication and co-ordination among teams. In situations where staff may need to be transferred between project teams (or work concurrently on more than one project), a set of integrated project schedules should ensure that such staff are available when required and do not suffer periods of enforced idleness.

Activity planning and scheduling techniques place an emphasis on completing the project in a minimum time at an acceptable cost or, alternatively, meeting an arbitrarily set target date at minimum cost. These are not, in themselves, concerned with meeting quality targets, which generally impose constraints on the scheduling process.

One effective way of shortening project durations is to carry out activities in parallel. Clearly we cannot undertake all the activities at the same time - some require the completion of other before they can start and there are likely to be resource constraints limiting how much may be done simultaneously. Activity scheduling will, however, give us an indication of the cost of these constraints in terms of lengthening timescales and provide us with an indication of how timescales may be shortened by relaxing those constraints. It is up to us, if we try relaxing precedence constraints by, for example, allowing a program online task to commence before the design has been completed, to ensure that we are clear about te potential effects on product quality.

When to Plan : Planning is an ongoing process of refinement, each iteration becoming more detailed and more accurate than the last. Over successive iterations, the emphasis and purpose of planning will shift.

During the feasibility study and project start-up the main purpose of planning will be to estimate timescales and the risks of not achieving target completion dates or keeping within budget. As the project proceeds beyond the feasibility study, the emphasis will be placed upon the production of activity plans for ensuring resource availability and cash flow control.

Throughout the project, until the final deliverable has reachedthe customer, monitoring and replanning must continue to correct any drift that might prevent meeting time or cost targets.

Activities of SPM : Software project management encompasses the following activities: measurement, project estimating, risk analysis, scheduling, tracking, and control.

(1) Measurement and metrics : To be most effective. software metrics should be collected for both the process and the product. Process oriented metrics can be collected during the process and after it has been completed. Process metrics collected during the process focus on the efficacy of quality assurance activities change management, and project management. Process measures are normalized using either lines of code or function points so that data collected from many different projects can be compared and analyzed in a consistent manner. Product metrics measure technical characteristics of the software that provide an indication of software quality measure can be applied to models created during analysis and design activities, the source code and testing data.

(2) Project estimating : Scheduling and budgets are often dictated by business issues. The role of estimating within the software process often serves as a "sanity check" on the predefined deadlines and budgets that have been established by management. (Ideally, the software engineering organization should be intimately involved in establishing deadlines and budgets, but this is not a perfect or fair world)

All software project estimation techniques require that the project have a bounded scope, and all rely on a high level functional decomposition of the project and an assessment of project difficulty and complexity. There are three broad classes of estimation techniques for software projects:

(a) *Effort estimation techniques* : The project manager creates a matrix in which the left hand column contains a list of major system functions derived using functional decomposition applied to project scope. The top row contains a list of major software engineering tasks derived from the common process framework. The manager (with the assistance of technical staff) estimates the effort required to accomplish each task for each function.

(b) *Size-oriented estimation* : A list of major system functions derived using functional decomposition applied to project scope. The "size" of each function is estimated using either lines of code (LOC) or function points (FP). Average productivity data (for instance, function points per person month) for similar functions or projects are used to generate an estimate of effort required for each function.

(c) *Empirical models* : Using the results of a large population of past projects, an empirical model that relates product size (in LOC or FP) to effort is developed using a statistical technique such as regression analysis. The product size for the work to be done is estimated and the empirical model is used to generate projected effort.

In addition to the above techniques, a software project manager can develop estimate by analogy. That is, by examining similar past projects and projecting effort and duration recorded for these projects to the current situation.

(3) Risk assessment, risk prioritization and risk management : The goals of these activities are :

(a) to identify those risks that have a high likelihood of occurrence

(b) to assess the consequence (impact) of each risk should it occur, and

(c) to develop a plan for mitigating the risks when possible, monitoring factors that may indicate, their arrival, and developing a set of contingency plans should they occur.

(4) Scheduling : The process definition and project management activities that have been discussed above feed the scheduling activity. The common process framework provides a work breakdown structure for scheduling. Available human resource, coupled with effort estimates and risk analysis provide the task interdependencies, parallelism and time lines that are used in constructing a project schedule.

(5) Tracking and control : Project tracking and control is most effective when it becomes and integral part of software engineering work. A well defined process framework should provide a set of milestones that can be used for project tracking. Control focuses on two major issues: quality and change.

To control quality, a software project team must establish effective techniques for software quality assurance, and to control change, the team should establish a software configuration management framework.

Q 5. What are backward and forward pass ? Also explain network planning model with its merits and demerits. (20)

Ans. The Fowrard Pass : The forward pass is carried out to calculate the earliest dates on which each activity may be started and completed.

Where an actual start date is known, the caculation may be carried out using actual dates. Alternatively we can use day or week numbers and that is the approach we shall adopt here. By convention, dates indicate the end of period and the project is therefore shown as starting at the end of week zero (or the beginning of week 1).

The forward pass and the calculation of earliest start dates are carried out according to the following reasoning :

(i) Activities A, B and F may start immediately, so the earliest date for their start is zero.

(ii) Activity A will take 6 weeks, so the earliest it can finish is week 6.

(iii) Activity B will take 4 weeks, so the earliest it can finish is week 4.

(iv) Activity F will take 10 weeks, so the earliest it can finish is week 10.

(v) Activity C can start as soon as A has finished so its earliest start date is week 6. It will take 3 weeks so the earliest it can finish is week 9.

(vi) Activities D and E can start as soon as B is complete so the earliest they can each start is week 4. Activity D, which will take 4 weeks, can therefore finish by week 8 and activity E_1 which will take 3 weeks, can therefore finish by week 7.

(vii) Activity G can not start until both E and F have been completed. It cannot therefore start until week 10 – the later of weeks 7 (for activity E) and 10(for activity F). It takes 3 weeks and finishes in week 13.

(viii) Similarly, Activity H cannot start until week 9 – the later of the two earliest finish dates for the preceding activities C and D.

(ix) The project will be complete when both activities H and G have been completed. Thus the earliest project completion date will be the later of weeks 11 and 13 – that is, week 13.

The results of the forward pass are shown in fig.(a).

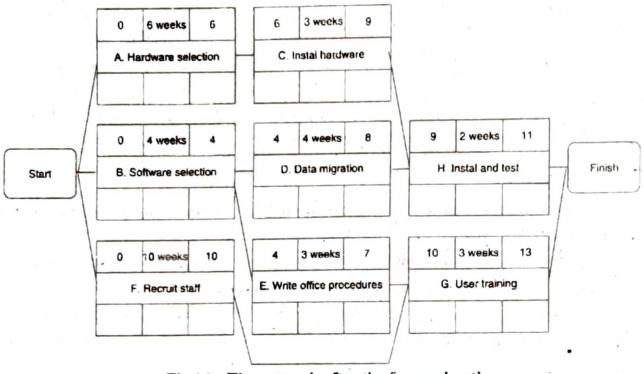


Fig.(a) : The network after the forward path

The Backward Pass : The second stage in the analysis of a critical path network is to carry out a backward pass to calculate the latest date at which each activity may be started and finished without delaying the end date of the project. In calculating the latest dates, we assume that the latest finish date for the project is the same as the earliest finish date – that is, we wish to complete the project as early as possible.

Fig.(b) illustrates our network after carrying out the backward pass. The latest activity dates are calculated as follows.

(i) The latest completion date for activities G and H is assumed to be week 13.

(ii) Activity H must therefore start at week 11 at the latest (13 – 2) and the latest start date for activity G is week 10(13 – 3).

(iii) The latest completion date for activities C and D is the latest date at which activity H must start – that is, week 11. They therefore have latest start dates of week 8 (11 – 3) and week 7 (11 – 4) respectively.

(iv) Activities E and F must be completed by week 10 so their earliest start dates are weeks 7(10 – 3) and 0(10 – 10) respectively.

(v) Activity B must be completed by week 7(the latest start date for both activities D and E) so its latest start is week(7 – 4).

(vi) Activity A must be completed by week 8(the latest start date for activity C) so its latest start is week 2(8 – 6).

(vii)The latest start date for the project start is the earliest of the latest start dates for activities A, B and F. This is week zero. This is, of course, not very suprising since it tells us that if the project does not start on time it won't finish on time.

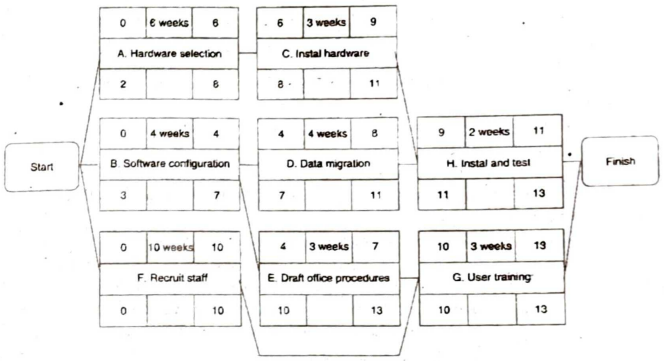


Fig.(b) : The network after the backward path

Network planning model : These project scheduling techniques model the project's activitites and thier relationships as a network. In the network, time flows from left to right. These techniques were originally developed in the 1950s – the two best known being CPM (Critical Path Method) and PERT(Program Evaluation Review Technique).

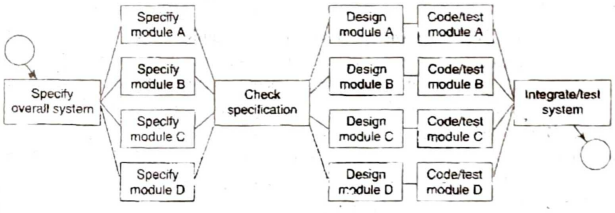


Fig.(c) : Network Planning Model

Both of these techniques used an activity-on-arrow approach to visualizing the project as a network where activities are drawn as arrows joining circles, or nodes, which represent the possible start and/or completion of an activity or set of activities. More recently a variation on these techniques, called precedence networks, has become popular. This method uses activity-on-node networks where activities are represented as nodes and the links between nodes represent precedence (or sequencing) requirements. This latter approach avoids some of the problems inherent in the activity-on-arrow representation and provides more scope for easily representing

certain situtations. It is this method that is adopted in the majority of computer applications currently available. These three methods are very similar and it must be admitted that many people use the same name (particularly CPM) indiscriminately to refer to any or all of the methods.

Fig.(c) shows the fragment of a network that has developed as an activity-on-node network.

Merits :

- Provide very efficient "High-speed" retrieval.
- *Simplicity* : The network model is conceptually simple and easy design.
- Ability to handle more relationships types the network model can handle the one to many and many to many relationships.
- *Ease to Date Access* : In the network database terminology, a relationship is a set. Each set comprise of two types of records, - an owner record and member record. In a network model an application can access an owner and all the member records within a sit.
- *Data Integrity* : In a network model no member can exist without an owner.
- *Data Independence* : The network model draws a clear lines of demaroation between program and the complex physical storage details.

Demerits :

- *System Complexity* : In a network model data are accessed one record at a time.
- *Lack of Structural Independence* : Making structural modifications to the database is very difficult in the network database models as the data access method is navigational.

Section-C

Q.6. Explain the resource allocation techniques. (20)

Ans. Resource allocation is a process and strategy involving a company deciding scarce resources should be used in the production of goods or services. A resource can be considered any factor of production, which is something used to product goods or services.

Method : In an economist's perfect world resources are optimally allocated when they are used to produce goods and services that match consumer neds and wants at the lowest possible lost of product. Efficiency of product on means fewer resources are expended in producing goods and services.

Process :

Strategic Planning : Resource allocation begins at strategic planning when a company formulates its vision and goals for the future the vision and strategic goals are accomplished through achievement of objectives.

Budgeting : Once you have set your objective you will then need to allocate sufficient resource to accomplish it. In practical terms this is often a matter of project. Budgeting in our example the company will allocate money for market research to determine unmounts consumer need and wants for computer tablet many for product design and developments, funds for production.

Resource Allocation Patterns : Resource management is a very important part of real time and embedded software design. This article discusses commonly used resource allocation patterns. The discussion is divided into two parts:

(i) Resources allocation algorithms.

(ii) Distributed resources allocation.

Resource Allocations :

(i) Hottest first (ii) Coldest first

(ii) Load balancing (iv) Future resource booking

(i) *Hottest first* : In hottest first resources allocation the resource last released is allocated on next resorce requrest. To implement this best in first out LIFO type of allocation. The list of tree resources is maintained as a stack.

(ii) *Coldest First* : In coldest first resources allocation the resource not allocated for maximize time is allocated to first implement this first is first out FIFO type of allocation the resources allocating entity keeps the tree resources in a queue.

(iii) *Load Balancing* : In situation involving multiple resource groups load balancing is used. A resource group is controlled by a local resource controllers. In this techniques the resource allocator first determines the highly loaded resource group.

(iv) *Future Resource Booking* : Here each resource allocation is for a specified time. The resource allocation is only valid till the specified time reached the resource is considered to be tree. Thus the resource does not need to be treed explicitly.

Distributed Resource Allocation : Most real time systems are distributed across multiple process. Different techniques are used to manage resource allocation in such distributed system. Some of these technique are.

- Centralized resorce.
- Heirarchical resource.
- Bidirectional resource.
- Random Access.

Centralized Resource : In this techniques a centralized allocator keeps track of all the available resources. All entities send massage requesting resources and the allocator responses with the allocated resources.

Hierarchical resource : In this techniques the resources allocation is done in multiple steps. First the centralized allocator takes the high level resource allocation decision. In Xenon trunk allocation is carried out in fellowing step :

(i) The centralized allocator at CAS determines which trunk group should be used to route outgoing calls.

(ii) The call request is then forwarded to the XEN handling the trunk group.

(iii) The XEM level allocator selects the actual trunk from the trunk group.

Bidirectional Resources : This scheme allow two independent allocators to allocate the same set of resources. It is used in situations like bidirectional trunk group.

Random Accesses : Wherever a resource needs to be shared between multiple entities which can not synchronize to each others and the do not have access to centralized allocator designers have a resort to random access to the resource.

Q.7. Define organization structure. Also expalin the concept of leadership.(20)

Ans. An **organizational structure** defines how activities such as task allocation, coordination and supervision are directed towards the achievement of organizational aims. It can also be considered as the viewing glass or perspective through which individuals see their organization and its environment.

Leadership : Leadership is generally taken to mean the ability to influence others in a group to act in a particular way in order to achieve group goals. A leader is not necessarily a good manager or vice versa, because managers have other roles to play, such as those of organizing, planning and controlling.

Authorities on this subject have found it very difficult to agree a list of the common characteristics of good leaders. It would, however, seem safe to say that they seem to have a greater need for power and achievement and have more self-control and more self-confidence than others.

Leadership is based on the idea of some kind of authority or power, although leaders do not necessarily have much formal authority. This power comes from either the person's position (position power) or from the person's individual qualities (personal power) or can be a mixture of the two. Position power has been further analysed into :

- *coercive power,* the ability to force someone to do something by threatening punishment;
- *connection power,* which is based on having access to those who have power;
- *legitimate power,* which is based on a person's title conferring a special status;
- *reward power,* where the holder can confer rewards on those who carry out tasks to their satisfaction.

Personal power, on the other hand, can be further analysed into :

- *expert power,* which comes from being the person who is able to do a specialized task;
- *information power,* where the holder has access to information that others do not;
- *referent power,* which is based on the personal attractiveness of the leader.

Leadership styles : Balanced against this is the need to involve the staff in some of the decision making in order to make the best use of expertise and to gain commitment.

Attempts have been made to measure leadership styles on two axes: directive vs. permissive and autocratic vs. democratic :

- *directive autocrat* makes decisions alone with close supervision of their implementation;
- *permissive autocrat* makes decision alone but gives subordinates latitude in implementation;

- *directive democrat* makes decisions participatively but closely supervises their implementation.
- *permissive democrat* makes decisions participative and gives subordinates latitude in implementation.

Another axis on which there have been attempts to measure management qualities has been on the degree to which a manager is task-oriented, that is, the extent to which the execution of the tasl. at hand is paramount, and the degree to which the manager is concerned about the people involved (people orientation). It is perhaps not surprising that subordinates appear to perform best with managers who score highly in both respects.

Work environments vary according to the amount of control that can be exerted over the work. Some jobs are routine and predictable (as when dealing with batched computer output). Others may be driven by outside factors (as in the case of a help-desk) or are situations where future direction is uncertain (for example, at the early stages of a feasibility study). Where there is a high degree of uncertainty, subordinates will seek guidance from above and welcome a task-oriented management style. As uncertainty is reduced, the task-oriented manager is likely to relax and to become more people-oriented and this will have good results. People-oriented and this will have good results. People-oriented managers are better where staff can control the work they do and know what to do without referring matters to their line managers. It is then argued that if control becomes even easier the people-oriented manager will be tempted to get involved in more task-centred questions and that this may have undesirable results.

Research findings also show that where team members are relatively inexperienced a task-oriented approach is most effective. As group members mature, consideration for their personal needs and aspirations becomes more valued. Where maturity is very high, then there is no need for a strong emphasis on either of these approaches.

Q.8. Explain the :

(a) product v/s process quality management. (10)

(b) Risk analysis. (10)

Ans. Product v/s process quality management : Difference between product quality and process quality are as follows :

Product quality	Process Quality
(i) Method are general purpose products.	(i) There are no methods, only process of method.
(ii) Proper(customized) use of methods will lead to uniform results.	(ii) These process influence the result using the method.
(iii) Product quality is focusing on meeting tolerances in the end result of the manu-facturing activities. The end result is measured on a standard of "good enough".	(iii) Process quality focuses on each activity and forces the activities to achieve maximum tolerances irrespective of the end result.

With a product based approach to planning and control, the focus on the product is convenient. It is often easier to measure the product qualities in a completed computer application rather than during its development. Trying to use the attributes of intermediate products created at earlier stages to predict the quality of the final application is difficult. An alternative approach is to scrutinize the quality of the processes used to develop software product.

(b) Risk analysis : Risk Analysis is also known as Risk Quantification. Risk Quantification or risk analysis is the process of evaluating risks to access the range of possible project outcomes. In other words we can define, Risk Analysis (RA) as a process that defines activities and methods to estimate and evaluate risk.

The risk analysis process begins with list of risks obtained from the earlier process of risk identification. Each risk from this list is taken for estimation and evaluation. To act on this steam, the organization needs an evaluation criteria and the risk data base.

The probability of a hazard's occuring is known as the *risk likelihood*; the effect that the resulting problem will have on the project, if it occurs, is known as the *risk impact* and the importance of the risk is known as the risk value or risk exposure. The risk value is calculated as :

$$risk\ exposure = risk\ likelihood \times risk\ impact$$

Q.9. What is software quality ? What are different parameters for measuring the quality of software project ? (20)

Ans. Software quality : Totality of characteristics of an entity that bears on its ability to satisfy stated and implied needs.

This means that the software product delivered should be as per the requirements defined.

Parameters for measuring the quality of software project : Different parameters for measuring the quality of software project are as follows :

(i) Reliability : This might be measured in terms of :

– *availability :* the percentage of a particular time interval that a system is usable;

– *mean time between failures :* the total service time divided by the number of failures;

– *failure on demand :* the probability that a system will not be available at the time required or the probability that a transaction will fail;

– *support activity :* the number of fault reports that are dealt with.

(ii) Maintainability : This is closely related to flexibility, the ease with which the software can be modified. The main difference is that before an amendment can be made, the fault has to be diagnosed. Maintainability can the therefore be seen as flexibility plus a new quality, diagnosability, which might be defined as the average amount of time needed to diagnose a fault.

(iii) Extendibility : This is a component of the more general quality of flexibility. It can be defined as the productivity needed to incorporate a new feature into an existing system expressed as a percentage of the normal productivity when developing the software from scratch.

Techniques for **enhancing the quality of software project** are as follows :

– **Increasing visibility :** Weinberg encouraged the simple practice of software programmers looking at each other's code.

– **Procedural structure :** Every process in the software development cycle has carefully laid down steps.

– **Checking intermediate stages :** Emphasis on checking the correctness of work at its earlier conceptual stages.

– **Inspection :** The principle of inspection can be extended to any document that is produced at any stage in the development process. When a piece of work is completed, copies of the work are distributed to co-workers who then spend some time going through the work noting any defects.

– **Formal methods :** It uses techniques that are unambiguous, mathematically based and specification language. They are used to define pre and post conditions for each procedure. Pre-conditions define the allowable states before processing of the various items of data that a procedure is to work upon. Post conditions define the state of those data items after the procedure has been executed.

– **Software quality circles :** A quality circle is a group of four to ten volunteers working in the same area to identify, analyse and solve their work related problems.

– **The GQM approach :** A number of metrics will need to be identified as needing collection in order to answer the question.

SOFTWARE PROJECT MANAGEMENT

Dec 2015

Paper Code: CSE-403-F

Note: ***Attempt five questions in all, selecting one question from each section. Q. No. 1 is compulsory.***

Q.1. Write short notes on the following :

(a) Identify Project scopes and objectives

(b) Estimation of efforts of each activity

(c) Calculating the Z values

(d) Cost schedules

(e) Product Vs Process quality

Ans. (a) Identify Project scopes and objectives : The activities in this step ensure that all the parties all the parties to the project agree on the objectives and are committed to the success of the project. A danger to be avoided to overlooking people who are affected by the project.

Step 1 : *Identify objectives and practical measure of the effectives in meeting those objectives.*

Step 2 : *Establish a project authority.*

A single overall project authority needs to the estblished so that there is unity of purpose among all those concerned.

Step 3 : *Identify all stakeholers in the project and their interests.*

Essentially all the parties who have an interest in the project need to be identified.

Step 4 : *Modify objectives in the light of stakeholder analysis.*

In order to gain the full cooperation of all concerned, it might be necessary to modify the project objectives. This can mean adding new features to the system giving a benefit to some stakeholder group as a means as a means of assuring their commitment to the project. This is potentially dangerous, since the system size might be increased and the original objectives obscured. Because of these dangers, this process must be done consciously and in a controlled manner.

Step 5 : *Establish methods of communication with all paries* : For internal staff, this should be fairly straightforward, but a project leader implementing a payroll system would need to find a contact point with BACS (Bankers Automated Clearing Scheme) for instance.

Ans.(b) Estimate Effort for Each activity :

Step 1 : *Carry out bottom up estimates*

At this point, estimates of the staff effort and other resources required, and the probable elapsed time needed for each activity will need to be produced. The method of arriving at each of these estimates will vary depending on the type of activity.

The individual activity estimates of effort should be summed to get an overall bottom-up estimate, which can be reconciled with the previous top-down estimate.

The avtivities on the activity network can be annotated with their elapsed times so that the oveall duration of the project can be calculated.

Step 2 : *Revise plan to create controllable activities*

The estimates for individual activities might reveal that some are going to take quite a long time. Long activities often make a project difficult to control, If an activity involving system testing is to take 12 weeks, it might be difficult after six weeks to judge accurately whether 50% of the work is completed. It would be better to break this down into a down into a series of smaller sub-tasks.

Ans.(c) The z value is calculated for each node that has a target date. It is equivalent to the number of standard deviations between the node's expected and target dates. It is calculated using the formula

$$z = \frac{T - t_e}{s}$$

where t_e is the expected date and T the target date.

Ans.(d)Cost schedules : A cost schedule is a schedule in which weekly or monthly costs over the life of the project are show. This will provide a more detailed and accurate estimate of costs and will serve as a plan against which project progress can be monitored.

Calculating cost is straightforward where the organization has standard cost figure for staff and other resources. Where this is not the case, then the project manager will have to calculate the costs.

In general, costs are catergorized as follows :

(i) *Staff costs* : There will include staff salaries as well as the other direct costs of employment such as the employer's contribution to social security funds, pension scheme contributions, holiday pay and sickness benefit. These are commonly charged to projects at hourly rates based on weekly work records completed by staff.

(ii) *Overheads* : Overheads represent expenditure that an organization incurs, which cannot be directly related to individual projects or jobs including space rental, interest charges and the costs of service departments (such as personnel). Overhead costs can be recovered by making a fixed charge on development departments (in which case they usually appear as a weekly or monthly charge for a project), or by an additional percentage charge on direct staff employment costs.

(iii) *Usage charges* : In some organizations projects are charged directly for use of resources such as computer time (rather than thier cost being recovered as an overhead). This will normally be on as 'as used' basis.

Ans. (e)Product Vs Process quality : Difference between product quality and process quality are as follows :

Product quality	Process Quality
(i) Method are general purpose products.	(i) There are no methods, only process of method.
(ii) Proper(customized) use of methods will lead to uniform results.	(ii) These process influence the result using the method.
(iii) Product quality is focusing on meeting tolerances in the end result of the manufacturing activities. The end result is measured on a standard of "good enough".	(iii) Process quality focuses on each activity and forces the activities to achieve maximum tolerances irrespective of the end result.

With a product based approach to planning and control, the focus on the product is convenient. It is often easier to measure the product qualities in a completed computer application rather than during its development. Trying to use the attributes of intermediate products created at earlier stages to predict the quality of the final application is difficult. An alternative approach is to scrutinize the quality of the processes used to develop software product.

