

T.Y.BSc.IT : SEM V (Apr 2019)
SOFTWARE PROJECT MANAGEMENT

Marks:75
Q.P.Code:57827

Q.1 Attempt the following (any THREE)

[15]

Q.1(a) Define project. Discuss some characteristics of software project which make them more difficult to manage compared to other projects.

[5]

Ans : To study project management it is necessary to first understand the concept of a project.

- A project is defined as an undertaking of a non-routine, non-repetitive nature having prescribed objectives in terms of scope, time, quality and cost.
- A project is to create something new, unique, or to enhance an existing product, service, or system.
- A project is a temporary endeavor undertaken to create a unique product, service, or result.
- A project is an endeavor to accomplish specific objectives through a unique set of interrelated Tasks and effective utilization of resources.

Some characteristics of software project that make them more different to handle are:

1. Invisibility

- When a physical artefact such as a bridge or road is being constructed the progress being made can actually be seen.
- With software, progress is not immediately visible to others and may be difficult to quantify in terms of the percentage of work done.

2. Complexity

- Software projects are complex in nature than other engineering projects and the complexity can be gauged by the success rate of these projects.

3. Flexibility

- The ease with software can be changed is usually seen as one of its strengths.
- However, this means that where the software system interfaces with a physical or organizational system, it is expected that, where necessary, the software will change to accommodate the other components rather than vice versa. This means the software systems are likely to be subject to a high degree of change.

4. Conformity

- The 'traditional' engineer usually works with physical systems and materials like cement and steel.
- These physical systems have complexity, but are governed by consistent physical laws. Software developers have to conform to the requirement of human clients. It is not just that individuals can be inconsistent.
- Organizations, because of lapses in collective memory, in internal communication or in effective decision making can exhibit remarkable, 'organizational stupidity'.

Q.1(b) Name different. Give very brief description of all the phases of Project Management Life Cycle (2 to 3 lines) and explain W5HH principle.

[5]

Ans. : The Software Project Management methodology comprises of five phases which are as follows :

- **(1) Phase I: Project Conceptualization and Initialization**
 - The primary project goal is very important in project methodology as it provides a basic for future project decisions and aids in defining the project scope.

- Project Initiation is the first official step or activity in the project methodology and marks the commencement of the project. The main idea behind this initiation is to ensure that the business need is properly understood by the project manager and is kept in mind throughout the lifecycle of the project.
- The Project Initiation stage enables the creation of the project charter that is the official document authorizing the project manager to undertake the project within the organization.
- **(2) Phase II: Developing Project Plan and Charter**
 - The planning process should complement the size and complexity of the project i.e. the larger and more complex the project the greater the planning effort while small routine project requires very less planning effort.
 - Planning is an iterative process, and may require constant changes in its budget, scope, schedule or quality, as per the requirement of the client, stakeholder or the management.
 - A project charter is a detailed official document prepared in line with the company's vision and goal describing in detail the finer nuances of the project and chalking out deadlines for the milestone within the project.
- **(3) Phase III: Project Execution and Control**
 - The product oriented process plays an important role during the execution phase of the project. Quality assurance, risk management, team development, etc. form the core of the supporting processes in the project execution.
 - The primary objective of the controlling process is to measure and manage the project activities and ensure that they are on the right track towards the goal and adhere to the scope, budget, schedule, and quality parameters.
 - Controlling process is present in each of the phase it has more emphasis in this phase.
- **(4) Phase IV: Project Closure**
 - The primary objective of the closing process group is to ensure that project reaches its logical conclusion and to bring the project to an orderly completion.
 - At this phase the project team has to ensure that the project integrates with the day-to-day operations of the organization and delivers information products as required.
 - Contract closure indicates that all the project deliverables have been successfully completed and all the agreed upon terms and conditions of the contract have been adhered too.
- **(5) Phase V: Project Evaluation**
 - The first part of the project review should be conducted to identify the best practices taken for the project in the whole methodology of the organization.
 - The second part takes place between the project manager and the whole team members which focus on reviewing individual performance of team members as well as that of the project manager.
 - The third part of the review should be conducted by a neutral party who should review the project, the project manager and the project team which focuses on the overall performance and the expectations by the client to the manager and its whole team.
 - The last part of the evaluation process should determine whether the project succeeded in providing value to the organization.
- The **W5HH** principle in software management exists to help project managers guide objectives, timeline , responsibilities, management styles, and resources.
- Created by **software engineer Barry Boehm**, the purpose behind the W5HH principle is to work through the objectives of a software project, the project timeline, team member responsibilities, management styles, and necessary resources.
- Boehm stated that an organizing principle is needed that works for any size project. So he developed W5HH as a guiding principle for software projects.
- To get the essence of the project, Boehm suggests an approach (W5HH) that addresses project objectives, milestones and schedules, responsibilities, management and technical approaches and required resources.