Section - A

Q.2. Explain software projects. What are the elements of a software project ? Also explain different characteristic of a software project.

Ans. Software project is the process of computer programming, documenting, testing, and bug fixing involved in creating and maintaining applications and frameworks resulting in a software product. Software development is a process of writing and maintaining the source code, but in a broader sense it includes all that is involved between the conception of the desired software through to the final manifestation of the software, sometimes in a planned and structured process. Therefore, software development may include research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products.

Essential Elements of Software Project:

(i) Choose the Project Methodology : A key decision is the methodology that will be used for your project. A traditional waterfall methodology is highly structured to deliver good results, but can result in longer projects based on its sequential set of tasks. Agile methodologies deliver quicker results, but require managing cross-functional teams and allowing them more freedom to create prototypes in several iterations as requirements are refined.

(ii) Identify Requirements : A solid understanding of user requirements forms the foundation for your software, yet there's often a rush to skip this and move to the coding phase. This may cause you to miss necessary requirements or try to meet an ever-changing target as new requirements are uncovered.

(iii) Understand the Technology : It's crucial that the project manager understands the maturity level of the technology used for the project, since technology changes at a rapid pace. If it's a well-understood technology, the chance of meeting the project schedule is high.

(iv) Communicate with Business Stakeholders : Technical jargon is a foreign language to most business stakeholders, so communication between the project manager, the technical team and other stakeholders can be a challenge. Project managers and technical team members need to talk about the requirements and project risks using business terminology. If users can't understand the explanation, they can't make informed decisions about the level of risk they're willing to accept.

(v) Deliver Phased Results : Many software projects are large, expensive and lengthy efforts. Often the new software isn't delivered until months or years after the requirements were originally documented.

(vi) Understand the Culture : Project managers should consider cultural issues in the project planning. This includes adding contingency time in the schedule to work through possible issues and clearly communicating the risks of taking short cuts.

Characteristic : Following are the most important aspects of software project :

1. Collaboration : The project management software should facilitate the team collaboration. This means that the relevant stakeholders of the project should be able to access and update the project documents whenever they want to. Therefore, the project management software should have access control and authentication management in order to grand access levels to the project stakeholders.

2. Scheduling : Scheduling is one of the main features that should be provided by project management software. Usually, modern project management software provides the ability to draw Gantt charts when it comes to activity scheduling .In addition to this, activity dependencies can also be added to the schedules, so such software will show you the project critical path and later changes to the critical path automatically. Base lining is also a useful feature offered by project management software. Usually, a project is based lined when the requirements are finalized. When requirements are changed and new requirements are added to the project later, project management team can compare the new schedule with the baseline schedule automatically to understand the project scope and cost deviations.

3. Issue Tracking : During the project life cycle, there can be many issues related to project that needs constant tracking and monitoring. Software defects is one of the good examples for this. Therefore, the project management software should have features to track and monitor the issues reported by various stakeholders of the project.

4. Document Management : A project has many documents in use. Most of these documents should be accessible to the stakeholders of the project. Therefore, the project management software should have a document management facility with correct access control system.In addition to this; documents need to be versioned whenever they are updated. Therefore, the document management feature should support document versioning as well.

5. Resource Management : Resource management of the project is one of the key expectations from project management software. This includes both human resources and other types. The project management software should show the utilization of each resource throughout the entire project life cycle.

Q.3. Explain the following steps of stepwise project planning :
(a) Identify activity risk
(b) Allocate resources.

Ans. (a) Identify Activity Risks :

Step 1 : Identify and quantify activity-based risks

We now want to look at each activity in turn and asses the risks to its successful outcome. The seriousness of each risk and likelihood of it occuring have to be gauged. At individual task level some risks are unavoidable and the general effect if a problem materializes is to make the task longer or more costly. A range of estimates can be produced to take into account the possible occurence of the risks.

Step 2 : Plan risk reduction and contingency measures where appropriate

It is possible to avoid or at least reduce some of the identified risks. Contingency plans specify action that is to be taken if a risk materializes. For example, a contingency plan could be to use contract staff if a member of the project team is unavailable at a key time because of illness.

Step 3 : Adjust overall plans and estimates to take account of risks

We can change our plans, perhaps by adding new activitives which reduce risks. For example new programming language could mean that we schedule training courses and time for the programmers to practise their new programming skills on some non-essential work.

(b) Allocate Resources :

Step 1 : Identify and allocate resources

The type of staff needed for each activity is recorded. The staff available for the project are identified and are provisionally allocated to asks.

Step 2 : Resvise plans and estimates to take into account resource constraints

Some staff might be needed for more than one task at the same time and, in this case, an order of priority is established. The decisions made here can have an effect the overall duration of the project when some tasks are delayed while waiting for staff to become free.

Ensuring someone is available to start work on an activity as soon as the proceeding activities have been completed might mean that they are idle while waiting for the job to start and are therefore used inefficiently.

Section - B

Q.4.(a) Write Albrecht function point analysis in detail.

Ans. Albrecht Function Point Analysis : This is a top-down method that was devised by Allan Albrecht when he worked for IBM. Albrecht was investigating programming productivity and needed to quantify the functional size of programs independently of their programming languages. He developed the idea of function point (FPs).

The basis of function point analysis is that information system comprise five major components, or 'external user types' in Albrecht's terminology, that are of benefit to the users.

(i) *External input types* are input transactions which update internal computer files.

(ii) *External output types* are transactions where data is output to the user. Typically these would be printed reports, as screen displays would tend to come under external inquiry types.

(iii) *External inquire types* : note the US spelling of inquiry – are transactions initiated by the user which provide information but do not update the internal files. The user inputs some information that directs the system to the details required.

(iv) *Logical internal file types* are the standing files used by the system. The term 'file' does not sit easily with modern information systems. It refers to a group of data items that is usually accessed together. It may be made up of one or more record types. For example, a purchase order file may be made up of a record type PURCHASE-ORDER plus a second which is repeated for each item ordered on the purchase order – PURCHASE-ORDER-ITEM. In structured systems analysis, a logical internal file would equate to a datastore, while record types would equate to relational tables or entity types.

(v) *External interface file types* allow for output and input that may pass to and from other computer applications. Examples of this would be the transmission of accounting data from an order processing system to the main ledger system or the production of a file of direct debit details on a magnetic or electronic medium to be passed to the Bankers Automated Clearing System (BACS). Files shared between applications would also be counted here.

The analyst identifies each instance of each external user type in the application. Each component is then classified as having either high, average or low complexity. The counts of each external user type in each complexity band are multiplied by specified weights (see Table A) to get FP scores which are summed to obtain an overall FP count which indicates the information processing size.

Table A : Albrecht complexity multipliers

External user type	Multiplier		
	Low	Average	High
External input type	3	4	6
External output type	4	5	7
External inquiry type	3	4	6
Logical internal file type	7	10	15
External interface file type	5	7	10

With FPs as originally defined by Albrecht, the question of whether the external user type was of high, low or average complexity was intutitive. The International FP User Group (IFPUG) has now promulgated rules on how this is assessed. For example, in the case of logical internal files and external interface files, the boundaries shown in Table B are used to decide the complexity level. Similar tables exist for external inputs and outputs.

Table B : IFPUG file type complexity

Number of record types	Number of data types		
	<20	20-50	>50
1	Low	Low	Average
2 to 5	Low	Average	High
>5	Average	High	High

Q.4.(b) Explain how you select the appropriate project report and choice of process.

Ans. Selection of an appropriate project report : The development of software in house suggest that the projects has certain characteristics :

- The project team and users belong to the same organization.
- The projects being considered slot into a portfolio of existing computer based systems.
- The methodologies and technologies to be used are not selected by the project manager, but are dictated by local standards.

However, where a series of development projects is being carried out by a software house for different external customers, the methodologies and technologies to be used will have to be decided for each individual project. This decision making process has been called 'technical planning' by some, although here we use the term 'project analysis'. Even where development is in house, it is important to spend some time looking for any characteristics of the new project that might make us take a different approach from that used on previous project.

The relevant part of the step add new approach is Step 3 : Analyse protect characteristics. The selection of a particular process model will add new products to the project Breakdown structure or new activities to the activity network. This will crete outputs for step 4 : Identify the products and activities of the project (see figure).

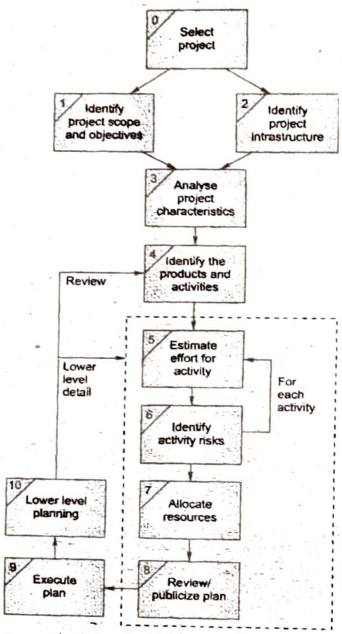


Fig. : Project analysis is the subject of step 3.

Choice of process Models : The word 'process' is sometimes used to emphasize the idea of a system *in action*. In order to achieve an outcome, the system will have to execute one or more activities ; this it its process. This idea can be applied to the development of computer based systems where a number of interrelated activities have to be undertaken to create a final

product. These activitives can be organized in different ways and we can call these process models.

A major part of the planning will be the choosing of the development methods to be used and the slc'ting of these into an overall process model.

The planner needs not only to select methods but also to specify how the method is to be applied. With methods such as SSADM, there is a considerable degree of choice about how it is to be applied : not all parts of SSADM are compulsory. Many student projects have the rather basic failing that at the planning stage they claim that, say SSADM is to be used : in the event, all that is produced are a few SSADM fregements such as a lop level flow diagram and a preliminary logical data structure diagram. If this is all the particular project requires, it should be stated at the outset.

Q.5.(a) Write down the different objectives of activity planning also discuss project schedule in detail.

Ans. The objectives of activity planning : In addition to providing project and resource schedules, activity planning aims to achieve a number of other objectives which may be summarized as follows:

(1) Feasibility assessment. Is the project possible within required timescales and resource constraints? It is not until we have constructed a detailed plan that we can forecast a completion date with any reasonable knowledge of its achievability. The fact that a project may have been estimated as requiring two work-years effort might not mean that it would be feasible to complete it within, say, three months were eight people to work on it - that will depend upon the availability of staff and the degree to which activities may be undertaken in parallel.

(2) Resource allocation. What are the most effective ways of allocating resources to the project and when should they be available? The project plan allows us to investigate the relationship between timescales and resource availability (in general, allocating additional resources to a project shortens its duration) and the efficacy of additional spending on resource procurement.

(3) Detailed costing. How much will the project cost and when is that expenditure likely to take place ? After producting an activity plan and allocating specific resources, we can obtain more detailed estimates of costs and their timing.

(4) Motivation. Providing targets and being seen to monitor achievement against targets is an effective way of motivating staff, particularly where they have been involved in setting those targets in the first place.

(5) Co-ordination. When do the staff in different departments need to be available to work on a particular projct and when do staff need to be transferred between projects? The projects plan, particularly with large projects involving more than a single project team, provides an effective vehicle for communication and co-ordination among teams. In situations where staff may need to be transferred between project teams (or work concurrently on more than one project), a set of integrated project schedules should ensure that such staff are available when required and do not suffer periods of enforced idleness.

Project schedule : Before work commences on a project or, possibly, a stage of a large project, the project plan must be developed to the level of showing dates when each activity should start and finish and when and how much of each resource will be required. Once the plan

has been refined to this level of detail we call it a project schedule. Creating schedule comprises four main stages.

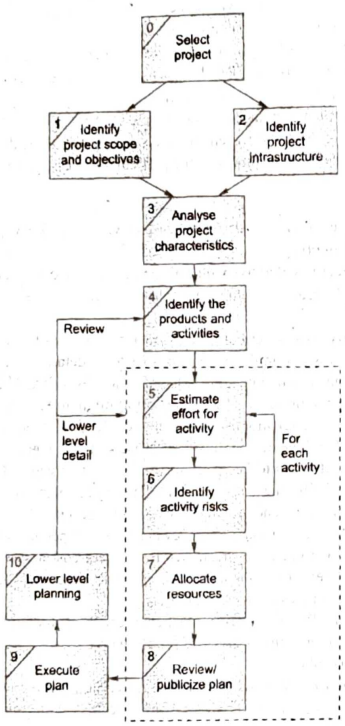


Fig. : Activity planning is carried out in step 4 and step 5.

The first step in producing the plan is to decide what activities need to be carried out and in what order they are to be done. From this we can construct an ideal activity plan - that is, a plan of when each activity would ideally be undertaken were resources not a constraint. This activity plan is generated by steps 4 and 5 of step Wise(Figure).

The ideal activity plan will then be subject of an activity risk analysis, aimed at identifying potential problems. This might suggest alterations to the ideal activity plan and will almost certainly have implications for resource allocation.

The third step is resource allocation. The expected availability of resources might place constraints on when certain activities can be carried out, and our ideal plan might need to be adapted to take account of this.

The final step is schedule production. Once resources have been allocated to each activity, we will be in a position to draw up and publish a project schedule, which indicates planned start and completion dates and a resource requirements statements for each activity.

Q.5.(b) What are different natures of risk ? Also focus on how risk can be analyzed and evaluating the risk to the schedule.

Ans. The Nature of Risk : For the purpose of identifying and managing those risks that may casue a project to overrum its time scale or budget, it is convenient of identify three types of risk :

- Those caused by the inhercent difficulties of estimation ;
- Those due to assumptions made during the planning process ;
- Those of unforeseen (or at least unplanned) events occuring.

Estimation errors : Some tasks are harder to estimate than others becuase of the lack of experience of similar tasks or becuase of the nature of a task. Producing a set of user manuals is reasonably straighforwed and, given that we have carried out similar tasks previously, we should be able to estimate with some degree of accuracy how long it will take and how much it will cost. On the other hand, the time required for program testing and debugging, might be difficult to predict with a similar degree of accuracy even if we have written programs in the past.

Estimation can be improved by anaylysing historic data for similar activities and similar systems. Keeping records comparing our original estimates with the final outcome will reveal the type of tasks that are difficult to estimate correctly.

Planning assumptions : At every stage during planning, assumptions are made, if not valid, may put the plan at risk. Our activity network, for example, is likely to be built on the assumption of using a particular design methodology – which may be subsequently changed. We generally assume that, following coding, a module will be tested and then integrated with others– we might not plan for module testing showing up the need for changes in the original design but, in the event, it might happen.

At each stage in the planning process, it is important to list explicity all of the assumptions that have been made the identify what effects they might have on the plan if they are inappropriate.

Eventualities : Some eventualities might never the forseen and we can only resign ourselves to the fact that unimaginable things do, sometimes, happen. They are, however, very rare. The majority of unexpected events can, in fact, be identified - the requirements specification might be altered after some of the modules have been coded, the senior programmer might take maternity leave, the required hardware might not be delivered on time. Such events do happen from time to time and, although the likeihood of any one them happening a particular project may be relatively low, they must be considerted and planned for.

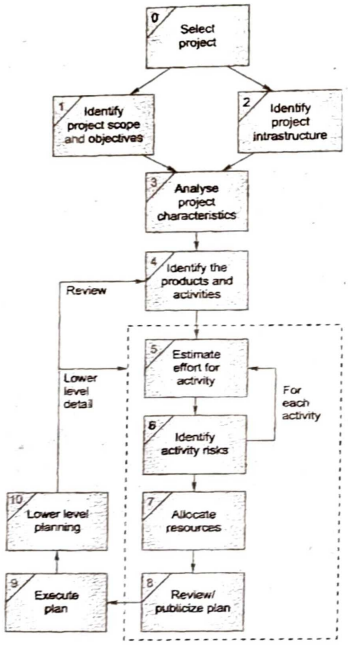


Fig. : Risk analysis is carried out in step 3 and step 6.

Risk Analysis : Risk Analysis is also known as Risk Quantification. Risk Quantification or risk analysis is the process of evaluating risks to access the range of possible project outcomes. In other words we can define, Risk Analysis (RA) as a process that defines activities and methods to estimate and evaluate risk.

The risk analysis process begins with list of risks obtained from the earlier process of risk identification. Each risk from this list is taken for estimation and evaluation. To act on this steam, the organization needs an evaluation criteria and the risk data base.

The probability of a hazard's occuring is known as the *risk likelihood*; the effect that the resulting problem will have on the project, if it occurs, is known as the *risk impact* and the importance of the risk is known as the risk value or risk exposure. The risk value is calculated as :

$$risk\ exposure = risk\ likelihood \times risk\ impact$$

Evaluating risks : Risk evaluation is meant to decide whether to proceed with the project or not. Risk evaluation consists of :

Ranking the risks : Ranking the risks based upon their risk exposures. Ranking shows the order of importance. It considers the following parameters :

- Confidence of the risk assessment
- Compound risks
- Number of risks
- Cost of action

Risk reduction strategies : It includes

Risk reduction leverage (RRL) : It is used to determine whether it is worthwhile to carry out the risk reduction plan. The higher is the RRL value, the more worthwhile is to carry out the risk reduction plan.

$$RRL = RE_{before} - RE_{after} / \text{Risk reduction cost}$$

Section -C

Q.6.(a) Explain the different nature of resources. How you identify the resource requirements ?

Ans. Nature of resources : A resource is any item of person required for the execution of the project. This covers many things - from paperclips to key personal - and it is unlikely that we would wish to itemize every resource required, let alone draw up a schedule for their use! Stationery and other standard office supplies, for example, need not normally he the concern of the project manager -ensurin there is always an adequate supply is the role of the office manager. The project manager must concentrate on those resources where there is a possibility that, without planning, they might not be sufficiently available when required.

Some resources, such as a project manager, will be required for the duration of the project whereas others, such as a specific software developer, might be required for a single activity. The former, while vital to the success of the project, does not require the same level of scheduling as the latter. Individual programmers, for example, might be committed to working on a number of projects and it will be important to book their time well in advance. In general, resources will fall into one of seven categories.

(i) Labour : The main iterms in this category will be members of the developments project team such as the project manager, systems analysts and software developers. Equally important will be the quality assurance team and other support staff and any employees of the client organization who might be required to undertake or participate in specific activities.

(ii) Equipment : Obvious items will include workstations and other computing and office equipment. We must not forget that staff also need basic equipment such as desks and chairs.

(iii) Materials : Materials are iterms that are consumed, rather than equipment that is used. They are of little consequence in most software project but can be important for some software that is to be widely distributed might, for example, require supplies of floppy disks to be specially obtained.

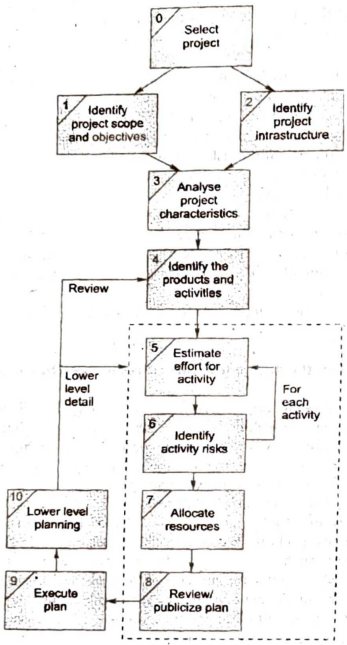


Fig. : Resource allocation is carried out as step 7.

(iv) Space : For projects that are undertaken with exsiting staff, space is normally readily available. If any addtional staff(recruited or contracted) should be needed then office space will need to be found.

(v) Services : Some projects will require procurement of specialist services -development of a wide area distributed system, for example, requires scheduling of telecommunications serives.

(vi) Time : Time is resource that a being offset against the other primary resources project time scales can sometimes be reduced by increasing other resources and will almost certainly be extended if they are unexpectedly reduced.

(vii) Money : Money is a secondary resource - it is used to buy other resources and will be consumed as other resources are used. It is similar to other resources in that it is a available at a cost in this case interset charges.

Identifying Resource Requirements : The first step in producing a resource allocation plan is to list the resources that will be required along with the expected level of demand. This will normally be done by considering each activity in turn and identifying the resources required. It is likely, however, that there will also be resources required that are not activity specific but are part of the project's infrastructure (such as the project manager) or required to support other resources (office space, for example, might be required to house contract software developers).

At this stage, it is necessary that the resource requirements list be as comprehensive as possible - it is better that something is included that may later be deleted as unnecessary than to omit something essential.

Q.6.(b) Explain how you create the frame work for the project. Also focus on change control.

Ans. Creating the Framework : Exercising control over a project and ensuring that targets are met is a matter of regular monitoring, finding out what is happening, and comparing it with current targets. If there is mismatch between the planned outcomes and the actual ones then either replanning is needed to bring the project back on target or the target will have to be revised. Fig.(1) illustrates a model of the project control cycle and shows how, once the initial project plan has been published, project control is a continual process of monitoring progress against that plan and, where necessary, revising the plan to take account of deviations. It also illustrates the important steps that must be taken after completion of the project so that the experienced gained in any one project can feed into the planning stages of future projects, thus allowing us to learn from past mistakes.

In practice we are normally concerned with departures from the plan in four dimensions: delays in meeting target dates, shortfalls in quality, indaquate functionality, and costs going target.

Responsibility : The overall responsibility for enuring satisfactory progress on a project is often the role of the project steering committee or project Board. Day to day responsibility will rest with the project manager and, in all but the smallest of projects aspects of this can be delegated to team leaders.

Fig.(2) illustrates the typical reporting structure found with medium and large projects. With small projects (employing around half a dozen or fewer staff) individual team members usually report directly to the project manager, but in most cases team leaders will collate reports on their section's progress and forward summaries to the project manager. These, in turn, will be incorporated into project level reports for the steering committee and via them or directly, progress reports for the client.

Assessing progress : Process assessement with normally be made on the basis of information collected and collated at regular intervals or when events occur. Wherever possible, this information will be objective and tangible whether or not a particular report has been delivered, for example. However, such end of activity deliverables might not occur sufficiently frequency throughout the life of the project. Here progress assessement will have to rely on the judgement of the team members who are carrying out the project activities.

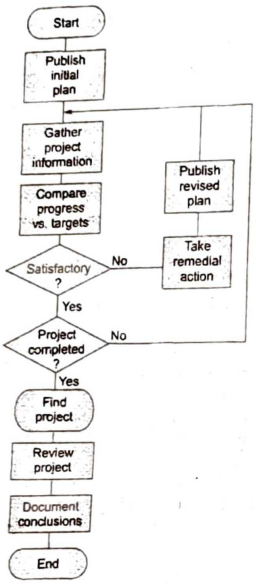


Fig.(1) : The project control cycle.

Fig.(2) : Project reporting structure.

Setting checkpoints : It is essential to set a series of checkpoints in the initial activity plan. Checkpoints may be

- Regular (monthley, for example)

- tied to specific events such as the production of a report or other deliverable.

Taking snap shots : The frequency with which the manager needs to receive information about progress will depend upon the size and degree of risk of the project or that of the project their control. Team leaders, for example, need to assess progress daily (particularly when employing inexperiened staff) whereas project managers may find weekly ; or monthly reporting appropriate. In general, the higher the level, the less frequent and less detailed the reporting needs to be.

There are however, strong arguments in favour of formal weekly collection of information from staff carrying out activities. Collecting data at the end of each week ensurs that information is provided while memories are still relativley fresh and provides a mechanism for individuals to review and reflect upon their progress during the past few days.

Major, or project level, progress reviews will generally take place at particular point during the life of a project commonly known as *review points* or *control points*. PRINCE2 for example, designates a series of check points where the status of work in a project or for a team is reviewed. At the end of each project stage, PRINCE 2 provides for an End Stage Assessement where an assessment of the project and consideration of its future are undertaken.

Change Control : We have assumed that the nature of the tasks to be carried out has not change Careful control of these changes is needed because an alteration in one document often implies changes to other documents and the system products based on that document.

C figuration librarian' role : Control of changes and documentation ought to be the responsibility of someone who may variously be named the configuration Liburation Manager or project Librarian. Among this person's duties would be :

- The identification of all items that are subject to change control.
- The establishment and maintenance of a central repository of the master copies of all project documentation and software products.
- The setting up and running of a formal set of procedures to deal with changes.
- The maintenance of records of who has access to which libary items and the status of each library item (e.g., whether under development, under test or released.

Change control procedures : A simple change control procedure for opertional systems might have the following steps :

(i) One or more users might perceise a need for a modification to a system and ask for a change request to be passed to the development staff.

(ii) The user management consider the change request and if they approve it pass it to the development management.

(iii) The development management delegate a member of staff to look at the request and to reports on the practicality and cost of carrying out the change. They would, as part of this, assess the products that would be affected by the change.

(iv) The develoment management report back to the user management on the finding and the user management decide whether, in view of the cost quoted, they wish to go ahead.

(v) One or more developers are authorized to take copies of the master products that are to be modified.

(vi) The copies are modified. In the case of software components this would involve modifying the code and recompiling and testing it.

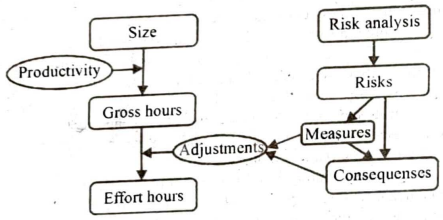
(vii) When the development of new versions of the product has been completed the user management will be notified and copies of the software will be released for user acceptance testing.

(viii) When the user is satisfied that the products are adequate they will authorize their operational release. The master copies of configuration items will be replaced.

Q.7. A size is the main factor the determining the cost of a project, an accurate size can be used to estimate the cost and schedule of the software project. Comment on this statement. Also write in brief about contract management and human resourse management.

Ans. Software project cost estimation: In software project cost estimation, the focus is usually on estimating the effort hours of the people in the team. The reason for this is that the effort hours usually drive the total costs of the project. Of course there are other costs involved, e.g. licenses, workplaces, infrastructure, but these costs are not driven by the software size and can also be calculated in an easier way.

A (simplified) estimation model is displayed in the following figure.



The size of the software to be developed is the main input parameter for the project estimate. It is crucial for the accuracy of the estimate that the size is measured accurately. Selecting a realistic productivity rate is also a very important step. This should be done based on historical data or with the help of professional parametric tools that are based on relevant industry data. Using company data is usually preferred, as this shows the actual capabilities of the organization which may be better or worse than industry average. Project specific characteristics can also be important to consider, e.g. schedule pressure, team size, quality constraints, et cetera. Therefore parametric tools are usually very useful in this step of a project estimate.

Multiplying the size by productivity, the gross effort hours are calculated. Usually some adjustments are necessary based on a risk analysis. If one needs to be 99% sure that there won't be an overrun of the costs for instance, the effort hours will probably be adjusted to create a contingency.

Contract management (contract administration): is the management of contracts made with customers, vendors, partners, or employees. The personnel involved in contract administration required to negotiate, support and manage effective contracts are often expensive to train and retain. Contract management includes negotiating the terms and conditions in contracts and

ensuring compliance with the terms and conditions, as well as documenting and agreeing on any changes or amendments that may arise during its implementation or execution. It can be summarized as the process of systematically and efficiently managing contract creation, execution, and analysis for the purpose of maximizing financial and operational performance and minimizing risk.

Common commercial contracts include employment letters, sales invoices, purchase orders, and utility contracts. Complex contracts are often necessary for construction projects, goods or services that are highly regulated, goods or services with detailed technical specifications, intellectual property (IP) agreements, outsourcing and international trade. Most larger contracts require the effective use of contract management software to aid administration among multiple parties.

Human resource management (**HRM** or simply **HR**) is the management of human resources. It is a function in organizations designed to maximize employee performance in service of an employer's strategic objectives. HR is primarily concerned with the management of people within organizations, focusing on policies and on systems. HR departments and units in organizations typically undertake a number of activities, including employee benefits design, employee recruitment, "training and development",performance appraisal, and rewarding (e.g., managing pay and benefit systems). HR also concerns itself with organizational change and industrial relations, that is, the balancing of organizational practices with requirements arising from collective bargaining and from governmental laws. HRM cover ... following core areas:

(i) job design and analysis,
(ii) workforce planning,
(iii) recruitment and selection,
(iv) training and development,
(v) performance management,
(vi) Remuneration compensation (remuneration)
(vii) Legal issues.

Human resource management has five core functions which are :

(i) Staffing
(ii) Human resource development
(iii) Compensation and benefits
(iv) Safety and health
(v) Employee and labour relations

Section - D

Q.8. What is software quality? Explain the different techniques to enhance the software quality.

Ans. Software quality : Software Quality is the conformance to explicit stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.

The above definition emphasize on these three important points :

– Software requirements are the foundation from which quality is measured. Lack of conformance to requirements is lack of quality.

– Specified standards define a set of development criteria that guide the manner in which software is engineered. If the criteria are not followed, lack of quality will almost surely in result.

– There is a set of implicit requirements that often goes unmentioned. If software conforms to its explicit requirements but fail to meet implicit requirements software quality is suspect.

Techniques for **enhancing the quality of software project** are as follows :

– **Increasing visibility :** Weinberg encouraged the simple practice of software programmers looking at each other's code.

– **Procedural structure :** Every process in the software development cycle has carefully laid down teps.

– **Checking intermediate stages :** Emphasis on checking the correctness of work at its earlier conceptual stages.

– **Inspection :** The principle of inspection can be extended to any document that is produced at any stage in the development process. When a piece of work is completed, copies of the work are distributed to co-workers who then spend some time going through the work noting any defects.

– **Formal methods :** It uses techniques that are unambiguous, mathematically based and specification language. They are used to define pre and post conditions for each procedure. Pre-conditions define the allowable states before processing of the various items of data that a procedure is to work upon. Post conditions define the state of those data items after the procedure has been executed.

– **Software quality circles :** A quality circle is a group of four to ten volunteers working in the same area to identify, analyse and solve their work related problems.

– **The GQM approach :** A number of metrics will need to be identified as needing collection in order to answer the question.

Q.9. Explain in detail about all the steps of any software project that you have developed in your program of study.

Ans. Following are the steps in software development :

(1) Identification of need : The sources of ideas for software products are legion. These ideas can come from market research including the demographics of potential new customers, existing customers, sales prospects who rejected the product, other internal software development staff, or a creative third party. Ideas for software products are usually first evaluated by marketing personnel for economic feasibility, for fit with existing channels distribution, for possible effects on existing product lines, required features, and for fit with the company's marketing objectives. In a marketing evaluation phase, the cost and time assumptions become evaluated. A decision is reached early in the first phase as to whether, based on the more detailed information generated by the marketing and development staff, the project should be pursued further.

Software development may involve compromising or going beyond what is required by the client, a software development project may stray into less technical concerns such as human resources, risk management, intellectual property, budgeting, crisis management, etc. These processes may also cause the role of business development to overlap with software development.

(2) Planning : Planning is an objective of each and every activity, where we want to discover things that belong to the project. An important task in creating a software program is extracting the requirements or requirements analysis. Customers typically have an abstract idea of what they want as an end result, but do not know what software should do. Skilled and experienced software engineers recognize incomplete, ambiguous, or even contradictory requirements at this point. Frequently demonstrating live code may help reduce the risk that the requirements are incorrect.

Once the general requirements are gathered from the client, an analysis of the scope of the development should be determined and clearly stated. This is often called a scope document.Certain functionality may be out of scope of the project as a function of cost or as a result of unclear requirements at the start of development. If the development is done externally, this document can be considered a legal document so that if there are ever disputes, any ambiguity of what was promised to the client can be clarified.

(3) Designing : Once the requirements are established, the design of the software can be established in a software design document. This involves a preliminary, or high-level design of the main modules with an overall picture (such as a block diagram) of how the parts fit together. The language, operating system, and hardware components should all be known at this time. Then a detailed or low-level design is created, perhaps with prototyping as proof-of-concept or to firm up requirements.

(4) Implementation, testing and documenting :

Implementation is the part of the process where software engineers actually program the code for the project.

Software testing is an integral and important phase of the software development process. This part of the process ensures that defects are recognized as soon as possible. In some processes, generally known as test-driven development, tests may be developed just before implementation and serve as a guide for the implementation's correctness.

Documenting the internal design of software for the purpose of future maintenance and enhancement is done throughout development. This may also include the writing of an API, be it external or internal. The software engineering process chosen by the developing team will determine how much internal documentation is necessary. Plan-driven models (e.g., Waterfall) generally produce more documentation than Agile models.

(5) Deployment and maintenance : Deployment starts directly after the code is appropriately tested, approved for release, and sold or otherwise distributed into a production environment. This may involve installation, customization (such as by setting parameters to the customer's values), testing, and possibly an extended period of evaluation. Software training and support is important, as software is only effective if it is used correctly. Maintaining and enhancing software to cope with newly discovered faults or requirements can take substantial time and effort, as missed requirements may force redesign of the software.

SOFTWARE PROJECT MANAGEMENT

Dec - 2016
Paper Code:-CSE-403-F

Note : ***Attempt five questions in all, selecting one question from each Section. Question No. 1 is compulsory. All questions carry equal marks.***

Q.1.(a) What is software project ?

Ans. Software project is the process of computer programming, documenting, testing, and bug fixing involved in creating and maintaining applications and frameworks resulting in a software product. Software development is a process of writing and maintaining the source code, but in a broader sense it includes all that is involved between the conception of the desired software through to the final manifestation of the software, sometimes in a planned and structured process. Therefore, software development may include research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products.

Characteristic : Following are the most important aspects of software project :

1. Collaboration : The project management software should facilitate the team collaboration. This means that the relevant stakeholders of the project should be able to access and update the project documents whenever they want to. Therefore, the project management software should have access control and authentication management in order to grand access levels to the project stakeholders.

2. Scheduling : Scheduling is one of the main features that should be provided by project management software. Usually, modern project management software provides the ability to draw Gantt charts when it comes to activity scheduling .In addition to this, activity dependencies can also be added to the schedules, so such software will show you the project critical path and later changes to the critical path automatically. Base lining is also a useful feature offered by project management software. Usually, a project is based lined when the requirements are finalized. When requirements are changed and new requirements are added to the project later, project management team can compare the new schedule with the baseline schedule automatically to understand the project scope and cost deviations.

3. Issue Tracking : During the project life cycle, there can be many issues related to project that needs constant tracking and monitoring. Software defects is one of the good examples for this. Therefore, the project management software should have features to track and monitor the issues reported by various stakeholders of the project.

4. Document Management : A project has many documents in use. Most of these documents should be accessible to the stakeholders of the project. Therefore, the project management software should have a document management facility with correct access control system.In addition to this; documents need to be versioned whenever they are updated. Therefore, the document management feature should support document versioning as well.

5. Resource Management : Resource management of the project is one of the key expectations from project management software. This includes both human resources and other types. The project management software should show the utilization of each resource throughout the entire project life cycle.

Q.1.(b) What is risk management ? How the risk identification is done ?

Ans. Risk Management : Risk is defined as an exposure to the chance of injury or loss. That is risk implies that there is a possibility that something negative may happen. In the context of software projects, negative implies that there is an adverse effect on cost, quality or schedule.

The objective of risk management is to avoid or minimize the adverse effects of unforeseen events by avoiding the risks or drawing up contingency plans for dealing with them.

Risk Identification : The first stage in any risk assessment exercise is to identify the hazards that might affect the duration or resource costs of the project. A hazard is an event that might occur and will, if it does occur, create a problem for the successful completion of the project. In identifying and analysing risks, we can usefully distinguish between the cause (or hazard), its immediate effect (the problem that it creates) and the risk that it will pose to the project.

Q.1.(c) Give the classification of cost benefit analysis.

Ans. Benefits may be categorized as follows :

(i) Direct benefits – These accrue directly from the operation of the proposed system. These could, for example, include the reduction is salary bills through the introduction of a new, computerized system.

(ii) Assessable indirect benefits – These are generally secondary benifits, such as increased accuracy through the introduction of a more user-friendly screen design where we might be able to estimate the reduction in errors, and hence costs, of the proposed system.

(iii) Intangible benefits – These are generally longer term or benefits that are considered very difficult to quantify. Enhanced job interest can lead to reduced staff turnover and, hence, lower recruitment costs.

Q.1.(d) Differentiate between process and product quality.

Ans. Product Vs Process quality : Difference between product quality and process quality are as follows :

Product quality	Process Quality
(i) Method are general purpose products.	(i) There are no methods, only process of method.
(ii) Proper(customized) use of methods will lead to uniform results.	(ii) These process influence the result using the method.

(iii) Product quality is focusing on meeting tolerances in the end result of the manufacturing activities. The end result is measured on a standard of "good enough".	(iii) Process quality focuses on each activity and forces the activities to achieve maximum tolerances irrespective of the end result.

With a product based approach to planning and control, the focus on the product is convenient. It is often easier to measure the product qualities in a completed computer application rather than during its development. Trying to use the attributes of intermediate products created at earlier stages to predict the quality of the final application is difficult. An alternative approach is to scrutinize the quality of the processes used to develop software product.

Section - A

Q.2.(a) What is software project ? Explain various types of software project briefly. **(10)**

Ans. Software Project : Software project is a specific plan or design. It helps to determine how to carry out a task before starting.

Various **types of software projects** are as follows :

(i) Desktop project management software gives individual users the most responsive and highly-graphical interface. Desktop applications normally store their data in a local file, although some allow collaboration between users or store their data in a central database. A simple file-based project plan can be shared between users if it is stored on a networked drive, and only one user accesses it at any given time.

(ii) Web-based project management software can be accessed through an intranet or extranet using a web browser and has all the usual advantages and disadvantages of web applications:

- Can be accessed from any type of computer without installing software
- Ease of access-control
- Provides multi-user facilities
- Only one software version and installation needs to be maintained
- Typically slower to respond than desktop applications
- Limited graphical capability compared to desktop applications
- Project information is not available offline.

(iii) Single-user project management systems work on the basis that only one person will need to edit the project plan at any time. This may be used in small organisations, or only a few people are involved in project planning. Desktop applications usually come into this category.

(iv) Collaborative project management systems are designed to support multiple users modifying different sections of the plan at once, ex. updating the areas they are personally responsible for so that those estimates get integrated into the overall plan. Web-based tools often fall into this category, but they can only be used when the user is online. Some client-server-based software tools replicate project and task information through a central server when users connect to the network.

(v) Integrated systems combine project management or project planning, with many

other aspects of company operations, ex. bug tracking issues can be assigned to each project, the list of project customers becomes a customer relationship management module, and each person on the project plan has their own task lists, calendars, messaging associated with their projects.

Q.2. Explain the following terms : **(5×2=10)**

(i) Risk management activity

(ii) Management control

Ans. (i) Risk management activity : The risk management process has several activities that are illustrated in Fig.

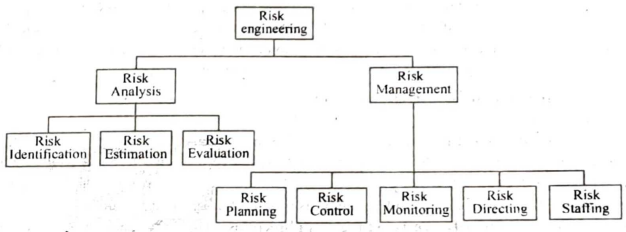


Fig. : Boehm's risk engineering task breakdown.

- *Risk identification* consists of listing all of the risks that can adversely affect the successful execution of the project.
- *Risk estimation* consists of assessing the likelihood and impact of each hazard.
- *Risk evaluation* consists of ranking the risks and determining risk aversion strategies.
- *Risk planning* consists of drawing up contingency plans and, where appropriate, adding these to the project's task structure. With small projects, risk planning is likely to be the responsibility of the project manager but medium or large projects will benefit from the appointment of a full-time risk manager.
- *Risk control* concerns the main functions of the risk manager in minimising and reacting to problems throughout the project. The function will include aspects of quality control in addition to dealing with problems are they occur.
- *Risk monitoring* must be an ongoing activity, as the importance and likelihood of particular risks can change as the project proceeds.
- *Risk directing* and *risk staffing* are concerned with the day-to-day management of risk. Risk aversion and probleme solving strategies frequently involve the use of additional stagg and this must be planned for and directed.

Ans.(ii)Management Control : Management involves setting objectives for a system and then monitoring the performance of the system. In the case of large undertakings, there will be a lot going on which management should be aware. The project management might estimate completion date for completing data transfer for each branch. These can be checked against the overall target data for completion of the phase of the project. They compare actual performance with one aspect of the overall project objectives. They might find that one or more branches will fail to complete the transfer of details in time. They would then need to consider what to do. One possibility is to move the staff temporarily from one branch to another.

Q.3. What is software project planning ? Explain in detail the various steps of software project planning. **(20)**

Ans. Software project planning : Software project planning is task, which is performed before the production of software actually starts. It is there for the software production but involves no concrete activity that has any direction connection with software production; rather it is a set of multiple processes, which facilitates software production.

Various steps of software project planning : Folloing are the various steps of software project planning :

Step 0 : Select project : This is called step 0 because in a way it is outside the main project planning process. Projects are not initiated out of thin air – some activity has to take place before deciding that this project rather than another is worth undertaking. This project evaluation may be done on an individual basis or as part of strategic planning.

Step 1 : Identify project scope and objectives : The activities in this step ensure that all the parties to the project agree on the objectives and are committed to the success of the project. A danger to be avoided is overlooking people who are affected by the project.

- Identify objectives and measures of effectiveness in meeting them
- Establish a project authority
- Identify all stakeholders in the project and their interests
- Modify objectives in the light of stakeholder analysis
- Establish methods of communications with all parties.

Step 2 : Identify project infrastructure : Projects are rarely initiated in a vacuum. There is usually some kind of existing infrastructure into which the project can fit. The project leader who does not already know about this structure needs to find out its precise nature.

- Establish relationship between project and strategic planning
- Identity installation standards and procedures
- Identity project team organization

Step 3 : Analysis project characteristics : The general purpose of this part of the planning operation is to ensure that the appropriate methods are used for the project.

- Distinguish the project as either objective-or product-driven
- Analyse other project characteristics
- Identify high level project risks

- Take into account user requirements concerning implementation
- Select general lifecycle approach
- Review overall resource estimates.

Step 4 : Identify project products and activities

- Identify and describe project products (or deliverables)
- Document generic product flows
- Recognize product instances
- Produce ideal activity network
- Modify ideal to take into account need for stages and checkpoints.

Step 5 : Estimate effort for each activity

- Carry out bottom-up estimates
- Revise plan to create controllable activities

Step 6 : Identify activity risks

- Identify and quantify activity-based risks
- Plan risk reduction and contingency measures where appropriate
- Adjust overall plans and estimates to take account of risks

Step 7 : Allocate resources

- Identify and allocate resources
- Revise plans and estimates to account for resource constraints

Step 8 : Review/publicize plan

- Review quality aspects of project plan
- Document plans and obtain agreement

Step 9 and 10: Execute plan and lower levels of planning : Once the project is under way, plans will need to be drawn up in greater detail for each activity as it becomes due. Detailed planning of the later stages will have to be delayed because more information will be available nearer the start of the stage. Of course, it is necessary to make provisional plans for the more distant tasks, because thinking about what has to be done can help unearth potential problems, but sight should not be lost of the fact that these plans are provisional.

Section - B

Q.4.(a) Differentiate between waterfall and V-process model with their relative merits and demerits. **(10)**

Ans. The Waterfall Model : The Waterfall Model was first Process Model to be introduced. It is a very common software development process model. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed fully before the next phase can begin. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In waterfall model phases do not overlap.

Advantages :

(i) Simple and easy to understand and use.

(ii) Easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process.

(iii) Phases are processed and completed one at a time.

(iv) Works well for smaller projects where requirements are very well understood.

Disadvantages :

(i) Once an application is in the testing stage, it is very difficult to go back and change something that was not well-thought out in the concept stage.

(ii) No working software is produced until late during the life cycle.

(iii) High amounts of risk and uncertainty.

(iv) Not a good model for complex and object-oriented projects.

(v) Poor model for long and ongoing projects.

(vi) Not suitable for the projects where requirements are at a moderate to high risk of changing.

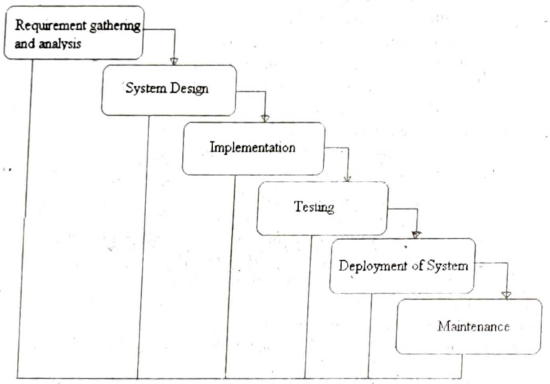


Fig. : Water Fall Model

V-Process model : V- model means Verification and Validation model. The V-Shaped life cycle is a sequential path of execution of processes. Each phase must be completed before the next phase begins. Testing of the product is planned in parallel with a corresponding phase of development.

The various phases of the V-model are as follows :

– **Requirements** like BRS and SRS begin the life cycle model just like the waterfall model. But, in this model before development is started, a system test plan is created. The test plan focuses on meeting the functionality specified in the requirements gathering.

– **The high-level design (HLD)** phase focuses on system architecture and design. It provide overview of solution, platform, system, product and service/process. An integration test plan is created in this phase as well in order to test the pieces of the software systems ability to work together.

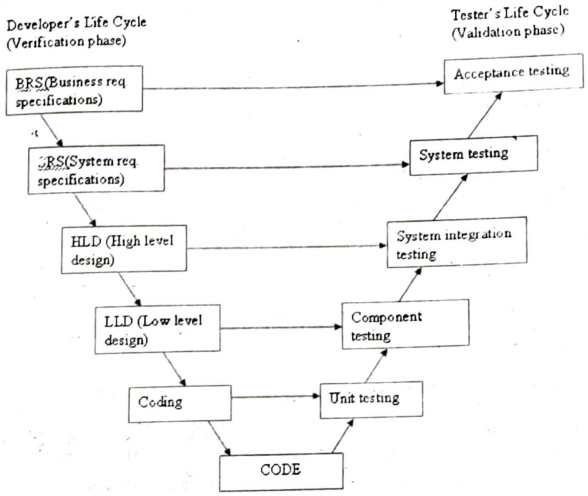


Fig. : V-Process Model

– **The low-level design (LLD)** phase is where the actual software components are designed. It defines the actual logic for each and every component of the system. Class diagram with all the methods and relation between classes comes under LLD. Component tests are created in this phase as well.

– **The implementation** phase is, again, where all coding takes place. Once coding is complete, the path of execution continues up the right side of the V where the test plans developed earlier are now put to use.

–**Coding:** This is at the bottom of the V-Shape model. Module design is converted into code by developers.

Advantages : (i) Simple and easy to use.

(ii) Testing activities like planning, test designing happens well before coding. This saves a lot of time. Hence higher chance of success over the waterfall model.

(iii) Proactive defect tracking – that is defects are found at early stage.

(iv) Avoids the downward flow of the defects.

(v) Works well for small projects where requirements are easily understood.

Disadvantages: (i) Very rigid and least flexible.

(ii) Software is developed during the implementation phase, so no early prototypes of the software are produced.

(iii) If any changes happen in midway, then the test documents along with requirement documents has to be updated.

Q.4.(b) What is cost-benefit analysis ? Explain the cost-benefit evaluation techniques in detail. (10)

Ans. Cost–benefit analysis (CBA), sometimes called **benefit–cost analysis (BCA)**, is a systematic approach to estimating the strengths and weaknesses of alternatives (for example in transactions, activities, functional business requirements); it is used to determine options that provide the best approach to achieve benefits while preserving savings. The CBA is also defined as a systematic process for calculating and comparing benefits and costs of a decision, policy (with particular regard to government policy) or (in general) project.

Broadly, CBA has two main purposes :

1. To determine if an investment/decision is sound (justification/feasibility) – verifying whether its benefits outweigh the costs, and by how much;

2. To provide a basis for comparing projects – which involves comparing the total expected cost of each option against its total expected benefits.

Cost-benefit evaluation techniques : Following are the main cost benefit evaluation techniques :

(1) Net profit : The net profit of a project is the difference between the total costs and the total income over the life of the project.

(2) Payback period : The payback period is the time taken to break even or pay back the initial investment. Normally, the project with the shortest payback period will be chosen on the basis that an organization will wish to minimize the time that a project is 'in debt'.

The advantage of the payback period is that it is simple to calculate and is not particularly sensitive to small forecasting errors. Its disadvantage as a selection techniuque is that it ignores the overall profitability of the project-in fact, it totally ignores any income (or expenditure) once the project has broken even.

(3) Return on investment : The return on investment (ROI), also known as the accounting rate of return (ARR), provides a way of comparing the net profitability to the investment required. There are some variations on the formula used to calculate the return on investment but a straightforward common version is

$$\text{ROI} = \frac{\text{average annual profit}}{\text{total investment}} \times 100$$

The return on investment provides a simple, easy to calculate measure of return on capital and is therefore quite popular. Unfortunately it suffers from two severe disadvantages. Like the net profitability, it takes no account of the timing of the cash flows. More importantly, it is tempting to compare the rate of return with current interest rates. However, this rate of return bears no relationship to the interest rates offered or charged by banks (or any other normal interest rate) since it takes no account of the timing of the cash flows or of the compounding of interest. It is therefore, potentially, very misleading.

(4) Net present value : The calculation of net present value is a project evaluation technique that lakes into account the profitability of a project and the timing of the cash flows that are produced. It does so by discounting future cash flows by a percentage known as the discount rate.

Q.5.What is a risk ? Discuss the various risks in projects ? How the risk management activities are derived and implemented ? (20)

Ans. Risk : Risk in a project is a measure of the inability to achieve objectives within cost, schedule, and constraints.

Risk can be categorized as follows :

(1) *Project risks* : risk that threaten the project (or the project schedule)

(2) *Product risks* : risk that threaten the quality of the software developed.

(3) *Business risks* : risk that threaten the development (or client) organization.

Risk Management Activities : Risk management must not be allowed to become "shelfware". The process must be a part of regularly scheduled periodic product management. It requires identifying and managing risks routinely throughout all phases of the project's life.

The risk management process has several activities that are illustrated in Fig.(1).