- He calls it the W5HH principle, after a series of questions that lead to a definition of key project characteristics and the resultant project plan:
 - **Why** is the system being developed?
 - Enables all parties to assess the validity of business reasons for the software work.
 - **What** will be done?
 - Establish the task set that will be required.
 - **When** it will be accomplished?
 - Project schedule to achieve milestone. The team establishes a project schedule by identifying when project tasks are to be conducted and when milestones are to be reached.
 - **Who** is responsible?
 - Role and responsibility of each member of the software team is defined.
 - **Where** are they organizationally located?
 - Not all roles and responsibilities reside within the software team itself. Customer, end user and stake holders also have responsibility.
 - **How** will the job be done technically and managerially?
 - Management and technical strategy must be defined.
 - **How** much of each resource is needed?
 - Develop estimation.
- Conclusion is that the people by interaction with other people, the recognition of management and their peers, and by being given opportunities for personal development.
- Software development groups should be fairly small and cohesive. The key factors that influence the effectiveness of a group are the people in that group, the way that it is organized, and the communication between groups and members.
- Communications within a group are influenced by factors such as the status of group members, the size of the group, the gender composition of the group, personalities and available communication channels.

Q.1(c) Define business case. Specify the content of business case document.

[5]

Ans. : The business case captures the reasoning for initiating a project or a task. It is the information needed for the authorization of the project. It is often presented in a well-structured written document, but may also come in the form of a short-verbal agreement or presentation. The logic behind it, is that whenever resources such as money or effort are consumed, they should be in a support of a specific business need.

➤ **Purpose:**

- The purpose of the business case is to document the justification for the undertaking of a project usually based on the estimated cost of development and implementation against the risks and the anticipated business benefits and savings to be gained.
- The total business change must be considered, which may be much wider than just the project development costs. The concept of the business case may exist under other names, e.g. project brief, project charter, high level project plan. Irrespective of the name the purpose is to present justification for project start-up and initiation.

Most organizations will have standard approach to a composing a business case. Some key elements usually include:

- Reasons
- Options (a brief description of the different options considered and option recommended)
- Benefits expected (expressed in measurable terms against today's situation)
- Risks (summary of the key risks of the project)
- Cost (extracted from the project plan)
- Timescales (summary of the project plan)
- Investment appraisal

- Business case development is a step that companies often use for project selection. It analysis how fulfilling the business case for the project will implement the corporate strategy and sustain the competitive advantage of the company.
- The business case is the key document for a project manager- it is both the justification for their activities and a benchmark by which the project benefits will be measured.
- It is also a main document of the project portfolio management process and as such, is the document used by the organizations project investment committee. However, the primary owner of the business case is the project sponsor. The sponsor is responsible for ensuring the continued viability of the project and that the benefits defined in the business case are realized after project completion.

Q.1(d) Write a short note on Portfolio management.

[5]

Ans. : A portfolio is a collection of projects, programs and other associated work that are grouped together to facilitate effective management of that work to meet strategic business objectives.

- The projects and programs within an organizations portfolio may not necessarily be associated with each other and the allotment of funding and resources is on them.
- Organizations manage their portfolio on the basis of specific goals such as maximizing the value of the portfolio by evaluation of projects and programs that could enhance the existing value of the portfolio and excluding projects not meeting the portfolio's strategic objectives.
- Other goals for managing portfolio could be balancing the portfolio investment to the investments, projects, programs and activities of the company's Information Technology department.
- The primary objective of IT project management is the quantification of previously undertaken IT projects and programs, enabling measurement and objective evaluation of investment scenarios.

Q.1(e) Define Net Profit, Payback Period and Returns on Investment. Calculate these values for the following cash flow forecast of a project.