Fig.(1) : Risk Management Activities.

All the above risk management activities are discussed below :

(1) Risk Assessment : Risk assessment activity include the following :

- Risk Identification
- Risk Analysis
- Risk Prioritization

All these activities are discussed below :

Risk Identification **:** Risk identification is a systematic attempt to specify threats to the project plan. The purpose or risk identification is to develop a list of risk items called risk statement. Risk identification can be facilitated with the help of a checklist of common risk areas for software projects, or by examining the contents of an organizational database of previously identified risks and mitigation strategies (both successful and unsuccessful).

Risk identification is carried out as a team process using brainstorming. To assist the process a list of risk types can be used. The end product of this step of the process is a list of risks that could occur and affect the product, the process or the business.

Within the identification phase, several activities occur. The main activities are :

(1) *Identify risks* : There are many techniques to be used to identify risk. Some of these are check-lists, interviews, brainstorm meetings, reviews and surveys. A checklist to be used as a tool for identification of risks is provided.

(2) *Define risk attributes* : After the risks are identified, they are evaluated with the criteria : likelihood of occurrence (probability), consequence and time frame for action. These values are initial estimations which are analysed more in the next phase.

(3) *Document* : The risks are then documented. Together with the name of the risks, a risk statement and context are to be specified. In this initial phase the description of the risk issue, the probability and the consequence are specified in subjective terms.

(4) *Communicate* : Spreading the knowledge to the project members.

Risk Analysis **:** When the risks have been identified, all items are alalyzed using different criteria. The purpose of the risk analysis is to assess the loss probability and magnitude of each risk item.

The input is the risk statement and context developed in the identification phase. The output of this phase is a risk list containing relative ranking of the risks and a further analysis of the description, probability, consequence and context. The main activities in this phase are :

(1) *Group similar risks* – Detect duplicates and find new risk items by grouping the identified risks into categories.

(2) *Determine risk drivers* – The risk drivers are parameters that effect the identified risk. For example, schedule drivers are included in the critical path model. Determining these properties help to assess and prioritize the risks.

(3) *Determine source of risks* – The sources of risks are the root causes of the risks. These are determined by asking the question why? and trying to figure out what may have caused the risk. Several root causes may lead to the same risk.

(4) *Estimate risk exposure* – The risk exposure is a measure of the probabilituy and the consequence of a risk item. The consequence can also be stated in terms of loss (for example life, money, property, reputation).

(5) *Evaluate against criteria* – Each risk item is evaluated using the predefined criteria, which are important for the specific project. Criteria may be stated in terms of the probability of occurrence, the consequence and the time frame. This information is used to prioritize the risks.

Risk prioritization **:** Risk prioritization helps the project focus on its most severe risks by assessing the risk exposure. Exposure is the product of the probability of incurring a loss due to the risk and the potential magnitude of that loss.

This prioritization can be done in a quantitative way, by estimating the probability (0.1 – 1.0) and relative loss, on a scale of 1 to 10, Multiplying these factors together provide an estimation of the risk exposure due to each risk item, which can run from 0.1 (don't give it another thought) through 10 (stand back, here it comes!).

The higher the exposure, the more aggressively the risk should be tackled. It may be easier to simply estimate both probability and impact as High, Medium, or Low. Those items having at least one dimension rated as High are the ones to worry about first.

(2) Risk control : Risk control is the process of managing risks to achieve the desired outcomes. Risk control process involves the following activities :

- Risk planning
- Risk Mitigation
- Risk Resolution
- Risk Monitoring

Risk Planning **:** Risk planning is to identify strategies to deal with risk. These strategies fall into three categories :

- Risk Avoidance
- Risk Minimization
- Risk Contingency plans

Risk planning strategies are discussed below :

Risk Avoidance : Risk avoidance is one way to deal with risk: don't do the risky thing! We may avoid risks by not undertaking certain projects, or by relying on proven rather than cutting edge technologies.

Risk avoidance attempts to reduce the probability of a risk. For example, user interface prototyping reduces the risk that users will find the interface unacceptable.

Risk Minimization : Risk minimization attempts to reduce the impact of a risk. For example, cross-training members of the development team reduces risks resulting from team members leaving the organization.

Risk Contingency Plans : Risk contingency plans preparations for dealing with a risk should it occur. For example identifying alternate sources of funding in case financial backers stop supporting the project or identifying organizations that may be interested in buying a software system in case the client organization involved in the development project backs out.

Risk Mitigation **:** The risk mitigation is a plan that would reduce or eliminate the highest risks. The key question is: What should be done and who is responsible to eliminate or minimize the risk?

The mitigation plan includes a description of the actions that can be taken to mitigate the red rated risk and assigns a primary handler for the action.

Risk Resolution **:** When a risk has occurred, it has to be solved. Risk resolution is the execution of the plans for dealing with each risk. If the risk is at the watch list, a plan of how to resolve the risk already had taken place. The project manager has to respond to the already chalked out plan of how to resolve the risk.

A project manager has to respond to the trigger and execute the action plan. The project manager also needs to report progress against the plan and correct for deviation.

The input to this phase is the risk action plan and the outputs are:

- Risk status
- Acceptable rists
- Reduced rework,
- Corrective action and
- Problem prevention.

Risk status is the progress of the risk management. Acceptable risks are the ones that are not to be solved. *Reduced rework* is a measure of the benefit of using risk management. This has to be calculated to determine whether the risk management works. *Corrective actions* are procedures that are known solutions if a problems occur and are generally accepted within the project or organization. *Problem prevention* occurs when trying to avoid problem and thereby eliminating their result.

Risk Monitoring **:** Risk monitoring is the continually reassessing of risks as the project proceeds and conditions change. For example, successful completion of beta testing means that the risk of the client organization rejecting the system is minimal, while large turnover in development staff usually increases project and product risks.

(3) Risk Reporting : Risk Reporting is reporting the status of the risks that were identified during risk identification and assessment stages.

All types of risks along with their status are reported properly as part of risk reporting activity. The entire information about risks is documented together with the full history of risks such as name of the risks, a risk statement, context, etc.

The risk management function should monitor and report its measures of risks to appropriate levels of senior management. Reports to other levels of senior management and the board may occur less frequently, but the frequency of reporting should provide these individuals with adequate information to judge the changing nature of the institution's risk profile.

To provide visibility of risks and progress in mitigating them, the following reports should be distributed on a regular basis as part of the normal project status reporting system:

Risk Watch List : Lists risks to facilitate monitoring risks and initiating risk responses.

Risk Mitigation Plan : Lists avoidance/mitigation actions, if and when risks occur.

Risk Profile : Displays planned, actual and projected progress in reducing risks.

Section - C

Q.6.What is resource and resource allocation ? Explain various resource allocation techniques in detail. How we identify the resource requirement for good software management ? **(20)**

Ans. Resource : A resource is any item or person required for the execution of the project.

Resource allocation : Resource allocation is a process and strategy involving a company deciding scarce resources should be used in the production of goods or services. A resource can be considered any factor of production, which is something used to product goods or services.

Resource allocation techniques : In an economist's perfect world resources are optimally allocated when they are used to produce goods and services that match consumer needs and wants at the lowest possible lost of product. Efficiency of product on means fewer resources are expended in producing goods and services.

(1) Strategic Planning : Resource allocation begins at strategic planning when a company formulates its vision and goals for the future the vision and strategic goals are accomplished through achievement of objectives.

(2) Budgeting : Once you have set your objective you will then need to allocate sufficient resource to accomplish it. In practical terms this is often a matter of project. Budgeting in our example the company will allocate money for market research to determine unmounts consumer need and wants for computer tablet many for product design and developments, funds for production.

(3) Resource Allocation Patterns : Resource management is a very important part of real time and embedded software design. This article discusses commonly used resource allocation patterns. The discussion is divided into two parts:

(i) Resources allocation algorithms.

(ii) Distributed resources allocation.

Resource Allocations :

(i) *Hottest first* : In hottest first resources allocation the resource last released is allocated on next resorce requrest. To implement this best in first out LIFO type of allocation. The list of tree resources is maintained as a stack.

(ii) *Coldest First* : In coldest first resources allocation the resource not allocated for maximize time is allocated to first implement this first is first out FIFO type of allocation the resources allocating entity keeps the tree resources in a queue.

(iii) *Load Balancing* : In situation involving multiple resource groups load balancing is used. A resource group is controlled by a local resource controllers. In this techniques the resource allocator first determines the highly loaded resource group.

(iv) *Future Resource Booking* : Here each resource allocation is for a specified time. The resource allocation is only valid till the specified time reached the resource is considered to be tree. Thus the resource does not need to be treed explicitly.

Distributed Resource Allocation : Most real time systems are distributed across multiple process. Different techniques are used to manage resource allocation in such distributed system. Some of these technique are.

- Centralized resorce.
- Heirarchical resource.
- Bidirectional resource.
- Random Access.

Centralized Resource : In this techniques a centralized allocator keeps track of all the available resources. All entities send massage requesting resources and the allocator responses with the allocated resources.

Hierarchical resource : In this techniques the resources allocation is done in multiple steps. First the centralized allocator takes the high level resource allocation decision. In Xenon trunk allocation is carried out in fellowing step:

(i) The centralized allocator at CAS determines which trunk group should be used to route outgoing calls.

(ii) The call request is then forwarded to the XEN handling the trunk group.

(iii) The XEM level allocator selects the actual trunk from the trunk group.

Bidirectional Resources : This scheme allow two independent allocators to allocate the same set of resources. It is used in situations like bidirectional trunk group.

Random Accesses : Wherever a resource needs to be shared between multiple entities which can not synchronize to each others and the do not have access to centralized allocator designers have a resort to random access to the resource.

Identifying Resource Requirements : The first step in producing a resource allocation plan is to list the resources that will be required along with the expected level of demand. This will normally be done by considering each activity in turn and identifying the resources required. It is likely, however, that there will also be resources required that are not activity specific but are part of the project's infrastructure (such as the project manager) or required to support other resources (office space, for example, might be required to house contract software developers).

At this stage, it is necessary that the resource requirements list be as comprehensive as possible - it is better that something is included that may later be deleted as unnecessary than to omit something essential.

Q.7.What is organizational structure ? Explain different types of organizational structure. **(20)**

Ans. An organizational structure defines how activities such as task allocation, coordination and supervision are directed toward the achievement of organizationalaims. It can also be considered as the viewing glass or perspective through which individuals see theirorganization and its environment.

The current types of organizational structure of project management are: functional organizational structure, project-based organizational structure and matrix organizational structure.

(1) Functional organizational structure : Functional organizational structure is to be managed in the current organization hierarchical structure, once the project begins operation, the various components of the project are taken by the functional units, each unit is responsible for its charged component. If the the project established, a functional area play a dominant role, functional areas on completion of the project, senior managers will be responsible for project coordination.

Advantages of this structure: First, the use of personnel with greater flexibility, as long as the choice of a suitable functional departments as the project supervisor, the department will be able to provide professional and technical personnel required by the project, and technology experts can also be used by different projects and after completion of the work can go back to his original work.

Second, when the project team members leave or leave the company, the functions can be used as the basis for maintaining the continuity of the project; third, functional department can provide a normal career path for professionals.

The *disadvantage* of this structure is: First, projects often lack of focus, each unit has its own core functions of general business, sometimes in order to meet their basic needs, responsibility for the project will be ignored, especially when the interest taken in the project brought to the unit not the same interest.

Second, such organization has certain difficulties in the inter-departmental cooperation and exchanges.

Third motivation is not strong enough for project participants, they think the project is an additional burden, and not directly related to their career development and upgrading.

Fourth, in such organizational structure, sometimes no one should assume full responsibility for the project, often the project manager is only responsible for part of the project, others are responsible for the other parts of the project, which leads to difficulties in coordination situation.

(2) Project-based organizational structure : Project organizational structure refers to the creation of an independent project team, the team's management is separated from the parent organization's other units, have their own technical staff and management, enterprise assigns certain resources to project team, and grant project manager of the largest free implementation of the project.

The *advantages* of this structure: First, focus on this project team, project manager is solely responsible for the project, the only task for project members is to complete the project, and they only report to the project manager, avoiding the multiple leadership.

Second, the project team's decision is developed within the project, the reaction time is short.

Third, in this project, members work with strong power, high cohesion, participants shared the common goal of the project, and individual has clear responsibilities.

The *disadvantage* of this organizational structure: First, when a company has several projects, each project has its own separate team, which will lead to duplication of efforts and the loss of scalable economies.

Second, the project team itself is an independent entity, prone to a condition known as "Project inflammatory" disease, that is, there is a clear dividing line between the project team and the parent organization, weakening the effective integration between project team and the parent organization.

Third, the project team members lack of a business continuity and security, once the project ended, return to their original functions may be more difficult.

(3) Matrix organizational structure : Matrix organizational structure is a hybrid form, it loads a level of project management structure on the functional hierarchical structure. According to the relative power of project managers and functional managers, in practice there are different

types of matrix systems, respectively, Functional Matrix: in this matrix, functional managers have greater powers than project managers); Project Matrix: in this matrix, project managers have greater powers than functional managers); Balance Matrix: in this matrix, functional managers and project managers have the equal powers.

The *advantages* of this organizational structure: First, it is the same as functional structure that resources can be shared in multiple projects, which can significantly reduces the problem of redundant staff.

Second, project is the focus of work, with a formal designated project manager will make him give more attention to the project, and responsible for the coordination and integration work between different units.

Third, when there are multiple projects simultaneously, the company can balance the resources to ensure that all the projects can progress to complete their respective costs and quality requirements.

Fourth, the anxiety of project members is reduced greatly after the end of the project, while they are strongly associated with the project, on the other hand, they have a "home" feeling about their functions.

The *disadvantage* is that this organizational structure: First, the matrix structure has exacerbated the tensions between functional manager and project manager.

Second, under any circumstances, sharing equipment, resources and personnel among different projects will lead to conflict and competition for scarce resources.

Third, in the process of project implementation, the project manager must negotiate and consult with the department managers on various issues, which leads to the delay in decision making.

Fourth, matrix management is not according to the principles of unified management, project members have two bosses, the project manager and functional managers, when their commands are divided, it will make members at a loss.

Section - D

Q.8.What is software quality ? How we enhance the software quality ? Explain various software quality enhancement techniques in detail. (20)

Ans. Software quality : Software Quality is the conformance to explicit stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.

The above definition emphasize on these three important points :

– Software requirements are the foundation from which quality is measured. Lack of conformance to requirements is lack of quality.

– Specified standards define a set of development criteria that guide the manner in which software is engineered. If the criteria are not followed, lack of quality will almost surely in result.

– There is a set of implicit requirements that often goes unmentioned. If software conforms to its explicit requirements but fail to meet implicit requirements software quality is suspect.

Techniques for **enhancing the quality of software project** are as follows :

– **Increasing visibility :** Weinberg encouraged the simple practice of software programmers looking at each other's code.

– **Procedural structure :** Every process in the software development cycle has carefully laid down steps.

– **Checking intermediate stages :** Emphasis on checking the correctness of work at its earlier conceptual stages.

– **Inspection :** The principle of inspection can be extended to any document that is produced at any stage in the development process. When a piece of work is completed, copies of the work are distributed to co-workers who then spend some time going through the work noting any defects.

– **Formal methods :** It uses techniques that are unambiguous, mathematically based and specification language. They are used to define pre and post conditions for each procedure. Pre-conditions define the allowable states before processing of the various items of data that a procedure is to work upon. Post conditions define the state of those data items after the procedure has been executed.

– **Software quality circles :** A quality circle is a group of four to ten volunteers working in the same area to identify, analyse and solve their work related problems.

– **The GQM approach :** A number of metrics will need to be identified as needing collection in order to answer the question.

Q.9. Write short note on the following : (10×2=20)

(i) Any SPM software

(ii) ISO 9126

Ans. (i) Software Project Management Software : Apollo is a web-based project-management and customer relationship management(CRM) software application developed by Application. Apollo was launched as public beta in 2010; it was formally released (out of beta) on the 11 th of April 2011.

Apollo has received considerable coverage for the fact that it's a one-page AJAX application based on the Dojo toolkit.

Features of Apollo : Apollo offers both project management and CRM features :

(i) to-do lists, milestone management, file sharing, time tracking, calendar, and a messaging system. Tasks can be created via email and users can import their data from Basecamp.

(ii) cases, deals, notes on contacts, tasks on contacts, important dates, calendar, tags. Users can import their data from Highrise and Capsule CRM.

Apollo uses heavily AJAX technologies, with the aim of getting the application to look as much as possible like a native one. Users can brand Apollo with their own organization logo.

Apollo is proprietary software and it's only available in English. Translations into additional languages are planned : they will be community-driven and will be done through a web interface. An API and Google contextual gadger are planned as well. Apollo lacks Google Apps integration or Gantt charts.

Ans.(ii)ISO 9126 : ISO 9126 standard was published in 1991 to tackle the question of the definition of software quality. This 13 page document was designed as a foundation upon which further, more detailed standards could be built.

ISO 9126 identifies six software quality characteristics :

(i) *Functionality* : Which covers the functions that a software product provides to satisfy user needs;

(ii) *Reliability* : Which relates to the capability of the software to maintain its level of performance;

(iii) *Usability* : Which relates to the effort needs to use the software;

(iv) *Efficiency* : Which relates to the physical resources used when the software is executed;

(v) *Maintainability* : Which relates to the effort needed to the make change to the software;

(vi) *Portability* : Which relates to the ability of the software to be transferred to a different environment.

ISO 9126 suggestes sub-characteristics for each of the primary characteristics. It is perhaps indicative of the difficulties of gaining widespread agreement that these sub-characteristics are outside the main standard and are given in the document for information only. They are useful as they clarify what is meant by the main characteristics.

Characteristic	Sub-characteristics
Functionality	Suitability Accuracy Interoperability Compliance Security
Reliability	Maturity Fault tolerance Recoverability
Usability	Understandability Learnability Operability
Efficiency	Time behaviour Resource behaviour
Maintainability	Analysability Changeability Stability Testability
Portability	Adaptability Installability Conformance Replaceability

SOFTWARE PROJECT MANAGEMENT

Dec - 2017
Paper Code:-CSE-403-F

Note : Attempt five questions in all, selecting one question from each Section. Question No. 1 is compulsory. All questions carry equal marks.

Q.1. Explain the following : **(4×5=20)**

(a) Software Project
(b) Return on investment
(c) Dangle and loops in activity networks
(d) Leadership
(e) Product vs process quality.

Ans. (a) Software Project : Software project is the process of computer programming, documenting, testing, and bug fixing involved in creating and maintaining applications and frameworks resulting in a software product. Software development is a process of writing and maintaining the source code, but in a broader sense it includes all that is involved between the conception of the desired software through to the final manifestation of the software, sometimes in a planned and structured process. Therefore, software development may include research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products.

Characteristic : Following are the most important aspects of software project :

1. Collaboration : The project management software should facilitate the team collaboration. This means that the relevant stakeholders of the project should be able to access and update the project documents whenever they want to. Therefore, the project management software should have access control and authentication management in order to grand access levels to the project stakeholders.

2. Scheduling : Scheduling is one of the main features that should be provided by project management software. Usually, modern project management software provides the ability to draw Gantt charts when it comes to activity scheduling .In addition to this, activity dependencies can also be added to the schedules, so such software will show you the project critical path and later changes to the critical path automatically. Base lining is also a useful feature offered by project management software. Usually, a project is based lined when the requirements are finalized. When requirements are changed and new requirements are added to the project later, project management team can compare the new schedule with the baseline schedule automatically to understand the project scope and cost deviations.

3. Issue Tracking : During the project life cycle, there can be many issues related to project that needs constant tracking and monitoring. Software defects is one of the good examples for this. Therefore, the project management software should have features to track and monitor the issues reported by various stakeholders of the project.

4. Document Management : A project has many documents in use. Most of these documents should be accessible to the stakeholders of the project. Therefore, the project management software should have a document management facility with correct access control

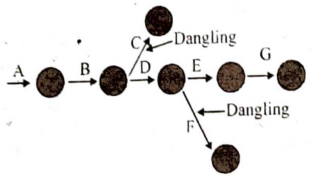
system. In addition to this; documents need to be versioned whenever they are updated. Therefore, the document management feature should support document versioning as well.

5. Resource Management : Resource management of the project is one of the key expectations from project management software. This includes both human resources and other types. The project management software should show the utilization of each resource throughout the entire project life cycle.

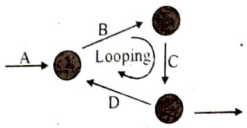
Ans.(b)Return on investment : The return on investment (ROI), also known as the accounting rate of return (ARR), provides a way of comparing the net profitability to the investment required. There are some variations on the formula used to calculate the return on investment but a straightforward common version is :

$$ROI = \frac{\text{average annual profit}}{\text{total investment}} \times 100$$

Ans.(c) Dangling : To cut off an activity prior to the completion of all activities in a network diagram is referred to as dangling. As reveal in the figure activities (5 - 10) and (6 - 7) are not the final activities in the network. So the diagram is incorrect and shows the error of dangling.



Looping or Cycling : Looping error is also called as cycling error in a network diagram. Making an endless loop in a network is called as error of looping as revealed in the following figure.



Ans.(d) Leadership : Leadership is generally taken to mean the ability to influence others in a group to act in a particular way in order to achieve group goals. A leader is not necessarily a good manager or vice versa, because managers have other roles to play, such as those of organizing, planning and controlling.

Authorities on this subject have found it very difficult to agree a list of the common ·tics of good leaders. It would, however, seem safe to say that they seem to have a ·ower and achievement and have more self-control and more self-confidence

Leadership is based on the idea of some kind of authority or power, although leaders do not necessarily have much formal authority. This power comes from either the person's position (position power) or from the person's individual qualities (personal poweor) or can be a mixture of the two. Position power has been further analysed into :

- **coercive power,** the ability to force someone to do something by threatening punishment;
- **connection power,** which is based on having access to those who have power;
- **legitimate power,** which is based on a person's title conferring a special status;
- **reward power,** where the holder can confer rewards on those who carry out tasks to their satisfaction.

Ans.(e) Product Vs Process quality : Difference between product quality and process quality are as follows :

Product quality	Process Quality
(i) Method are general purpose products.	(i) There are no methods, only process of method.
(ii) Proper(customized) use of methods will lead to uniform results.	(ii) These process influence the result using the method.
(iii) Product quality is focusing on meeting tolerances in the end result of the manu-facturing activities. The end result is measured on a standard of "good enough".	(iii) Process quality focuses on each activity and forces the activities to achieve maximum tolerances irrespective of the end result.

With a product based approach to planning and control, the focus on the product is convenient. It is often easier to measure the product qualities in a completed computer application rather than during its development. Trying to use the attributes of intermediate products created at earlier stages to predict the quality of the final application is difficult. An alternative approach is to scrutinize the quality of the processes used to develop software product.

Section – A

Q.2.(a) Explain in detail activities covered by software project management?(10)

Ans. Different activities covered by SPM are as follows :

(i) The feasibility study assesses whether a project is worth starting – that is has a valid business case. Information is gathered about the requirements of the proposed application. Requirements elicitation can, at least initially, be complex and difficult. The stakeholders may know the aims they wish to pursue, but not be sure about the means of achievement. The developmental and operational, and the value of the benefits of the new system, will also have to be estimated. With a large system, the feasibility study could be a project in its own right with its own plan. The study could be part of a strategic planning exercise examining a range of potential software developments. Sometimes an organization-assesses a programme of development made up of a number of projects.

(ii) Planning : It the feasibility study indicates that the prospective project appears viable, then project planning can start. For larger projects, we would not do all our detailed planning at the beginning. We create an outline plan for the whole project and detailed one for the

first stage. Because we will have more detailed and accurate project information after the earlier stages of the project have been completed, planning of the later stages is left to nearer their start.

(iii) Project execution: The project can now be executed. The execution of a project often contains design and implementation sub-phases. Students new to project planning often find that the boundary between design and planning can be hazy. Design is making decisions about the form of the products to be created. This could relate to the external apperance of the software, that is, the user interface, or the internal architecturre. The plan details the activities to be carried out to create these products. Planning and design can be confused because at the most detailed level, planning decisions are influenced by design decisions. Thus a software product with five major components is likely to require five sets of activities to create them.

Q.2.(b) What is Project and explain with its characteristics which make them different from each other projects ? **(10)**

Ans. Project : A project is a unique venture with specific start and end dates. This is different from an ongoing task that doesn't have an end date. Projects are run by people and often involve different parts of an organization. Constraints on project include cost, schedule, resources, and quality. There is a give and taken between these items *i.e.* you can't have it all. Usually projects are divisible into stages or phases each with their own set of priorities and goals.

Definitions : A project is a temporary activity characterized by having a start date, specific objectives and constraints, estabilised responsibilities, a budget and schedule, and a completion date.

OR

A project is a set of related tasks that are coordinated to achieve specific objectives in a given time limit.

OR

"A project is a series of activities or tasks that have a specific objective to be completed within certain specifications, have defined start and end dates, have funding limits (if applicable), and consume resources (*i.e.*, money, people, equipment)."

OR

James Lewis views a project "as a one-time job that has definite starting and end points, clearly defined objectives, scope and a budget ; differentiated from repetitive activities such as production, order processing and so on ; a special activity with very tactical goals."

Characteristics of a project : The various characteristics of a project are as follows :

(1) Projects have a purpose : Projects have clearly-defined aims and set out to produce clearly-defined results. Their purpose is to solve a "problem', and this involves analyzing needs beforehand. Suggesting one or more solutions, it aims at lasting social change.

(2) Projects are realistic : Their aims must be achievable, and this means taking account both of requirements and of the finanical and human resources available.

(3) Projects are limited in time and space : They have a beginning and an end, and are implemented in a specific place and context.

(4) Projects are complex : Projects call on various planning and implementation skills, and involve various partners and players.

(5) Projects are collective : Projects are the product of collective endeavour. They are run by teams, involve various partners and cater for the needs of others.

(6) Projects are unique : All projects stem from new ideas. They provide a specific response to a need (problem) in a specific context. They are innovative.

(7) Projects are an adventure : Every project is different and ground-breaking, they always involve some uncertainty and rise.

(8) Projects are made up of stage : Projects have distinct, identifiable stages.

(9) Projects can be assessed : Projects are planned and broken down into measurable aims, which must be open to evaluation.

Q.3. Explain stepwise : an overview of project planning ? **(20)**

Ans. Various steps of software project planning : Folloing are the various steps of software project planning :

Step 0 : Select project : This is called step 0 because in a way it is outside the main project planning process. Projects are not initiated out of thin air – some activity has to take place before deciding that this project rather than another is worth undertaking. This project evaluation may be done on an individual basis or as part of strategic planning.

Step 1 : Identify project scope and objectives : The activities in this step ensure that all the parties to the project agree on the objectives and are committed to the success of the project. A danger to be avoided is overlooking people who are affected by the project.

- Identify objectives and measures of effectiveness in meeting them
- Establish a project authority
- Identify all stakeholders in the project and their interests
- Modify objectives in the light of stakeholder analysis
- Establish methods of communications with all parties.

Step 2 : Identify project infrastructure : Projects are rarely initiated in a vacuum. There is usually some kind of existing infrastructure into which the project can fit. The project leader who does not already know about this structure needs to find out its precise nature.

- Establish relationship between project and strategic planning
- Identity installation standards and procedures
- Identity project team organization

Step 3 : Analysis project characteristics : The general purpose of this part of the planning operation is to ensure that the appropriate methods are used for the project.

- Distinguish the project as either objective-or product-driven
- Analyse other project characteristics
- Identify high level project risks
- Take into account user requirements concerning implementation
- Select general lifecycle approach
- Review overall resource estimates.

Step 4 : Identify project products and activities

- Identify and describe project products (or deliverables)
- Document generic product flows
- Recognize product instances
- Produce ideal activity network
- Modify ideal to take into account need for stages and checkpoints.

Step 5 : Estimate effort for each activity

- Carry out bottom-up estimates
- Revise plan to create controllable activities

Step 6 : Identify activity risks
- Identify and quantify activity-based risks
- Plan risk reduction and contingency measures where appropriate
- Adjust overall plans and estimates to take account of risks

Step 7 : Allocate resources
- Identify and allocate resources
- Revise plans and estimates to account for resource constraints

Step 8 : Review/publicize plan
- Review quality aspects of project plan
- Document plans and obtain agreement

Step 9 and 10: Execute plan and lower levels of planning : Once the project is under way, plans will need to be drawn up in greater detail for each activity as it becomes due. Detailed planning of the later stages will have to be delayed because more information will be available nearer the start of the stage. Of course, it is necessary to make provisional plans for the more distant tasks, because thinking about what has to be done can help unearth potential problems, but sight should not be lost of the fact that these plans are provisional.

Section – B

Q.4. Describe various phases of waterfall model. **(20)**

Ans. The *Waterfall Model* was first Process Model to be introduced. It is very simple to understand and use. In a *Waterfall* model, each phase must be completed before the next phase can begin and there is no overlapping in the phases. *Waterfall*model is the earliest *SDLC* approach that was used for software development.

In "*The Waterfall*" approach, the whole process of *software development* is divided into separate phases. The outcome of one phase acts as the input for the next phase sequentially. This means that any phase in the development process begins only if the previous phase is complete. The waterfall model is a sequential design process in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of *Conception, Initiation, Analysis, Design, Construction, Testing, Production/ Implementation and Maintenance.*

As the *Waterfall Model* illustrates the software development process in a linear sequential flow; hence it is also referred to as a *Linear-Sequential Life Cycle Model.*

Sequential Phases in Waterfall Model :

(i) Requirements: The first phase involves understanding what need to be design and what is its function, purpose etc. Here, the specifications of the input and output or the final product are studied and marked.

(ii) System Design: The requirement specifications from first phase are studied in this phase and system design is prepared. System Design helps in specifying hardware and system

requirements and also helps in defining overall system architecture. The software code to be written in the next stage is created now.

(iii) Implementation: With inputs from system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality which is referred to as Unit Testing.

(iv) Integration and Testing: All the units developed in the implementation phase are integrated into a system after testing of each unit. The software designed, needs to go through constant software testing to find out if there are any flaw or errors. Testing is done so that the client does not face any problem during the installation of the software.

(v) Deployment of System: Once the functional and non-functio nal testing is done, the product is deployed in the customer environment or released into the market.

(vi) Maintenance: This step occurs after installation, and involves making modifications to the system or an individual component to alter attributes or improve performance.These modifications arise either due to change requests initiated by the customer, or defects uncovered during live use of the system. Client is provided with regular maintenance and support for the developed software.

All these phases are cascaded to each other in which progress is seen as flowing steadily downwards (like a waterfall) through the phases. The next phase is started only after the defined set of goals are achieved for previous phase and it is signed off, so the name "Waterfall Model".

Advantages of Waterfall Model :

(i) The advantage of waterfall development is that it allows for departmentalization and control. A schedule can be set with deadlines for each stage of development and a product can proceed through the development process model phases one by one.

(ii) The waterfall model progresses through easily understandable and explainable phases and thus it is easy to use.

(iii) It is easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process.

(iv) In this model, phases are processed and completed one at a time and they do not overlap. Waterfall model works well for smaller projects where requirements are very well understood.

Disadvantages of Waterfall Model :

(i) It is difficult to estimate time and cost for each phase of the development process.

(ii) Once an application is in the testing stage, it is very difficult to go back and change something that was not well-thought out in the concept stage.

(iii) Not a good model for complex and object-oriented projects.

(iv) Not suitable for the projects where requirements are at a moderate to high risk of changing.

Q.5. Explain cost benefit evaluation technique and cash flow forecasting. (20)

Ans. Cost benefit analysis : Cost benefit analysis (CBA) is a technique for assessing the monetary social costs and benefits of a capital investment project over a given time period. The principles of cost-benefit analysis (CBA) are as follows :

– Appraisal of a project : It is an economic technique for project appraisal, widely used in business as well as government spending projects (for example should a business invest in a new information system)

– Incorporates externalities into the equation: It can, if required, include wider social/environmental impacts as well as 'private' economic costs and benefits so that externalities are incorporated into the decision process. In this way, CBA can be used to estimate the social welfare effects of an investment

– Time matters! CBA can take account of the economics of time – known as discounting. This is important when looking at environmental impacts of a project in the years ahead

Process : The following is a list of steps that comprise a generic cost–benefit analysis.

– List alternative projects/programs.
– List stakeholders.
– Select measurement(s) and measure all cost/benefit elements.
– Predict outcome of cost and benefits over relevant time period.
– Convert all costs and benefits into a common currency.
– Apply discount rate.
– Calculate net present value of project options.
– Perform sensitivity analysis.
– Adopt recommended choice.

Uses of CBA :

(i) CBA has traditionally been applied to big public sector projects such as new motorways, by-passes, dams, tunnels, bridges, flood relief schemes and new power stations.

(ii) The basic principles of CBA can be applied to many other projects or programmes. For example, - public health programmes (e.g. the mass immunization of children using new drugs), an investment in a new rail safety systems, or opening a new railway line.

(iii) Cost benefit analysis was also used during an inquiry into genetically modified foods.

(iv) Increasingly the principles of cost benefit analysis are being used to evaluate the returns from investment in environmental projects such as wind farms and the development of other sources of renewable energy, an area where the UK continues to lag behind.

(v) Because financial resources are scarce, CBA allows different projects to be ranked according to those that provide the highest expected net gains in social welfare - this is particularly important given the limitations of government spending.

Cash flow forecasting : A cash flow forecast will indicate when expenditure and income will take place. It is the forecasting of the cash flows that will take place and their timing.

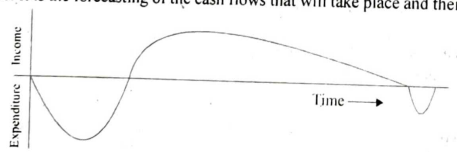


Fig. : Typical product life cycle cash flow

Accurate cash flow forecasting is not easy, as it is done early in the project's lifecycle. When estimating future cash flows, it is usual to ignore the effects of inflation. Forecast of inflation rate tends to be uncertain. Moreover, if expenditure is increased due to inflation it is likely that income will rise proportionately.

Section – C

Q.6. Write notes on the following : (20)

(a) What factors needed to be kept in mind while allocating resources.

(b) Scheduling resources

(c) Cost schedules.

Ans. (a) There are several factors that can affect resource allocation, whether you are in an agency-client situation or working on an in-house project. Here are five factors that can pose a challenge to resource allocation or lead to resources needing to be re-allocated :

1: Changes in Timeline or Project Scope : High-level executives and clients tend to want everything as soon as possible, even within an agreed-upon schedule timeline. And what's more, the scope of a project can shift as the client's needs change. For example, a small project may arise while your team is working on a bigger project for the same client, and the client would like the smaller project completed in three days. The project manager must find out who on staff may have time to work on the new project, and, if no one does, quickly find a contractor to do the job.

2: Resource Availability : Say your agency's gotten a request for a UX project, but your best UX designer is out on vacation for three weeks. The agency's only other full-time UX person is already working part-time on another important project. The project manager needs to decide if that person can handle the UX project in the time allotted, or if a contractor or another resource needs to be found. Another alternative might be that the staff UX person and a contractor could split the work. The project manager works with the head of UX to find out how to get the appropriate UX resource selected for and allocated to the project.

3: Project Dependencies : In most projects, there are stages of work that depend on other work being completed before they can begin. In a typical digital project, for instance, a group of developers might need to write code or a script for certain functionality before any creative or content work can be done.

"If the development slips," Kenning says, "then that will affect when the writers or UX people can start — and that timing change could affect who is available as well." Project managers need to be aware of these dependencies and how they might affect their projects so they can allocate resources for the right piece of the project.

4: Uncertain Timing of Deliverables : "Resource allocation is part science and part art," says Kimberley Kelly, an Atlanta-based marketing expert and principal at MasonKelly. "A lot of times, decisions need to be made to get a project off the ground, when the timing of certain deliverables isn't yet known," she notes.

For instance, let's say a six-month project has 60 copywriting hours assigned. The copywriter needs to attend the kickoff and other meetings to begin working on content strategy, but the website wireframes need to be built and content models created before the bulk of the copywriting can begin.

In some situations, a project manager might allocate five hours per week to a writer over 12 weeks, taking his best guess on when that writing might happen. In the early weeks of a project, the likelihood of that writer needing to create actual copy is probably fairly low. "It can be a balancing

act," Kenning says, because that writer may not get to dive in until later in the project, and then need to dedicate two 30-hour work weeks to be able to focus on and write the copy.

5. Urgency Compared with Other Projects : In many agencies, the most important clients and projects will often trump smaller requests (or at least push them back on the schedule). A smaller, quick-turn design ask is not likely to be something for which you would pull your lead designer off a months-long product launch project. The project manager and department heads need to weigh the urgency and importance of each project, and allocate resources accordingly. In the case of smaller projects with quick turnaround times, contractors can be a good solution.

Ans.(b) Scheduling resources : Each activity has been scheduled to start at its earliest start date – a sensible initial strategy, since we would, other things being equal, wish to save any float to allow for contingencies.

Changing the level of resources on a project over time, particularly personnel, generally adds to the cost of a project. Recruiting staff has costs and even where staff are transferred internally, time will be needed for familiarization with the new project environment.

An additional problem with an uneven resource histogram is that it is more likely to call for levels of resource beyond those available. Fig.(1) illustrates how, by adjusting the start date of some activities and splitting others, a resource histogram can, subject to constraints such as precedence requirements, be smoothed to contain resource demand at available levels. The different letters represent staff working on a series of module testing tasks, that is, one person working on task A, two on tasks B and C etc.

In Fig.(1), the original histogram was created by scheduling the activities at their earliest start dates. The resource histogram shows the typical peaked shape caused by earliest start date scheduling and calls for a total of nine staff where only five are available for the project.

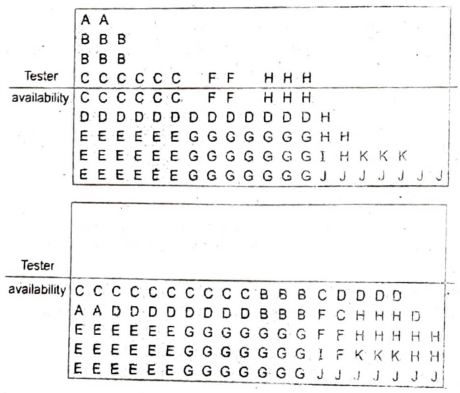


Fig.(1) : A resource histogram showing demand for staff before and after smoothing.

By delaying the start of some of the activities, it has been possible to smooth the histogram and reduce the maximum level of demand for the resource. Notice that some activities, such as C and D, have been split. Where non-critical activities can be split they can provide a useful way of filling troughs in the demand for a resource, but in software projects it is difficult to split tasks without increasing the time they take.

Some of the activities call for more than one unit of the resource at a time – activity F, for example, requires two programmers, each working for two weeks. It might be possible to reschedule this activity to use one programmer over four weeks although that has not been considered in this case.

In practice, resources have to be allocated to a project on an activity-by-activity basis and finding the 'best' allocation can be time consuming and difficult. As soon as a member of the project team is allocated to an activity that activity acquires a scheduled start and finish date and the team member becomes unavailable for other activities for that period. Thus, allocating a resource to one activity limits the flexibility for resource allocation and scheduling of other activities.

It is therefore helpful to prioritize activities so that resources can be allocated to competing activities in some rational order. The priority must always be to allocate resources to critical path activities and then to those activities that are most likely to affect others. In that way, lower priority activities are made to fit around the more critical, already scheduled activities.

Of the various ways of prioritizing activities, two are described below :

- **Total float priority :** Activities are ordered according to their total float, those with the smallest total float having the highest priority. In the simplest application of this method, activities are allocated resources in ascending order of total float. However, as scheduling proceeds, activities will be delayed (if resources are not available at their earliest start dates) and total floats will be reduced. It is therefore desirable to recalculate floats (and hence reorder the list) each time an activity is delayed.
- **Ordered list priority :** With this method, activities that can proceed at the same time are ordered according to a set of simple criteria. An example of this is Burman's priority list, which takes into account activity duration as well as total float :
  1. Shortest critical activity;
  2. Critical activities;
  3. Shortest non-critical activity;
  4. Non-critical activity with least float;
  5. Non- critical activities.

Unfortunately, resource smoothing, or even containment of resource demand to available levels, is not always possible within planned time-scales-deferring activities to smooth out resource peaks often puts project completion. Where that is the case, we need to consider ways of increasing the available resource levels or altering working methods.

Ans.(c)Cost schedules : A cost schedule is a schedule in which weekly or monthly costs over the life of the project are show. This will provide a more detailed and accurate estimate of costs and will serve as a plan against which project progress can be monitored.

Calculating cost is straightforward where the organization has standard cost figure for staff and other resources. Where this is not the case, then the project manager will have to calculate the costs.

In general, costs are catergorized as follows :

(i) *Staff costs* : There will include staff salaries as well as the other direct costs of employment such as the employer's contribution to social security funds, pension scheme contributions, holiday pay and sickness benefit. These are commonly charged to projects at hourly rates based on weekly work records completed by staff.

(ii) *Overheads* : Overheads represent expenditure that an organization incurs, which cannot be directly related to individual projects or jobs including space rental, interest charges and the costs of service departments (such as personnel). Overhead costs can be recovered by making a fixed charge on development departments (in which case they usually appear as a weekly or monthly charge for a project), or by an additional percentage charge on direct staff employment costs.

(iii) *Usage charges* : In some organizations projects are charged directly for use of resources such as computer time (rather than thier cost being recovered as an overhead). This will normally be on as 'as used' basis.

Q.7. Explain project control cycle and explain its whole framework. **(20)**

Ans. Creating the Framework : Exercising control over a project and ensuring that targets are met is a matter of regular monitoring, finding out what is happening, and comparing it with current targets. If there is mismatch between the planned outcomes and the actual ones then either replanning is needed to bring the project back on target or the target will have to be revised. Fig.(1) illustrates a model of the project control cycle and shows how, once the initial project plan has been published, project control is a continual process of monitoring progress against the plan and, where necessary, revising the plan to take account of deviations. It also illustrates the important steps that must be taken after completion of the project so that the experienced gained in any one project can feed into the planning stages of future projects, thus allowing us to learn from past mistakes.

In practice we are normally concerned with departures from the plan in four dimensions; delays in meeting target dates, shortfalls in quality, indaquate functionality, and costs going target.

Responsibility : The overall responsibility for enuring satisfactory progress on a project is often the role of the project steering committee or project Board. Day to day responsibility will rest with the project manager and, in all but the smallest of projects aspects of this can be delegated to team leaders.

Fig.(2) illustrates the typical reporting structure found with medium and large projects. With small projects (employing around half a dozen or fewer staff) individual team members usually report directly to the project manager, but in most cases team leaders will collate reports on their section's progress and forward summaries to the project manager. These, in turn, will be incorporated into project level reports for the steering committee and via them or directly, progress reports for the client.

Assessing progress : Process assessement with normally be made on the basis of information collected and collated at regular intervals or when events occur. Wherever possible, this information will be objective and tangible whether or not a particular report has been delivered, for example. However, such end of activity deliverables might not occur sufficiently frequency throughout the life of the project. Here progress assessement will have to rely on the judgement of the team members who are carrying out the project activities.

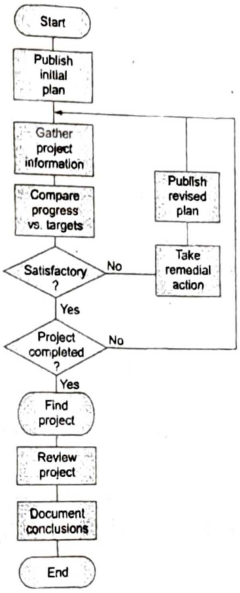


Fig.(1) : The project control cycle.

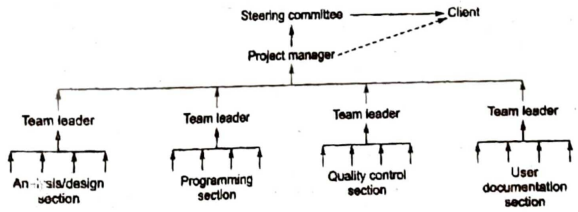


Fig.(2) : Project reporting structure.

Setting checkpoints : It is essential to set a series of checkpoints in the initial activity plan. Checkpoints may be

- Regular (monthley, for example)

• tied to specific events such as the production of a report or other deliverable.

Taking snap shots : The frequency with which the manager needs to receive information about progress will depend upon the size and degree of risk of the project or that of the project their control. Team leaders, for example, need to assess progress daily (particularly when employing inexperienced staff) whereas project managers may find weekly ; or monthly reporting appropriate. In general, the higher the level, the less frequent and less detailed the reporting needs to be.

There are however, strong arguments in favour of formal weekly collection of information from staff carrying out activities. Collecting data at the end of each week ensurs that information is provided while memories are still relativley fresh and provides a mechanism for individuals to review and reflect upon their progress during the past few days.

Major, or project level, progress reviews will generally take place at particular point during the life of a project commonly known as *review points* or *control points*. PRINCE2 for example, designates a series of check points where the status of work in a project or for a team is reviewed. At the end of each project stage, PRINCE 2 provides for an End Stage Assessement where an assessment of the project and consideration of its future are undertaken.

Section – D

Q.8. What is the place of software quality in project planning and write its importance ? **(20)**

Ans. The place of software quality in project planning : Quality will be of concern at all stages of project planning and execution, but will be of particular interest at the following points in the step wise framework [Fig.(1)].

- **Step 2 : Identify project infrastructure :** Within this step, activity 2.2 identifies installation standards and procedures. Some of these will almost certainly be about quality.
- **Step 3 : Analyse project characteristics :** In activity 3.2 ('Analyse other project characteristics–including quality based ones') the system to be implemented will be examined to see if it has any special quality requirements.

If, for example, it is extremely safety-critical then a whole range of additional activities can be added; these include such things as *n*-version development, where a number of teams develop versions of the same software that are then run in parallel with the outputs being cross-checked for discrepancies.

- **Step 4 : Identify the products and activities of the project** : It is at this point that the entry, exit and process requirements are identified for each activity.
- **Step 8 : Review and publicize plan :** At this stage, the overall quality aspects of the project plan are reviewed.

Importance : Importance of software quality are as follows :

(i) *Increasing criticality of software :* The final customer or user is naturally anxious about the general quality of software, especially its reliability. This is increasingly the case as organizations become more dependent on their computer systems and software is used more and more in areas which are safety critical, for example to control aircraft.

(ii) *The intangibility of software :* This makes it difficult to know whether a particular task in a project has been completed satisfactorily. The results of these tasks can be made tangible by demanding that the developers produce 'deliverables' that can be examined for quality.

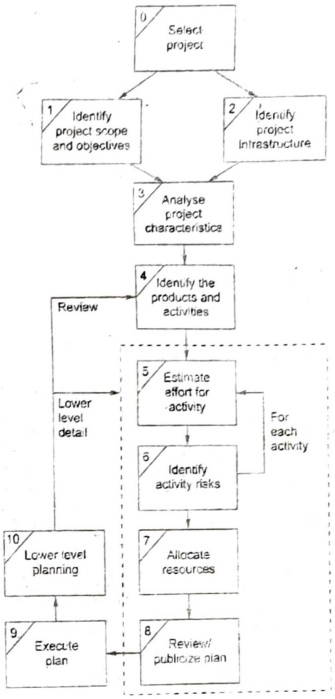


Fig.(1) : The place of software quality in step wise.

(iii) *Accumulating errors during software development :* As computer system development is made up a of a number of steps where the output from one step is the input to the next, the error in the earlier deliverables will be added to those in the later steps leading to an accumulating detrimental effect, and generaly, the later in a project that an error is found the more expensive it will be to fix. In additoin, because the number of errors in the system is unknown the debugging phases of a project are particularly difficult to control.

Q.9. Explain CMM (capability maturity models) and its level in details. **(20)**

Ans. SEI Capability Maturity Model : SEI Capability Maturity Model (SEI CMM) helped organizations to improve the quality of the software they develop and therefore adoption of SEI CMM model has significant business benefits.

SEI CMM can be used two ways: capability evaluation and software process assessment. Capability evaluation and software process assessment differ in motivation, objective, and the final use of the result. Capability evaluation provides a way to assess the software process capability of an organization. The results of capability evaluation indicates the likely contractor performance if the contractor is awarded a work. Therefore, the results of software process capability assessment can be used to select a contractor. On the other hand, software process assessment is used by an organization with the objective to improve its process capability. Thus, this type of assessment is for purely internal use.

SEI CMM classifies software development industries into the following five maturity levels. The different levels of SEI CMM have been designed so that it is easy for an organization to slowly build its quality system starting from scratch.

Level 1: Initial. A software development organization at this level is characterized by ad hoc activities. Very few or no processes are defined and followed. Since software production processes are not defined, different engineers follow their own process and as a result development efforts be. me chaotic. Therefore, it is also called chaotic level. The success of projects depends on individual efforts and heroics. When engineers leave, the successors have great difficulty in understanding the process followed and the work completed. Since formal project management practices are not followed, under time pressure short cuts are tried out leading to low quality.

Level 2: Repeatable. At this level, the basic project management practices such as tracking cost and schedule are established. Size and cost estimation techniques like function point analysis, COCOMO, etc. are used. The necessary process discipline is in place to repeat earlier success on projects with similar applications. Please remember that opportunity to repeat a process exists only when a company produces a family of products.

Level 3: Defined. At this level the processes for both management and development activities are defined and documented. There is a common organization-wide understanding of activities, roles, and responsibilities. The processes though defined, the process and product qualities are not measured. ISO 9000 aims at achieving this level.

Level 4: Managed. At this level, the focus is on software metrics. Two types of metrics are collected. Product metrics measure the characteristics of the product being developed, such as its size, reliability, time complexity, understandability, etc. Process metrics reflect the effectiver .s of the process being used, such as average defect correction time, productivity, average number of defects found per hour inspection, average number of failures detected during testing per LOC, etc. Quantitative quality goals are set for the products. The software process and product quality are measured and quantitative quality requirements for the product are met. Various tools like Pareto charts, fishbone diagrams, etc. are used to measure the product and process quality. The process metrics are used to check if a project performed satisfactorily. Thus, the results of process measurements are used to evaluate project performance rather than improve the process.

Level 5: Optimizing. At this stage, process and product metrics are collected. Process and product measurement data are analyzed for continuous process improvement. For example, if from an analysis of the process measurement results, it was found that the code reviews were not very effective and a large number of errors were detected only during the unit testing, then the process may be fine tuned to make the review more effective. Also, the lessons learned from specific projects are incorporated in to the process. Continuous process improvement is achieved both by carefully analyzing the quantitative feedback from the process measurements and also from application of innovative ideas and technologies. Such an organization identifies the best software engineering practices and innovations which may be tools, methods, or processes. These best practices are transferred throughout the organization.

SOFTWARE PROJECT MANAGEMENT

Dec. - 2019

Paper Code : CSE-403-F

Note : ***Attempt five questions in all, selecting one question from each Section. Question No. 1 is compulsory. All questions carry equal marks.***

Q.1.(a) Briefly describe Risk Profile Analysis.

Ans. Risk analysis is the assessing of probability and seriousness of each risk. Probability may be very low, low, moderate, high or very high. Risk effects might be catastrophic, serious, tolerable or insignificant.

Risk	Probability	Effect
-Organisational financial problems force reductions in the project budget.	Low	Catastrophic
-It is impossible to recruit staff with the skills required for the project.	High	Catastrophic
-Key staff are ill at critical times in the project.	Moderate	Serious
-Software components that should be reused contain defects which limit their functionality.	Moderate	Serious
-Changes to requirements that require major design rework are proposed.	Moderate	Serious
-The organization is restructured so that different management are responsible for the project.	High	Serious

Q.1.(b) What is software quality? What is the importance of software quality in software project management? **(5)**

Ans. Software quality : Software Quality is the conformance to explicit stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.

The above definition emphasize on these three important points :

– Software requirements are the foundation from which quality is measured. Lack of conformance to requirements is lack of quality.

– Specified standards define a set of development criteria that guide the manner in which software is engineered. If the criteria are not followed, lack of quality will almost surely in result.

– There is a set of implicit requirements that often goes unmentioned. If software conforms to its explicit requirements but fail to meet implicit requirements software quality is suspect.

Importance of software quality are as follows :

(i) *Increasing criticality of software :* The final customer or user is naturally anxious about the general quality of software, especially its reliability. This is increasingly the case as

organizations become more dependent on their computer systems and software is used more and more in areas which are safety critical, for example to control aircraft.

(ii) *The intangibility of software* : This makes it difficult to know whether a particular task in a project has been completed satisfactorily. The results of these tasks can be made tangible by demanding that the developers produce 'deliverables' that can be examined for quality.

(iii) *Accumulating errors during software development* : As computer system development is made up a of a number of steps where the output from one step is the input to the next, the error in the earlier deliverables will be added to those in the later steps leading to an accumulating detrimental effect, and generaly, the later in a project that an error is found the more expensive it will be to fix. In additoin, because the number of errors in the system is unknown the debugging phases of a project are particularly difficult to control.

Q.1.(c) What is risk? Name its categories. **(5)**

Ans. Risk : A risk is a potential future harm that may arise from some present action such as, a schedule slip or a cost overrun. Risk management is a series of steps whose objectives are to identify, address, and eliminate software risk items before they become either threats to successful software operation or a major source of expensive rework.

Its various categories are as follows :

(i) Risk Avoidance :
- Risk anticipation
- Risk tools

(ii) Risk detection :
- Risk analysis
- Risk prioritization

(iii) Risk control
- Risk pending
- Risk resolution
- Risk not solvable

(iv) Risk recovery
- Full
- Partial
- Extra/alternate feature

Q.1.(d) What is cost monitoring? Describe. **(5)**

Ans. Cost monitoring : Cost monitoring is an important component of project control. Not only in itself, but also because it provides an indication of the effort that has gone into a project. A project might be on time but only because more money has been spent on activities than originally budgeted. A cumulative expenditure chart such that as shown in fig. provides a simple method of comparing actual and planned expenditure. By itself it is not particularly meaningful. Fig. illustrate a project that is running late or one that is one time but has shown substantial cost saving.

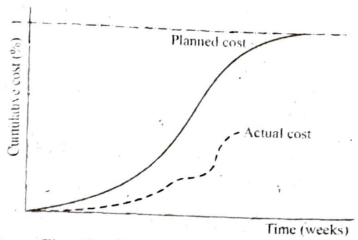


Fig. : Tracking cumulative expenditure

SECTION - A

Q.2. What is software project management? Why is it so important? Discuss the activities covered by SPM. **(20)**

Ans.Software project management is the art and science of planning and leading software projects. It is a sub-discipline of project management in which software projects are planned, implemented, monitored and controlled.

It is **important** because it affects nearly every aspect of our lives and has become pervasive in our commerce, our culture and our everyday activities software impact on our society and culture is significant. As software importance grows, the software community continually attempts to develop technologies that will make it easier, faster and less expensive to build high-quality computer programs.

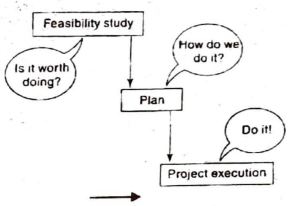


Fig. : The feasibility study/plan/execution cycle

Different activities covered by SPM are as follows :

(i) The feasibility study assesses whether a project is worth starting – that is has a valid business case. Information is gathered about the requirements of the proposed application. Requirements elicitation can, at least initially, be complex and difficult. The stakeholders may

know the aims they wish to pursue, but not be sure about the means of achievement. The developmental and operational, and the value of the benefits of the new system, will also have to be estimated. With a large system, the feasibility study could be a project in its own right with its own plan. The study could be part of a strategic planning exercise examining a range of potential software developments. Sometimes an organization-assesses a programme of development made up of a number of projects.

(ii) Planning : It the feasibility study indicates that the prospective project appears viable, then project planning can start. For larger projects, we would not do all our detailed planning at the beginning. We create an outline plan for the whole project and detailed one for the first stage. Because we will have more detailed and accurate project information after the earlier stages of the project have been completed, planning of the later stages is left to nearer their start.

(iii) Project execution: The project can now be executed. The execution of a project often contains design and implementation sub-phases. Students new to project planning often find that the boundary between design and planning can be hazy. Design is making decisions about the form of the products to be created. This could relate to the external apperance of the software, that is, the user interface, or the internal architecturre. The plan details the activities to be carried out to create these products. Planning and design can be confused because at the most detailed level, planning decisions are influenced by design decisions. Thus a software product with five major components is likely to require five sets of activities to create them.

Q.3.(a) Give an outline of stepwise planning activities. **(10)**

Ans. An outline of stepwise planning activities is as follows :

Step	Activities within step
0	Select project
1	Identify project scope and objectives.
	1.1 Identify objectives and measures of effectiveness in meeting them.
	1.2 Establish a project authority
	1.3 Identify all stakeholders in the project and their interest.
	1.4 Modify objectives in the light of stakeholder analysis
	1.5 Establish methods of communications with all parties
2.	Identify project infrastructure
	2.1 Establish relationship between project and strategic planning
	2.2 Identity installation standards and procedures
	2.3 Identity project team organization
3.	Analyse project characteristics
	3.1 Distinguish the project as either objective-or product-driven
	3.2 Analyse other project characteristics
	3.3 Identify high level project risks
	3.4 Take into account user requirements concerning implementation
	3.5 Select general lifecycle approach
	3.6 Review overall resource estimates.
4.	Identify project products and activities
	4.1 Identify and describe project products (or deleverables)
	4.2 Document generic product flows
	4.3 Recognize product instances
	4.4 Produce ideal activity network
	4.5 Modify ideal to take into account need for stages and checkpoints
5.	Estimate effort for each activity
	5.1 Carry out bottom-up estimates
	5.2 Revise plan to create controllable activities
6.	Identify activity risks
	6.1 Identify and quantify activity-based risks
	6.2 Plan risk reduction and contingency measure where appropriate
	6.3 Adjust plans and estimates to take account of risks
7.	Allocate resources
	7.1 Identify and allocate resources
	7.2 Revise plans and estimates to account for resource constraints
8.	Review/publicize plan
	8.1 Review quality aspects of project plan
	8.2 Document plans and obtain agreement
9.	Execute plan
10.	Lower levels of planning

Q.3.(b) Discuss in detail about project management characteristics & identifying activity risk. **(10)**

Ans. Characteristics of project management are as follows :

(i) Objectives oriented : Project management is focused on achieving specific project objectives with customer satisfaction. It is results-oriented.

(ii) Change oriented : Project management is a vehicle for planning and managing change in an organized manner. It adopts flexibility in doing things in a risky environment.

(iii) Single Responsibility Center : The project manager is the single responsibility center accountable for project outcomes. The role of project manager is crucial from inception to completion of the project. He is a project leader and champion. He motivates team members to excel.

(iv) Team-based : Project management consists of a multi-disciplinary project team with a wide range of skill and experiences.The team has project dedication.Each member has responsibility and accountability for a unit of work. Self-management is emphasized. So is member participation. The team membership is flexible and changes with project needs.

(v) Functional Coordination : Project management requires coordination along functional lines. The work flow is both vertical and horizontal in a matrix organization structure.

(vi) Planning and Control : Project management required integrated planning and control systems for continuous improvement.

(vii) Constraints : Project management achieves results within the constraints of time, cost and quality. It is a time and resources limited activity. It is focused on customer needs.

(viii) Body of Knowledge: Project management consists of a body of knowledge.

Identifying activity risk : Risk identification is an integrative process. The frequency of iteration and who participates in each cycle will vary from case to case. The project team should be involved in the process so that they can develop and maintain a sense of ownership of

and responsibility for, the risks and associated risk response actions. Stakeholders outside the project team may provide additional objective information. Especially important is the risk tolerance of the Stakeholders. This is invaluable information in Risk Planning.

The Risk Identification process usually leads to the Qualitative Risk Analysis process. Alternatively, it can lead directly to the Quantitative Risk Analysis process when conducted by an experienced risk manager. On some occasions, simply the identification of a risk may suggest its response, and these should be recorded for further analysis and implementation in the Risk Response Planning process.

SECTION - B

Q.4.(a) Explain the spiral model in detail. **(10)**

Ans. Spiral model : The spiral model is an evolutionary software model that couples the iterative nature of prototyping with the controlled and systematic aspects of the linear segmental model. The spiral model has four phases: Planning, Risk Analysis, Engineering and Evaluation. A software project repeatedly passes through these phases in iterations (called Spirals in this model). The baseline spiral, starting in the planning phase, requirements are gathered and risk is assessed. Each subsequent spirals builds on the baseline spiral. Requirements are gathered during the planning phase. In the risk analysis phase, a process is undertaken to identify risk and alternate solutions. A prototype is produced at the end of the risk analysis phase.

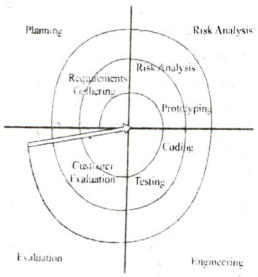


Fig. : Spiral Model

Software is produced in the engineering phase, along with testing at the end of the phase. The evaluation phase allows the customer to evaluate the output of the project to date before the project continues to the next spiral.

Advantages :

(i) High amount of risk analysis hence, avoidance of Risk is enhanced.
(ii) Good for large and mission-critical projects.
(iii) Strong approval and documentation control.
(iv) Additional Functionality can be added at a later date.
(v) Software is produced early in the software life cycle.

Disadvantages:

(i) Can be a costly model to use.
(ii) Risk analysis requires highly specific expertise.
(iii) Project's success is highly dependent on the risk analysis phase.
(iv) Doesn't work well for smaller projects.

Q.4.(b) Write a short note on cash flow forecasting. **(10)**

Ans.Cash flow forecasting : A cash flow forecast will indicate when expenditure and income will take place. It is the forecasting of the cash flows that will take place and their timing.

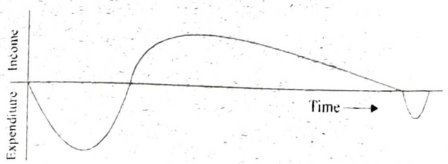


Fig. : Typical product life cycle cash flow

Accurate cash flow forecasting is not easy, as it is done early in the project's lifecycle. When estimating future cash flows, it is usual to ignore the effects of inflation. Forecast of inflation rate tends to be uncertain. Moreover, if expenditure is increased due to inflation it is likely that income will rise proportionately.

Q.5.(a) What is risk management? Discuss the tools and techniques used for risk identification. **(10)**

Ans. Risk Management : Risk is defined as an exposure to the chance of injury or loss. That is risk implies that there is a possibility that something negative may happen. In the context of software projects, negative implies that there is an adverse effect on cost, quality or schedule.

The objective of risk management is to avoid or minimize the adverse effects of unforeseen events by avoiding the risks or drawing up contingency plans for dealing with them.

Risk Identification : The first stage in any risk assessment exercise is to identify the hazards that might affect the duration or resource costs of the project. A hazard is an event that might occur and will, if it does occur, create a problem for the successful completion of the project. In identifying and analysing risks, we can usefully distinguish between the cause (or hazard), its immediate effect (the problem that it creates) and the risk that it will pose to the project.

Risk Management Activities : Risk management must not be allowed to become "shelfware". The process must be a part of regularly scheduled periodic product management. It requires identifying and managing risks routinely throughout all phases of the project's life.

The risk management process has several activities that are illustrated in Fig.(1).

Fig.(1) : Risk Management Activities.

All the above risk management activities are discussed below :

(1) Risk Assessment : Risk assessment activity include the following :

- Risk Identification
- Risk Analysis
- Risk Prioritization

All these activities are discussed below :

***Risk Identification* :** Risk identification is a systematic attempt to specify threats to the project plan. The purpose or risk identification is to develop a list of risk items called risk statement. Risk identification can be facilitated with the help of a checklist of common risk areas for software projects, or by examining the contents of an organizational database of previously identified risks and mitigation strategies (both successful and unsuccessful).

Risk identification is carried out as a team process using brainstorming. To assist the process a list of risk types can be used. The end product of this step of the process is a list of risks that could occur and affect the product, the process or the business.

Within the identification phase, several activities occur. The main activities are :

(1) *Identify risks* : There are many techniques to be used to identify risk. Some of these are check-lists, interviews, brainstorm meetings, reviews and surveys. A checklist to be used as a tool for identification of risks is provided.

(2) *Define risk attributes* : After the risks are identified, they are evaluated with the criteria : likelihood of occurrence (probability), consequence and time frame for action. These values are initial estimations which are analysed more in the next phase.

(3) *Document* : The risks are then documented. Together with the name of the risks, a risk statement and context are to be specified. In this initial phase the description of the risk issue, the probability and the consequence are specified in subjective terms.

(4) *Communicate* : Spreading the knowledge to the project members.

***Risk Analysis* :** When the risks have been identified, all items are alalyzed using different criteria. The purpose of the risk analysis is to assess the loss probability and magnitude of each risk item.

The input is the risk statement and context developed in the identification phase. The output of this phase is a risk list containing relative ranking of the risks and a further analysis of the description, probability, consequence and context. The main activities in this phase are :

(1) *Group similar risks* – Detect duplicates and find new risk items by grouping the identified risks into categories.

(2) *Determine risk drivers* – The risk drivers are parameters that effect the identified risk. For example, schedule drivers are included in the critical path model. Determining these properties help to assess and prioritize the risks.

(3) *Determine source of risks* – The sources of risks are the root causes of the risks. These are determined by asking the question why? and trying to figure out what may have caused the risk. Several root causes may lead to the same risk.

(4) *Estimate risk exposure* – The risk exposure is a measure of the probabilituy and the consequence of a risk item. The consequence can also be stated in terms of loss (for example life, money, property, reputation).

(5) *Evaluate against criteria* – Each risk item is evaluated using the predefined criteria. which are important for the specific project. Criteria may be stated in terms of the probability of occurrence, the consequence and the time frame. This information is used to prioritize the risks.

***Risk prioritization* :** Risk prioritization helps the project focus on its most severe risks by assessing the risk exposure. Exposure is the product of the probability of incurring a loss due to the risk and the potential magnitude of that loss.

This prioritization can be done in a quantitative way, by estimating the probability (0.1 – 1.0) and relative loss, on a scale of 1 to 10. Multiplying these factors together provide an estimation of the risk exposure due to each risk item, which can run from 0.1 (don't give it another thought) through 10 (stand back, here it comes!).

The higher the exposure, the more aggressively the risk should be tackled. It may be easier to simply estimate both probability and impact as High, Medium, or Low. Those items having at least one dimension rated as High are the ones to worry about first.

(2) Risk control : Risk control is the process of managing risks to achieve the desired outcomes. Risk control process involves the following activities :

- Risk planning
- Risk Mitigation
- Risk Resolution
- Risk Monitoring

***Risk Planning* :** Risk planning is to identify strategies to deal with risk. These strategies fall into three categories :

- Risk Avoidance
- Risk Minimization
- Risk Continguency plans

Risk planning strategies are discussed below :

Risk Avoidance : Risk avoidance is one way to deal with risk: don't do the risky thing! We may avoid risks by not undertaking certain projects, or by relying on proven rather than cutting edge technologies.

Risk avoidance attempts to reduce the probability of a risk. For example, user interface prototyping reduces the risk that users will find the interface unacceptable.

Risk Minimization : Risk minimization attempts to reduce the impact of a risk. For example, cross-training members of the development team reduces risks resulting from team members leaving the organization.

Risk Contingency Plans : Risk contingency plans preparations for dealing with a risk should it occur. For example identifying alternate sources of funding in case financial backers stop supporting the project or identifying organizations that may be interested in buying a software system in case the client organization involved in the development project backs out.

Risk Mitigation : The risk mitigation is a plan that would reduce or eliminate the highest risks. The key question is: What should be done and who is responsible to eliminate or minimize the risk?

The mitigation plan includes a description of the actions that can be taken to mitigate the red rated risk and assigns a primary handler for the action.

Risk Resolution : When a risk has occurred, it has to be solved. Risk resolution is the execution of the plans for dealing with each risk. If the risk is at the watch list, a plan of how to resolve the risk already had taken place. The project manager has to respond to the already chalked out plan of how to resolve the risk.

A project manager has to respond to the trigger and execute the action plan. The project manager also needs to report progress against the plan and correct for deviation.

The input to this phase is the risk action plan and the outputs are:

- Risk status
- Acceptable rists
- Reduced rework,
- Corrective action and
- Problem prevention.

Risk status is the progress of the risk management. Acceptable risks are the ones that are not to be solved. *Reduced rework* is a measure of the benefit of using risk management. This has to be calculated to determine whether the risk management works. *Corrective actions* are procedures that are known solutions if a problems occur and are generally accepted within the project or organization. *Problem prevention* occurs when trying to avoid problem and thereby eliminating their result.

Risk Monitoring : Risk monitoring is the continually reassessing of risks as the project proceeds and conditions change. For example, successful completion of beta testing means that the risk of the client organization rejecting the system is minimal, while large turnover in development staff usually increases project and product risks.

(3) Risk Reporting : Risk Reporting is reporting the status of the risks that were identified during risk identification and assessment stages.

All types of risks along with their status are reported properly as part of risk reporting activity. The entire information about risks is documented together with the full history of risks such as name of the risks, a risk statement, context, etc.

The risk management function should monitor and report its measures of risks to appropriate levels of senior management. Reports to other levels of senior management and the board may occur less frequently, but the frequency of reporting should provide these individuals with adequate information to judge the changing nature of the institution's risk profile.

To provide visibility of risks and progress in mitigating them, the following reports should be distributed on a regular basis as part of the normal project status reporting system:

Risk Watch List : Lists risks to facilitate monitoring risks and initiating risk responses.

Risk Mitigation Plan : Lists avoidance/mitigation actions, if and when risks occur.

Risk Profile : Displays planned, actual and projected progress in reducing risks.

Q.5.(b) Explain network planning model in detail. **(10)**

Ans. Network planning model : These project scheduling techniques model the project's activitites and thier relationships as a network. In the network, time flows from left to right. These techniques were originally developed in the 1950s – the two best known being CPM (Critical Path Method) and PERT(Program Evaluation Review Technique).

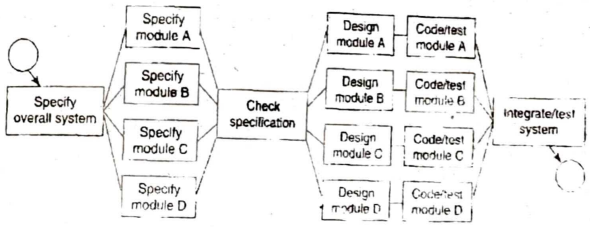


Fig. : Network Planning Model

Both of these techniques used an activity-on-arrow approach to visualizing the project as a network where activities are drawn as arrows joining circles, or nodes, which represent the possible start and/or completion of an activity or set of activities. More recently a variation on these techniques, called precedence networks, has become popular. This method uses activity-on-node networks where activities are represented as nodes and the links between nodes represent precedence (or sequencing) requirements. This latter approach avoids some of the problems inherent in the activity-on-arrow representation and provides more scope for easily representing certain situtations. It is this method that is adopted in the majority of computer applications currently available. These three methods are very similar and it must be admitted that many people use the same name (particularly CPM) indiscriminately to refer to any or all of the methods.

Fig. shows the fragment of a network that has developed as an activity-on-node network.

Merits :

- Provide very efficient "High-speed" retrieval.
- *Simplicity* : The network model is conceptually simple and easy design.
- Ability to handle more relationships types the network model can handle the one to many and many to many relationships.
- *Ease to Date Access* : In the network database terminology, a relationship is a set. Each set comprise of two types of records, - an owner record and member record. In a network model an application can access an owner and all the member records within a sit.
- *Data Integrity* : In a network model no member can exist without an owner.
- *Data Independence* : The network model draws a clear lines of demaroation between program and the complex physical storage details.

Demerits :

- *System Complexity* : In a network model data are accessed one record at a time.
- *Lack of Structural Independence* : Making structural modifications to the database is very difficult in the network database models as the data access method is navigational.

SECTION - C

Q.6.(c) Describe Resource Allocation. Also discuss the nature of resources and resource requirements in detail. **(10)**

Ans. Resource allocation : Resource allocation is a process and strategy involving a company deciding scarce resources should be used in the production of goods or services. A resource can be considered any factor of production, which is something used to product goods or services.

Resource allocation techniques : In an economist's perfect world resources are optimally allocated when they are used to produce goods and services that match consumer needs and wants at the lowest possible lost of product. Efficiency of product on means fewer resources are expended in producing goods and services.

(1) Strategic Planning : Resource allocation begins at strategic planning when a company formulates its vision and goals for the future the vision and strategic goals are accomplished through achievement of objectives.

(2) Budgeting : Once you have set your objective you will then need to allocate sufficient resource to accomplish it. In practical terms this is often a matter of project. Budgeting in our example the company will allocate money for market research to determine unmounts consumer need and wants for computer tablet many for product design and developments, funds for production.

(3) Resource Allocation Patterns : Resource management is a very important part of real time and embedded software design. This article discusses commonly used resource allocation patterns. The discussion is divided into two parts:

(i) Resources allocation algorithms.
(ii) Distributed resources allocation.

Resource Allocations :

(i) *Hottest first* : In hottest first resources allocation the resource last released is allocated on next resorce requrest. To implement this best in first out LIFO type of allocation. The list of tree resources is maintained as a stack.

(ii) *Coldest First* : In coldest first resources allocation the resource not allocated for maximize time is allocated to first implement this first is first out FIFO type of allocation the resources allocating entity keeps the tree resources in a queue.

(iii) *Load Balancing* : In situation involving multiple resource groups load balancing is used. A resource group is controlled by a local resource controllers. In this techniques the resource allocator first determines the highly loaded resource group.

(iv) *Future Resource Booking* : Here each resource allocation is for a specified time. The resource allocation is only valid till the specified time reached the resource is considered to be tree. Thus the resource does not need to be treed explicitly.

Nature of resources : A resource is any item of person required for the execution of the project. This covers many things - from paperclips to key personal - and it is unlikely that we would wish to itemize every resource required, let alone draw up a schedule for their use! Stationery and other standard office supplies, for example, need not normally he the concern of the project manager -ensurin there is always an adequate supply is the role of the office manager. The project manager must concentrate on those resources where there is a possibility that, without planning, they might not be sufficiently available when required.

Some resources, such as a project manager, will be required for the duration of the project whereas others, such as a specific software developer, might be required for a single activity. The former, while vital to the succcess of the project, does not require the same level of scheduling as the latter. Individual programmers, for example, might be committed to working on a number of projects and it will be important to book their time well in advance. In general, resources will fall into one of seven categories.

(i) Labour : The main iterms in this category will be members of the developments project team such as the project manager, systems analysts and software developers. Equally important will be the quality assurance team and other support staff and any employees of the client organization who might be required to undertake or participate in specific activities.

(ii) Equipment : Obvious items will include workstations and other computing and office equipment. We must not forget that staff also need basic equipment such as desks and chairs.

(iii) Materials : Materials are iterms that are consumed, rather than equipment that is used. They are of little consequence in most software project but can be important for some software that is to be widely distributed might, for example, require supplies of floppy disks to be specially obtained.

(iv) Space : For projects that are undertaken with exsiting staff. space is normally readily available. If any addtional staff(recruited or contracted) should be needed then office space will need to be found.

(v) Services : Some projects will require procurement of specialist services -development of a wide area distributed system, for example, requires scheduling of telecommunications serives.

(vi) Time : Time is resource that a being offset against the other primary resources project time scales can sometimes be reduced by increasing other resources and will almost certainly be extended if they are unexpectedly reduced.

(vii) Money : Money is a secondary resource - it is used to buy other resources and will be consumed as other resources are used. It is similar to other resources in that it is a available at a cost in this case interset charges.

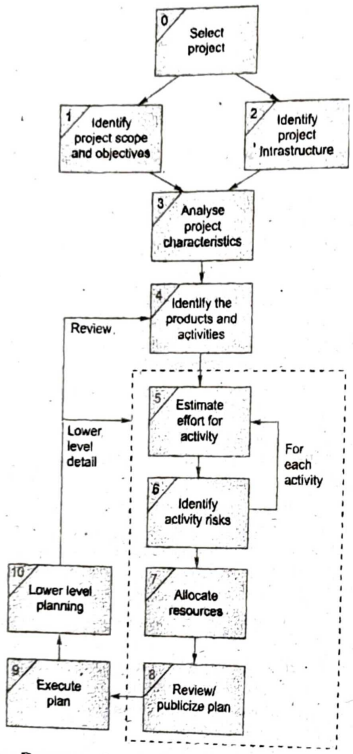


Fig. : Resource allocation is carried out as step 7.

Identifying Resource Requirements : The first step in producing a resource allocation plan is to list the resources that will be required along with the expected level of demand. This will normally be done by considering each activity in turn and identifying the resources required. It is likely, however, that there will also be resources required that are not activity specific but are part of the project's infrastructure (such as the project manager) or required to support other resources (office space, for example, might be required to house contract software developers).

At this stage, it is necessary that the resource requirements list be as comprehensive as possible - it is better that something is included that may later be deleted as unnecessary than to omit something essential.

Q.6.(b) What do you mean by prioritizing monitoring? What is its need? Explain. **(10)**

Ans. Prioritizing monitoring : Prioritizing monitoring is a significant part of project management. All project activities should be carefully monitored while the project is being accomplished. This helps project manager to keep informed of work progress, foresee possible problems and apply timely correctives. It is important that project monitoring is simple and not time-consuming. Project monitoring software may really help to simplify this process.

In this section we list the priorities we might apply in deciding levels of monitoring :

(i) *Critical path activities :* Any delay in an activity on the critical path will cause a delay in the completion date for the project. Critical path activities are therefore likely to have a very high priority for close monitoring.

(ii) *Activities with no free float :* A delay in any activity with no free float will delay at least some subsequent activities, even though, if the delay is less than the total float, it might not delay the project completion date. These subsequent delays can have serious effects on our resource schedule as a delay in a subsequent activity could mean that the resources for the activity will become unavailable before that activity is completed because they are committed elsewhere.

(iii) *Activities with less than a specified float :* If any activity has very little float, it might use up this float before the regular activity monitoring brings the problem to the project manager's attention.

(iv) *High risk activities :* A set of high risk activities should have been identified as part of the initial risk profiling exercise. These activities will be given close attention because they are most likely to overrun or overspend.

(v) *Activities using control risk :* Activities can be critical because they are very expensive. Staff or other resources might be available only for a limited period especially if they are controlled outside the project team. In any event, an activity that demands a critical resource requires a high level of monitoring.

Q.7.(a) What is contract? Explain types of contracts. Discuss the stages of contract placement in detail. **(10)**

Ans. Contract : Contract is a voluntary, deliberate, and legally binding agreement between two or more competent parties. Contracts are usually written but may be spoken or implied, and generally have to do with employment, sale or lease, or tenancy.

A contractual relationship is evidenced by (1) an offer, (2) acceptance of the offer, and a (3) valid (legal and valuable) consideration. Each party to a contract acquires rights and duties relative to the rights and duties of the other parties. However, while all parties may expect a fair benefit from the contract (otherwise courts may set it aside as inequitable) it does not follow that each party will benefit to an equal extent. Existence of contractual-relationship does not necessarily mean the contract is enforceable, or that it is not void (see void contract) or voidable (see voidable Contract). Contracts are normally enforceable whether or not in a written form, although a written contract protects all parties to it. Some contracts, (such as for sale of real property, installment plans, or insurance policies) must be in writing to be legally binding and enforceable. Other contracts (see implied in fact

contract and implied in law contract) are assumed in, and enforced by, law whether or not the involved parties desired to enter into a contract.

Types of contract : The external resources required could be in the form of services. A simple example of this could be using temporary staff on short term contracts to carry out some project tasks.

A more far-reaching use of external services would be for the contractor not only to supply the new system but to also operate it on the customer's behalf.

On the other hand, the contract could be placed for the supply of a *completed software application*.

This could be :

(i) a *bespoke* system, that is, a system that is created from scratch specifically for one customer;

(ii) *off-the-shelf*, which you buy 'as is' – this is sometimes referred to as *shrink-wrapped* software;

(iii) *customized off-the shelf*(COTS) software – this is a basic core system, which is modified to meet the needs of a particular customer.

Where equipment is being supplied then, in English law, this may be regarded as a contract for the supply of goods. In the case of the supply of software this may be regarded as supplying a service(to write the software) or the granting of a licence(or permission) to use the software, which remains in the ownership of the supplier. These distinctions will have legal implications.

Another way of classifying contracts is by the way that the payment to suppliers is calculated. We will look at :

(a) fixed price contracts;

(b) time and materials contracts;

(c) fixed price per delivered unit contracts.

Fixed price contracts : As the name implies, in this situation a price is fixed when the contract is signed. The customer knows that, if there are no changes in the contract terms, this is the price to be paid on the completion of the work. In order for this to be effective, the customer's requirement has to be known and fixed at the outset. In other words, when the contract is to construct a software system, the detailed requirements analysis must already have been carried out. Once the development is under way, the customer will not be able to change their requirements without renegotiating the price of the contract.

Time and material contracts : With this type of contract, the customer is charged at a fixed rate per unit of effort, for example, per staff-hour. At the start of the project, the supplier normally provides an estimate of the overall cost based on their current understanding of the customer's requirements, but this is not the basis for the final payment.

Fixed price per unit delivered contracts : This is oftern associated with function point(FP) counting. The size of the system to be delivered is calculated or estimated at the outset of the project. The size of the system to be delivered might be estimated in lines of code, but FPs can be more easily and reliably derived requirements documents. A price per unit is also quoted. The final price is then the unit price multiplied by the number of units.

Various **Stages in Contract** are as follows :

(i) Requirements analysis : The requirements document might typically have sections with the heading shown in Table.

Table : Main sections in a requirements document

(i)	Introduction
(ii)	A description of any existing systems and the current environment
(iii)	The customer's future strategy or plans
(iv)	System requirements – mandotory – desirable
(v)	Deadlines
(vi)	Additional information required from potential suppliers

The requirements define carefully the functions of the new application and all the necessary inputs and outputs for these functions. They also state any standards that apply, and the existing systems with which the new' system should be compatible. There will also need to be operational and quality requirements, concerning such matters as the required response times, reliability, usability and maintainability of the new system.

(ii) Evaluation plan : Having drawn up a list of requirements, we need a plan of how the proposals are to be evaluated. The situation will be different if the contract is for a system that is to be specially written rather than an off-the-shelf package. In the latter case, it is the application itself that is being evaluated while in the former situation it is proposal for an application.

Ways of checking that the mandatory requirements are met need to be identified. The next consideration is how the desirable requirements can be evaluated.

(iii) Invitation to tender : Having produced the requirements and the evaluation plan, it is now possible to issue the invitation to tender to prospective suppliers. Essentially, this will be the requirement document with a supporting letter containing information about how responses to the invitation are to be lodged. A deadline will be specified and it is hoped that by then a number of proposals with price quotations will have been received.

(iv) Evaluation of Proposals : The process of evaluation may include :

– Scrutiny of the proposal documents;
– interviewing supplier's representatives;
– demonstrations;
– site visits;
– practical tests.

Q.7.(b) Explain cost schedule in detail. **(10)**

Ans. Cost scheduling : A cost schedule is a schedule in which weekly or monthly costs over the life of the project are show. This will provide a more detailed and accurate estimate of costs and will serve as a plan against which project progress can be monitored.

Calculating cost is straightforward where the organization has standard cost figure for staff and other resources. Where this is not the case, then the project manager will have to calculate the costs.

In general, costs are catergorized as follows :

(i) *Staff costs* : There will include staff salaries as well as the other direct costs of employment such as the employer's contribution to social security funds, pension scheme contributions, holiday pay and sickness benefit. These are commonly charged to projects at hourly rates based on weekly work records completed by staff.

(ii) *Overheads* : Overheads represent expenditure that an organization incurs, which cannot be directly related to individual projects or jobs including space rental, interest charges and the costs of service departments (such as personnel). Overhead costs can be recovered by making a fixed charge on development departments (in which case they usually appear as a weekly or monthly charge for a project), or by an additional percentage charge on direct staff employment costs.

(iii) *Usage charges* : In some organizations projects are charged directly for use of resources such as computer time (rather than thier cost being recovered as an overhead). This will normally be on as 'as used' basis.

SECTION - D

Q.8. Explain in detail various techniques to enhance software quality. (20)

Ans. Techniques for **enhancing the quality of software project** are as follows :

– Increasing visibility : Weinberg encouraged the simple practice of software programmers looking at each other's code.

– Procedural structure : Every process in the software development cycle has carefully laid down steps.

– Checking intermediate stages : Emphasis on checking the correctness of work at its earlier conceptual stages.

– Inspection : The principle of inspection can be extended to any document that is produced at any stage in the development process. When a piece of work is completed, copies of the work are distributed to co-workers who then spend some time going through the work noting any defects.

– Formal methods : It uses techniques that are unambiguous, mathematically based and specification language. They are used to define pre and post conditions for each procedure. Pre-conditions define the allowable states before processing of the various items of data that a procedure is to work upon. Post conditions define the state of those data items after the procedure has been executed.

– Software quality circles : A quality circle is a group of four to ten volunteers working in the same area to identify, analyse and solve their work related problems.

– The GQM approach : A number of metrics will need to be identified as needing collection in order to answer the question.

Q.9. Explain the following : (20)

(a) ISO 9126 for software quality

(b) Project 2000

Ans. (a) ISO 9126 for software quality : ISO 9126 standard was published in 1991 to tackle the question of the definition of software quality. This 13 page document was designed as a foundation upon which further, more detailed standards could be built.

ISO 9126 identifies six software quality characteristics :

(i) *Functionality* : Which covers the functions that a software product provides to satisfy user needs;

(ii) *Reliability* : Which relates to the capability of the software to maintain its level of performance;

(iii) *Usability* : Which relates to the effort needs to use the software;

(iv) *Efficiency* : Which relates to the physical resources used when the software is executed;

(v) *Maintainability* : Which relates to the effort needed to the make change to the software;

(vi) *Portability* : Which relates to the ability of the software to be transferred to a different environment.

ISO 9126 suggestes sub-characteristics for each of the primary characteristics. It is perhaps indicative of the difficulties of gaining widespread agreement that these sub-characteristics are outside the main standard and are given in the document for information only. They are useful as they clarify what is meant by the main characteristics.

Characteristic	Sub-characteristics
Functionality	Suitability Accuracy Interoperability Compliance Security
Reliability	Maturity Fault tolerance Recoverability
Usability	Understandability Learnability Operability
Efficiency	Time behaviour Resource behaviour
Maintainability	Analysability Changeability Stability Testability
Portability	Adaptability Installability Conformance Replaceability

Ans.(b) Project : A project is a temporary activity characterized by having a start date, specific objectives and constrains, established responsibilities, a budget and schedule, and a completion date.

OR

A project is a set of related tasks that are coordinated to achieve specific objectives in a given time limit.

OR

"A project is a series of activities or tasks that have a specific objective to be completed within the certain specifications, have defined start and end dates, have funding limits(if applicable), and consume resources(i.e., money, people, equipment)." – Harold Kerner

OR

Characteristics of a Project :

The various characteristics of a project are as follows :

1. Projects have a purpose : Project have clearly-defined aims and set out to produce clearly-defined results. Their purpose is to solve a "problem", and this involves analyzing needs beforehand. Suggesting one or more solutions, it aims at lasting social change.

2. Projects are realistic: Their aims must be achievable, and this means taking account both of requirements and of the financial and human resources available.

3. Projects are limited in time and space : They have a beginning and an end, and are implemented in a specific place and context.

4. Projects are complx : Projects call on various planning and implementation skills, and involve various partners and players.

5. Projects are collective : Projects are the product of collective endeavour. They are run by teams, involve various partners and cater for the needs of others.

6. Projects are unique : All projects stem from new ideas. They provide a specific response to a need(problem) in a specific contex. They are innovative.

7. Projcets are an adventure : Every project is different and ground-breaking, they always involve some uncertainty and rise.

8. Projects are made up of stages : Projects have distinct, identifiable stages.

9. Projects can be assessed : Projects are planned and broken down into measurable aims, which must be open to evaluation.

SOFTWARE PROJECT MANAGEMENT

Feb - 2022

Paper Code:-PEC-CSE-403-G/PEC-IT-407-G

Note : Attempt five questions in all, selecting one question from each Section. Question No. 1 is compulsory. All questions carry equal marks.

Q.1.(a) Explain V-process Model. **(2.5)**

Ans. V-Process model : V- model means Verification and Validation model. The V-Shaped life cycle is a sequential path of execution of processes. Each phase must be completed before the next phase begins. Testing of the product is planned in parallel with a corresponding phase of development.

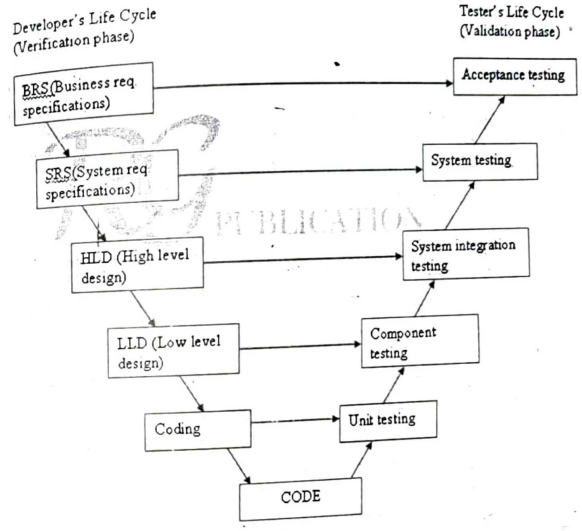


Fig. : V-Process Model

Q.1.(b) Risk management in software development. **(2.5)**

Ans. Risk management is an essential component of project planning. Risk management in software engineering entails identifying and estimating the likelihood of risks in order of their impact on the project.

Software development is a high-level activity that employs a wide range of technological advancements. Every software development project contains elements of uncertainty due to these and other factors. The amount of risk associated with each project activity determines the success of a software development project. It is not enough to simply be aware of the dangers. To achieve success, project management must identify, assess, prioritize, and manage all major risks.

The objective of risk management is to avoid or minimize the adverse effects of unforeseen events by avoiding the risks or drawing up contingency plans for dealing with them.

Principle of Risk Management :

(i) *Global Perspective*: In this, we review the bigger system description, design, and implementation. We look at the chance and the impact the risk is going to have.

(ii) *Take a forward-looking view*: Consider the threat which may appear in the future and create future plans for directing the next events.

(iii) *Open Communication*: This is to allow the free flow of communications between the client and the team members so that they have certainty about the risks.

(iv) *Integrated management*: In this method risk management is made an integral part of project management.

(v) *Continuous process*: In this phase, the risks are tracked continuously throughout the risk management paradigm.

Q.1.(c) What is Resource allocaiton ? (2.5)

Ans. Resource allocation is the process of assigning and managing assets in a manner that supports an organization's strategic planning goals.

Resource allocation includes managing tangible assets such as hardware to make the best use of softer assets such as human capital. Resource allocation involves balancing competing needs and priorities, and determining the best course of action to maximize the use of limited resources and get the best return on investment.

In practicing resource allocation, organizations must first establish their desired goal, such as increased revenue, improved productivity or better brand recognition. They then must assess what resources will be needed to reach that goal.

Q.1.(d) Discuss cost management. (2.5)

Ans. Cost management is the process of planning and controlling the costs associated with running a business. It includes collecting, analyzing and reporting cost information to more effectively budget, forecast and monitor costs. Cost management practices can be applied to specific projects or to the company's overall operating model. Cost management typically focuses on generating savings and maximizing profits in the longer term.

Q.1.(e) Who is software project manager ? (2.5)

Ans. A software project manager is the most important person inside a team who takes the overall responsibilities to manage the software projects and play an important role in the successful completion of the projects. A project manager has to face many difficult situations to accomplish these works. In fact, the job responsibilities of a project manager range from invisible activities like building up team morale to highly visible customer presentations. Most of the managers take responsibility for writing the project proposal, project cost estimation, scheduling, project staffing, software process tailoring, project monitoring and control, software configuration management, risk management, managerial report writing and presentation and interfacing with clients.

Q.1.(f) Who is stake holder ? (2.5)

Ans. These are people who have a stake or interest in the project. It is important that they be identified as early as possible, because you need to set up adequate communication channels with them right from the start. The project leader also has in be aware that not everybody who is involved with a project has the same motivation and objectives. The end users might, for instance, be concerned about the ease of use of the system while their managers might be interested in the staff savings the new system will allow.

Possible stakeholders in a sofware project might be internal to the project team, external in the project team but in the same organization, or totally external to the organization.

Unit–I

Q.2. Whatis software project ? Explain various types of software projects. (15)

Ans. Software Project : Software project is the process of computer programming, documenting, testing, and bug fixing involved in creating and maintaining applications and frameworks resulting in a software product. Software development is a process of writing and maintaining the source code, but in a broader sense it includes all that is involved between the conception of the desired software through to the final manifestation of the software, sometimes in a planned and structured process. Therefore, software development may include research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products.

Various **types of software projects** are as follows :

(i) Desktop project management software gives individual users the most responsive and highly-graphical interface. Desktop applications normally store their data in a local file, although some allow collaboration between users or store their data in a central database. A simple file-based project plan can be shared between users if it is stored on a networked drive, and only one user accesses it at any given time.

(ii) Web-based project management software can be accessed through an intranet or extranet using a web browser and has all the usual advantages and disadvantages of web applications:

- Can be accessed from any type of computer without installing software
- Ease of access-control
- Provides multi-user facilities
- Only one software version and installation needs to be maintained
- Typically slower to respond than desktop applications
- Limited graphical capability compared to desktop applications
- Project information is not available offline.

(iii) Single-user project management systems work on the basis that only one person will need to edit the project plan at any time. This may be used in small organisations, or only a few people are involved in project planning. Desktop applications usually come into this category.

(iv) Collaborative project management systems are designed to support multiple users modifying different sections of the plan at once, ex. updating the areas they are personally responsible for so that those estimates get integrated into the overall plan. Web-based tools often fall into this category, but they can only be used when the user is online. Some client-server-based software tools replicate project and task information through a central server when users connect to the network.

(v) Integrated systems combine project management or project planning, with many other aspects of company operations, ex. bug tracking issues can be assigned to each project, the list of project customers becomes a customer relationship management module, and each person on the project plan has their own task lists, calendars, messaging associated with their projects.

Q.3. Explain the stepwise project planning of software project manager during software development. **(15)**

Ans. Various steps of software project planning : Folloing are the various steps of software project planning :

Step 0 : Select project : This is called step 0 because in a way it is outside the main project planning process. Projects are not initiated out of thin air – some activity has to take place before deciding that this project rather than another is worth undertaking. This project evaluation may be done on an individual basis or as part of strategic planning.

Step 1 : Identify project scope and objectives : The activities in this step ensure that all the parties to the project agree on the objectives and are committed to the success of the project. A danger to be avoided is overlooking people who are affected by the project.

- Identify objectives and measures of effectiveness in meeting them
- Establish a project authority
- Identify all stakeholders in the project and their interests
- Modify objectives in the light of stakeholder analysis
- Establish methods of communications with all parties.

Step 2 : Identify project infrastructure : Projects are rarely initiated in a vacuum. There is usually some kind of existing infrastructure into which the project can fit. The project leader who does not already know about this structure needs to find out its precise nature.

- Establish relationship between project and strategic planning
- Identity installation standards and procedures
- Identity project team organization

Step 3 : Analysis project characteristics : The general purpose of this part of the planning operation is to ensure that the appropriate methods are used for the project.

- Distinguish the project as either objective-or product-driven
- Analyse other project characteristics
- Identify high level project risks
- Take into account user requirements concerning implementation
- Select general lifecycle approach
- Review overall resource estimates.

Step 4 : Identify project products and activities

- Identify and describe project products (or deliverables)
- Document generic product flows
- Recognize product instances
- Produce ideal activity network
- Modify ideal to take into account need for stages and checkpoints.

Step 5 : Estimate effort for each activity

- Carry out bottom-up estimates
- Revise plan to create controllable activities

Step 6 : Identify activity risks

- Identify and quantify activity-based risks
- Plan risk reduction and contingency measures where appropriate
- Adjust overall plans and estimates to take account of risks

Step 7 : Allocate resources

- Identify and allocate resources
- Revise plans and estimates to account for resource constraints

Step 8 : Review/publicize plan

- Review quality aspects of project plan
- Document plans and obtain agreement

Step 9 and 10: Execute plan and lower levels of planning : Once the project is under way, plans will need to be drawn up in greater detail for each activity as it becomes due. Detailed planning of the later stages will have to be delayed because more information will be available nearer the start of the stage. Of course, it is necessary to make provisional plans for the more distant tasks, because thinking about what has to be done can help unearth potential problems, but sight should not be lost of the fact that these plans are provisional.

Unit – II

Q.4. What is cost benefit analyss ? Explain the cost benefit evaluation techniques in detail. **(15)**

Ans. Cost–benefit analysis (CBA), sometimes called **benefit–cost analysis (BCA),** is a systematic approach to estimating the strengths and weaknesses of alternatives (for example in transactions, activities, functional business requirements); it is used to determine options that provide the best approach to achieve benefits while preserving savings. The CBA is also defined as a systematic process for calculating and comparing benefits and costs of a decision, policy (with particular regard to government policy) or (in general) project.

Broadly, CBA has two main purposes :

1. To determine if an investment/decision is sound (justification/feasibility) – verifying whether its benefits outweigh the costs, and by how much;

2. To provide a basis for comparing projects – which involves comparing the total expected cost of each option against its total expected benefits.

Cost-benefit evaluation techniques : Following are the main cost benefit evaluation techniques :

(1) Net profit : The net profit of a project is the difference between the total costs and the total income over the life of the project.

(2) Payback period : The payback period is the time taken to break even or pay back the initial investment. Normally, the project with the shortest payback period will be chosen on the basis that an organization will wish to minimize the time that a project is 'in debt'.

The advantage of the payback period is that it is simple to calculate and is not particularly sensitive to small forecasting errors. Its disadvantage as a selection techniuque is that it ignores the overall profitability of the project-in fact, it totally ignores any income (or expenditure) once the project has broken even.

(3) Return on investment : The return on investment (ROI), also known as the accounting rate of return (ARR), provides a way of comparing the net profitability to the investment required. There are some variations on the formula used to calculate the return on investment but a straightforward common version is

$$\text{ROI} = \frac{\text{average annual profit}}{\text{total investment}} \times 100$$

The return on investment provides a simple, easy to calculate measure of return on capital and is therefore quite popular. Unfortunately it suffers from two severe disadvantages. Like the net profitability, it takes no account of the timing of the cash flows. More importantly, it is tempting to compare the rate of return with current interest rates. However, this rate of return bears no relationship to the interest rates offered or charged by banks (or any other normal interest rate) since it takes no account of the timing of the cash flows or of the compounding of interest. It is therefore, potentially, very misleading.

(4) Net present value : The calculation of net present value is a project evaluation technique that lakes into account the profitability of a project and the timing of the cash flows that are produced. It does so by discounting future cash flows by a percentage known as the discount rate.

Q.5. What is risk ? Discuss the various risk in projects ? How tthe risk management plans are derived and implemented ? **(15)**

Ans. Risk : Risk in a project is a measure of the inability to achieve objectives within cost, schedule, and constraints.

Risk can be categorized as follows :

(1) *Project risks* : risk that threaten the project (or the project schedule)

(2) *Product risks* : risk that threaten the quality of the software developed.

(3) *Business risks* : risk that threaten the development (or client) organization.

Risk Management Activities : Risk management must not be allowed to become "shelfware". The process must be a part of regularly scheduled periodic product management. It requires identifying and managing risks routinely throughout all phases of the project's life.

The risk management process has several activities that are illustrated in Fig.(1).

All the above risk management activities are discussed below :

(1) Risk Assessment : Risk assessment activity include the following :

- Risk Identification
- Risk Analysis
- Risk Prioritization

All these activities are discussed below :

***Risk Identification* :** Risk identification is a systematic attempt to specify threats to the project plan. The purpose or risk identification is to develop a list of risk items called risk statement. Risk identification can be facilitated with the help of a checklist of common risk areas for software projects, or by examining the contents of an organizational database of previously identified risks and mitigation strategies (both successful and unsuccessful).

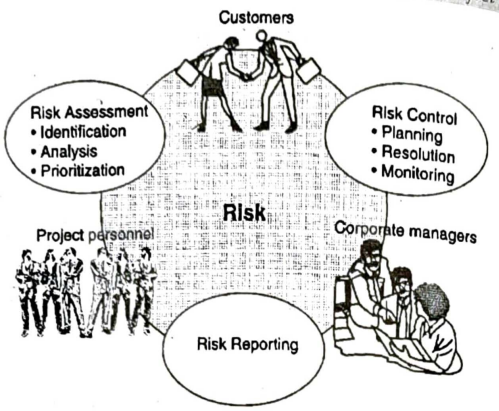


Fig.(1) : Risk Management Activities.

Risk identification is carried out as a team process using brainstorming. To assist the process a list of risk types can be used. The end product of this step of the process is a list of risks that could occur and affect the product, the process or the business.

Within the identification phase, several activities occur. The main activities are :

(1) *Identify risks* : There are many techniques to be used to identify risk. Some of these are check-lists, interviews, brainstorm meetings, reviews and surveys. A checklist to be used as a tool for identification of risks is provided.

(2) *Define risk attributes* : After the risks are identified, they are evaluated with the criteria : likelihood of occurrence (probability), consequence and time frame for action. These values are initial estimations which are analysed more in the next phase.

(3) *Document* : The risks are then documented. Together with the name of the risks, a risk statement and context are to be specified. In this initial phase the description of the risk issue, the probability and the consequence are specified in subjective terms.

(4) *Communicate* : Spreading the knowledge to the project members.

Risk Analysis **:** When the risks have been identified, all items are alalyzed using different criteria. The purpose of the risk analysis is to assess the loss probability and magnitude of each risk item.

The input is the risk statement and context developed in the identification phase. The output of this phase is a risk list containing relative ranking of the risks and a further analysis of the description, probability, consequence and context. The main activities in this phase are :

(1) *Group similar risks* – Detect duplicates and find new risk items by grouping the identified risks into categories.

(2) *Determine risk drivers* – The risk drivers are parameters that effect the identified risk. For example, schedule drivers are included in the critical path model. Determining these properties help to assess and prioritize the risks.

(3) *Determine source of risks* – The sources of risks are the root causes of the risks. These are determined by asking the question why? and trying to figure out what may have caused the risk. Several root causes may lead to the same risk.

(4) *Estimate risk exposure* – The risk exposure is a measure of the probabilituy and the consequence of a risk item. The consequence can also be stated in terms of loss (for example life, money, property, reputation).

(5) *Evaluate against criteria* – Each risk item is evaluated using the predefined criteria, which are important for the specific project. Criteria may be stated in terms of the probability of occurrence, the consequence and the time frame. This information is used to prioritize the risks.

Risk prioritization **:** Risk prioritization helps the project focus on its most severe risks by assessing the risk exposure. Exposure is the product of the probability of incurring a loss due to the risk and the potential magnitude of that loss.

This prioritization can be done in a quantitative way, by estimating the probability (0.1 – 1.0) and relative loss, on a scale of 1 to 10. Multiplying these factors together provide an estimation of the risk exposure due to each risk item, which can run from 0.1 (don't give it another thought) through 10 (stand back, here it comes!).

The higher the exposure, the more aggressively the risk should be tackled. It may be easier to simply estimate both probability and impact as High, Medium, or Low. Those items having at least one dimension rated as High are the ones to worry about first.

(2) Risk control : Risk control is the process of managing risks to achieve the desired outcomes. Risk control process involves the following activities :

- Risk planning
- Risk Mitigation
- Risk Resolution
- Risk Monitoring

Risk Planning **:** Risk planning is to identify strategies to deal with risk. These strategies fall into three categories :

- Risk Avoidance
- Risk Minimization
- Risk Contingency plans

Risk planning strategies are discussed below :

Risk Avoidance : Risk avoidance is one way to deal with risk: don't do the risky thing! We may avoid risks by not undertaking certain projects, or by relying on proven rather than cutting edge technologies.

Risk avoidance attempts to reduce the probability of a risk. For example, user interface prototyping reduces the risk that users will find the interface unacceptable.

Risk Minimization : Risk minimization attempts to reduce the impact of a risk. For example, cross-training members of the development team reduces risks resulting from team members leaving the organization.

Risk Contingency Plans : Risk contingency plans preparations for dealing with a risk should it occur. For example identifying alternate sources of funding in case financial backers stop supporting the project or identifying organizations that may be interested in buying a software system in case the client organization involved in the development project backs out.

Risk Mitigation : The risk mitigation is a plan that would reduce or eliminate the highest risks. The key question is: What should be done and who is responsible to eliminate or minimize the risk?

The mitigation plan includes a description of the actions that can be taken to mitigate the red rated risk and assigns a primary handler for the action.

Risk Resolution : When a risk has occurred, it has to be solved. Risk resolution is the execution of the plans for dealing with each risk. If the risk is at the watch list, a plan of how to resolve the risk already had taken place. The project manager has to respond to the already chalked out plan of how to resolve the risk.

A project manager has to respond to the trigger and execute the action plan. The project manager also needs to report progress against the plan and correct for deviation.

The input to this phase is the risk action plan and the outputs are:

- Risk status
- Acceptable rists
- Reduced rework,
- Corrective action and
- Problem prevention.

Risk status is the progress of the risk management. Acceptable risks are the ones that are not to be solved. *Reduced rework* is a measure of the benefit of using risk management. This has to be calculated to determine whether the risk management works. *Corrective actions* are procedures that are known solutions if a problems occur and are generally accepted within the project or organization. *Problem prevention* occurs when trying to avoid problem and thereby eliminating their result.

Risk Monitoring : Risk monitoring is the continually reassessing of risks as the project proceeds and conditions change. For example, successful completion of beta testing means that the risk of the client organization rejecting the system is minimal, while large turnover in development staff usually increases project and product risks.

(3) Risk Reporting : Risk Reporting is reporting the status of the risks that were identified during risk identification and assessment stages.

All types of risks along with their status are reported properly as part of risk reporting activity. The entire information about risks is documented together with the full history of risks such as name of the risks, a risk statement, context, etc.

The risk management function should monitor and report its measures of risks to appropriate levels of senior management. Reports to other levels of senior management and the board may occur less frequently, but the frequency of reporting should provide these individuals with adequate information to judge the changing nature of the institution's risk profile.

To provide visibility of risks and progress in mitigating them, the following reports should be distributed on a regular basis as part of the normal project status reporting system:

Risk Watch List : Lists risks to facilitate monitoring risks and initiating risk responses.

Risk Mitigation Plan : Lists avoidance/mitigation actions, if and when risks occur.

Risk Profile : Displays planned, actual and projected progress in reducing risks.

Unit – III

Q.6. Describe Resource Allocation. Also discuss the nature of resources and resource requirements in detail. (15)

Ans. Resource allocation : Resource allocation is a process and strategy involving a company deciding scarce resources should be used in the production of goods or services. A resource can be considered any factor of production, which is something used to product goods or services.

Resource allocation techniques : In an economist's perfect world resources are optimally allocated when they are used to produce goods and services that match consumer needs and wants at the lowest possible lost of product. Efficiency of product on means fewer resources are expended in producing goods and services.

(1) Strategic Planning : Resource allocation begins at strategic planning when a company formulates its vision and goals for the future the vision and strategic goals are accomplished through achievement of objectives.

(2) Budgeting : Once you have set your objective you will then need to allocate sufficient resource to accomplish it. In practical terms this is often a matter of project. Budgeting in our example the company will allocate money for market research to determine unmounts consumer need and wants for computer tablet many for product design and developments, funds for production.

(3) Resource Allocation Patterns : Resource management is a very important part of real time and embedded software design. This article discusses commonly used resource allocation patterns. The discussion is divided into two parts:

(i) Resources allocation algorithms.

(ii) Distributed resources allocation.

Resource Allocations :

(i) *Hottest first* : In hottest first resources allocation the resource last released is allocated on next resorce requrest. To implement this best in first out LIFO type of allocation. The list of tree resources is maintained as a stack.

(ii) *Coldest First* : In coldest first resources allocation the resource not allocated for maximize time is allocated to first implement this first is first out FIFO type of allocation the resources allocating entity keeps the tree resources in a queue.

(iii) *Load Balancing* : In situation involving multiple resource groups load balancing is used. A resource group is controlled by a local resource controllers. In this techniques the resource allocator first determines the highly loaded resource group.

(iv) *Future Resource Booking* : Here each resource allocation is for a specified time. The resource allocation is only valid till the specified time reached the resource is considered to be tree. Thus the resource does not need to be treed explicitly.

Nature of resources : A resource is any item of person required for the execution of the project. This covers many things - from paperclips to key personal - and it is unlikely that we would wish to itemize every resource required, let alone draw up a schedule for their use! Stationery and other standard office supplies, for example, need not normally he the concern of the project manager -ensurin there is always an adequate supply is the role of the office manager. The project manager must concentrate on those resources where there is a possibility that, without planning, they might not be sufficiently available when required.

Some resources, such as a project manager, will be required for the duration of the project whereas others, such as a specific software developer, might be required for a single activity. The former, while vital to the succcess of the project, does not require the same level of scheduling as the latter. Individual programmers, for example, might be committed to working on a number of projects and it will be important to book their time well in advance. In general, resources will fall into one of seven categories.

(i) Labour : The main iterms in this category will be members of the developments project team such as the project manager, systems analysts and software developers. Equally important will be the quality assurance team and other support staff and any employees of the client organization who might be required to undertake or participate in specific activities.

(ii) Equipment : Obvious items will include workstations and other computing and office equipment. We must not forget that staff also need basic equipment such as desks and chairs.

(iii) Materials : Materials are iterms that are consumed, rather than equipment that is used. They are of little consequence in most software project but can be important for some

software that is to be widely distributed might, for example, require supplies of floppy disks to be specially obtained.

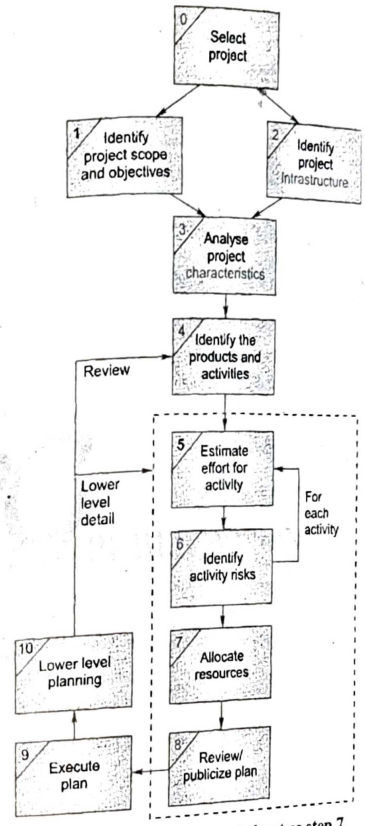


Fig. : Resource allocation is carried out as step 7.

(iv) Space : For projects that are undertaken with exsiting staff, space is normally readily available. If any addtional staff(recruited or contracted) should be needed then office space will need to be found.

(v) Services : Some projects will require procurement of specialist services - development of a wide area distributed system, for example, requires scheduling of telecommunications serives.

(vi) Time : Time is resource that a being offset against the other primary resources project time scales can sometimes be reduced by increasing other resources and will almost certainly be extended if they are unexpectedly reduced.

(vii) Money : Money is a secondary resource - it is used to buy other resources and will be consumed as other resources are used. It is similar to other resources in that it is a available at a cost in this case interset charges.

Identifying Resource Requirements : The first step in producing a resource allocation plan is to list the resources that will be required along with the expected level of demand. This will normally be done by considering each activity in turn and identifying the resources required. It is likely, however, that there will also be resources required that are not activity specific but are part of the project's infrastructure (such as the project manager) or required to support other resources (office space, for example, might be required to house contract software developers).

At this stage, it is necessary that the resource requirements list be as comprehensive as possible - it is better that something is included that may later be deleted as unnecessary than to omit something essential.

Q.7. Discuss different type of contract, its stages and different terms related to contract. Explain the concept of contract management. **(15)**

Ans. Types of contract : The external resources required could be in the form of *services*. A simple example of this could be using temporary staff on short term contracts to carry out some project tasks.

A more far-reaching use of external services would be for the contractor not only to supply the new system but to also operate it on the customer's behalf.

On the other hand, the contract could be placed for the supply of a *completed software application*.

This could be :

(i) a *bespoke* system, that is, a system that is created from scratch specifically for one customer;

(ii) *off-the-shelf*, which you buy 'as is' – this is sometimes referred to as *shrink-wrapped* software;

(iii) *customized off-the shelf*(COTS) software – this is a basic core system, which is modified to meet the needs of a particular customer.

Where equipment is being supplied then, in English law, this may be regarded as a contract for the supply of goods. In the case of the supply of software this may be regarded as supplying a service(to write the software) or the granting of a licence(or permission) to use the

software, which remains in the ownership of the supplier. These implications.

Another way of classifying contracts is by the way that the payment to suppliers is calculated. We will look at :

(a) fixed price contracts;

(b) time and materials contracts;

(c) fixed price per delivered unit contracts.

Fixed price contracts : As the name implies, in this situation a price is fixed when the contract is signed. The customer knows that, if there are no changes in the contract terms, this is the price to be paid on the completion of the work. In order for this to be effective, the customer's requirement has to be known and fixed at the outset. In other words, when the contract is to construct a software system, the detailed requirements analysis must already have been carried out. Once the development is under way, the customer will not be able to change their requirements without renegotiating the price of the contract.

Time and material contracts : With this type of contract, the customer is charged at a fixed rate per unit of effort, for example, per staff-hour. At the start of the project, the supplier normally provides an estimate of the overall cost based on their current understanding of the customer's requirements, but this is not the basis for the final payment.

Fixed price per unit delivered contracts : This is oftern associated with function point(FP) counting. The size of the system to be delivered is calculated or estimated at the outset of the project. The size of the system to be delivered might be estimated in lines of code, but FPs can be more easily and reliably derived requirements documents. A price per unit is also quoted. The final price is then the unit price multiplied by the number of units.

Various **Stages in Contract** are as follows :

(i) Requirements analysis : The requirements document might typically have sections with the heading shown in Table.

Table : Main sections in a requirements document

(i)	Introduction
(ii)	A description of any existing systems and the current environment
(iiii)	The customer's future strategy or plans
(iv)	System requirements – mandotory – desirable
(v)	Deadlines
(vi)	Additional information required from potential suppliers

The requirements define carefully the functions of the new application and all the necessary inputs and outputs for these functions. They also state any standards that apply, and the existing

systems with which the new' system should be compatible. There will also need to be operational and quality requirements, concerning such matters as the required response times, reliability, usability and maintainability of the new system.

(ii) Evaluation plan : Having drawn up a list of requirements, we need a plan of how the proposals are to be evaluated. The situation will be different if the contract is for a system that is to be specially written rather than an off-the-shelf package. In the latter case, it is the application itself that is being evaluated while in the former situation it is proposal for an application.

Ways of checking that the mandatory requirements are met need to be identified. The next consideration is how the desirable requirements can be evaluated.

(iii) Invitation to tender : Having produced the requirements and the evaluation plan, it is now possible to issue the invitation to tender to prospective suppliers. Essentially, this will be the requirement document with a supporting letter containing information about how responses to the invitation are to be lodged. A deadline will be specified and it is hoped that by then a number of proposals with price quotations will have been received.

(iv) Evaluation of Proposals : The process of evaluation may include :

- Scrutiny of the proposal documents;
- interviewing supplier's representatives;
- demonstrations;
- site visits;
- practical tests.

Typical Terms of a Contract :

Definition : The terminology used in the contract document may need to be defined, e.g. who is meant by the words 'client' and 'supplier'.

Form of agreement : For example, is it a contact of sale, a lease, or a licence ? Also, can the subject of the contract, such as a licence to use a software package, be transferred to another party ?

Goods and services to be supplied : Equipment and software to be supplied. This should include an actual list of the individual pieces of equipment to be delivered, complete with the specific model numbers.

Services to be provided. This would cover such things as :

- training;
- documentation;
- installation;
- conversion of existing files;
- maintenance agreements;
- transitional insurance arrangements.

Ownership of the software : Who has ownership of the software ? There may be two key issues here: first, whether the customer can sell the software to others and, second, whether the supplier can sell the software to others.

Environment : Where physical equipment is to be installed, the demarcation line between the supplier's and customer's responsibilities with regard to such matters as accommodation and electrical supply needs to be specified. Where software is being supplied, the compatibility of the software with the existing hardware and operating system platforms would need to be confirmed.

Customer commitments : Even when work is carried out by external contractors, a development project still needs the participation of the customer. The customer may have to provide accommodation for the suppliers and perhaps other facilities such as telephone lines.

Acceptance procedures : Good practice is to accept a delivered system only after user acceptances tests. Part of the contract would specify such details as the time that the customer will have to conduct the tests, deliverables upon which the acceptance tests depends and the procedure for signing off the testing as completed.

Standards : This covers the standards with which the goods and services should comply. For example, a customer could require the supplier to conform to the ISO 12207 standard relating to the software life cycle and its documentatiton (or, more likely, a customized sub-set of the standard). Within the European Union, goverment customers with contracts for projects above a certain threshold value must, by law, ensure that the work conforms to certain standards.

Project and quality management : The arrangements for the management of the project must be agreed. These include the frequency and nature of progress meetings and the progress information to be supplied to the customer. The contract could require that appropriate ISO 9001 standards are followed.

Timetable : Provides a schedule of when the key parts of the project should be completed. This timetable will commit both the supplier and the customer. For example, the supplier may only be able to instal the software on the agreed date if the customer makes the hardware platform available at that time.

Price and payment method : Obviously the price is very important. What also needs to be agreed is when the payments are to be made. The supplier's desire to be able to meet costs as they are incurred needs to be balanced by the customer's requirement to ensure that goods and services are satisfactory before parting with their money.

Contract Management : The forms of communication between the supplier and customer during the project could be specified in the contract. It would probably suit all concerned if the contractor is left to get on with the work. However, at certain decision points (or milestones) the customer might wish to examine work already done and make decisions about the future

direction of the project. The project could require representatives of the supplier and customer to interact at key points in the development cycle–for example, users may need to provide information to assist interface design.

One way of identifying the decision points is to divide a large project into increments. For each increment there could be an interface design phase, and the customer might need to approve the designs before the increment is built. There could also be decision points between increments.

For each decision point, the deliverables from the suppliers, the decisions to be made by the customer and the possible outcomes need to be defined. These decision points have added significance if they are the basis for payment to the contractor. The customer also has responsibilities at these decision points – for example, the contractor should not be delayed unnecessarily awaiting customer approval of interim deliverables.

There will be concerns about the quality of contracted work. The ISO 12207 standard envisages the possibility of there being agents, independent of both the supplier and customer, who will carry out verification, validation and quality assurance. It also allows for joint reviews of project processes and products to be agreed when the contract is negotiated.

We saw earlier that changes to requirements will vary the contract terms. Oral evidence is not normally admissible to contradict, add to, or vary the terms of a written contract, so that agreed changes need to be documented. A change control procedure must record requests for changes, the supplier's agreement to them and the cost for additional work.

The supplier might not meet a legal obligation. This might not be their fault, if, for example, the customer causes the delay by lateness in giving the necessary approvals for intermediate products. If no action is taken when the default occurs, this might imply that the customer in fact condones the failure and could lead to the loss of legal rights. The customer should protect their rights by officially notifying the supplier that the failure has been recognized. It will be recalled that under English law any claim for liquidated damages should be based on actual losses, so the customer needs to keep an accurate record of the actual losses incurred as a result of the default.

Unit – IV

Q.8. What is software quality ? How are enhance the software quality ? Explain various software equality enhancement techniques in detail ? (15)

Ans. Software quality : Software Quality is the conformance to explicit stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.

The above definition emphasize on these three important points :

– Software requirements are the foundation from which quality is measured. Lack of conformance to requirements is lack of quality.

– Specified standards define a set of development criteria that guide the manner in which software is engineered. If the criteria are not followed, lack of quality will almost surely in result.

– There is a set of implicit requirements that often goes unmentioned. If software conforms to its explicit requirements but fail to meet implicit requirements software quality is suspect.

Techniques for **enhancing the quality of software project** are as follows :

– **Increasing visibility :** Weinberg encouraged the simple practice of software programmers looking at each other's code.

– **Procedural structure :** Every process in the software development cycle has carefully laid down steps.

– **Checking intermediate stages :** Emphasis on checking the correctness of work at its earlier conceptual stages.

– **Inspection :** The principle of inspection can be extended to any document that is produced at any stage in the development process. When a piece of work is completed, copies of the work are distributed to co-workers who then spend some time going through the work noting any defects.

– **Formal methods :** It uses techniques that are unambiguous, mathematically based and specification language. They are used to define pre and post conditions for each procedure. Pre-conditions define the allowable states before processing of the various items of data that a procedure is to work upon. Post conditions define the state of those data items after the procedure has been executed.

– **Software quality circles :** A quality circle is a group of four to ten volunteers working in the same area to identify, analyse and solve their work related problems.

– **The GQM approach :** A number of metrics will need to be identified as needing collection in order to answer the question.

Q.9. Writte short note on any two of the following : (15)

(a) Project 2000

(b) Product versus process quality management

(c) ISO 9126

Ans.(a) Project 2000 : A project is a temporary activity characterized by having a start date, specific objectives and constrains, established responsibilities, a budget and schedule, and a completion date.

OR

A project is a set of related tasks that are coordinated to achieve specific objectives in a given time limit.

OR

"A project is a series of activities or tasks that have a specific objective to be completed within the certain specifications, have defined start and end dates, have funding limits(if applicable), and consume resources(i.e., money, people, equipment)." – Harold Kerner

OR

Characteristics of a Project :

The various characteristics of a project are as follows :

1. Projects have a purpose : Project have clearly-defined aims and set out to produce clearly-defined results. Their purpose is to solve a "problem", and this involves analyzing needs beforehand. Suggesting one or more solutions, it aims at lasting social change.

2. Projects are realistic: Their aims must be achievable, and this means taking account both of requirements and of the financial and human resources available.

3. Projects are limited in time and space : They have a beginning and an end, and are implemented in a specific place and context.

4. Projects are complex : Projects call on various planning and implementation skills, and involve various partners and players.

5. Projects are collective : Projects are the product of collective endeavour. They are run by teams, involve various partners and cater for the needs of others.

6. Projects are unique : All projects stem from new ideas. They provide a specific response to a need(problem) in a specific contex. They are innovative.

7. Projcets are an adventure : Every project is different and ground-breaking, they always involve some uncertainty and rise.

8. Projects are made up of stages : Projects have distinct, identifiable stages.

9. Projects can be assessed : Projects are planned and broken down into measurable aims, which must be open to evaluation.

Ans.(b)Product versus process quality management : Difference between product quality and process quality are as follows :

Product quality	Process Quality
(i) Method are general purpose products.	(i) There are no methods, only process of method.
(ii) Proper(customized) use of methods will lead to uniform results.	(ii) These process influence the result using the method.
(iii) Product quality is focusing on meeting tolerances in the end result of the manufacturing activities. The end result is measured on a standard of "good enough".	(iii) Process quality focuses on each activity and forces the activities to achieve maximum tolerances irrespective of the end result.

With a product based approach to planning and control, the focus on the product is convenient. It is often easier to measure the product qualities in a completed computer application rather than during its development. Trying to use the attributes of intermediate products created at earlier stages to predict the quality of the final application is difficult. An alternative approach is to scrutinize the quality of the processes used to develop software product.

Ans.(c) ISO 9126 : ISO 9126 standard was published in 1991 to tackle the question of the definition of software quality. This 13 page document was designed as a foundation upon which further, more detailed standards could be built.

ISO 9126 identifies six software quality characteristics :

(i) *Functionality :* Which covers the functions that a software product provides to satisfy user needs;

(ii) *Reliability :* Which relates to the capability of the software to maintain its level of performance;

(iii) *Usability :* Which relates to the effort needs to use the software;

(iv) *Efficiency :* Which relates to the physical resources used when the software is executed;

(v) *Maintainability :* Which relates to the effort needed to the make change to the software;

(vi) *Portability :* Which relates to the ability of the software to be transferred to a different environment.

ISO 9126 suggestes sub-characteristics for each of the primary characteristics. It is perhaps indicative of the difficulties of gaining widespread agreement that these sub-characteristics are outside the main standard and are given in the document for information only. They are useful as they clarify what is meant by the main characteristics.

Characteristic	Sub-characteristics
Functionality	Suitability Accuracy Interoperability Compliance Security

Reliability	Maturity Fault tolerance Recoverability
Usability	Understandability Learnability Operability
Efficiency	Time behaviour Resource behaviour
Maintainability	Analysability Changeability Stability Testability
Portability	Adaptability Installability Conformance Replaceability