[5]

Year	Cash-Flow
0	-1,00,000
1	20,000
2	30,000
3	20,000
4	30,000
5	60,000

Ans. : I. Net Profit

- The actual profit after working expenses not included in the calculation of gross profit have been paid.
- Net Profit is the difference between the total costs and the total income over the entire life of the project.
- This is a simple method of calculating the total benefits of the project. However, this method does not show profit relative to the size of the investment.

II. Payback Period

- The Payback Period helps to determine the length of time required to recover the initial cash outlay in the project. Simply it is the method used to calculate the time required to earn back the cost incurred in the investments through the successive cash inflows.
- It is also called as payout method it is a computationally simple project evaluation approach that has been used for many years.
- The procedure is to determine how long it takes a project to return the cost of the original investment.

III. Return on Investment

- It is a performance measure used to evaluate the efficiency of an investment or compare the efficiency of a number of different investments. ROI tries to directly measure the amount of return on a particular investment, relative to the investment's cost.

- The accounting rate of return (ARR) or the Return on Investment (ROI) method of evaluating projects is so named because it parallels traditional accounting concepts of income and investment.
- A project is evaluated by computing a rate of return on the investment, using accounting measures of net income. The formula for the accounting rate of return is,

ARR=

$$\frac{\text{Annual revenue from project} - \text{Annual exp. Of project}}{\text{Project investment}} * 100$$

Soln. : Calculate net profit, payable period and return on investment for the following cash flow forecast of a project.

Year	Cash-flow	Cumulative cash flow
0	-1,00,000	-
1	20,000	20,000
2	30,000	50,000
3	20,000	70,000
4	30,000	1,40,000
5	60,000	1,60,000

- (i) Net profit = 1,60,000 – 1,00,000 = 60,000
- (ii) Break even year is the year in which cash inflows = cash out flows. Since in the above project the cumulative cash inflow matches the cash outflow in the 4th year the project break even is achieved in the 4th year
- (iii) Payback period = year previous to BEP
 + $\frac{\text{Sum cash flow of BEP} - \text{Total cash outflow}}{\text{Cash flow during break even year}} * 12$
 = 3 year-s + $\frac{1,00,000 - 1,00,000}{30,000} * 12$
 = 3 years
- (iv) Return investment (ROI)
 = $\frac{\text{Cumulative Cash inflows} - \text{Cash outflow}}{\text{Project investor}} * 100$
 = $\frac{1,60,000 - 1,00,000}{1,00,000}$
ROI = 60%

Q.1(f) Outline the general approach that might be taken for project planning in an organization step by step manner.

[5]

Ans. : The project planning phase is the longest and most important of the project cycle. Without proper scope planning, a project has a poor chance of success.

- Project teams should decide on a budget, set timelines, and identify any roadblocks to success. They should spend the necessary time planning a project and make any plan changes before moving on to the next phase.
- The team may put project plans in writing to clarify to clarify roles, responsibilities and project deadlines.
- A project plan is an iterative process that communicates the approach and intent of the project manager. A project plan will provide the details of the processes that will be used in the project and how the project work will be executed, controlled, and commissioned.
- The first step in Project Planning is to research the business opportunity or problem that the project aims to address.
- A good research will enable the project manager to develop a thorough understanding of the problem. The research can be done by interviewing the key stakeholders.

- The success of the project hinges on a clear understanding on the part of the project manager and key stakeholders as to the motive and end result of the project.
- The vision for the end result of the project should be mutually developed by the key stakeholders and project manager.

Q.2 Attempt the following (any THREE)

[15]

Q.2(a) Describe briefly five steps of project analysis.

[5]

Ans. : A project manager will lead their team through these 5 phases in succession regardless of project size until the project is complete. Every major work project goes through five phases. The length and details may vary from project to project, but all will still follow the same basic framework. The formal stages of a project are as follows:

- (i) **Initiation:** project team formation, project chartering, and kick-off
 - (ii) **Planning:** finalizing the project scope, defining the detailed work breakdown, assessing risk, identifying resource requirements, finalizing the schedule, and preparing for the actual work
 - (iii) **Execution:** performing the actual work required by the project definition and scope
 - (iv) **Monitor and Control:** the actual management, reporting, and control of the resources and budgets during the execution phase
 - (v) **Project Close:** delivery of the project, assessment of lessons learned, adjournment of the project team
- For agile or iterative development-type projects, planning and execution take place in short spurts or sprints. with the stages repeating until the project is completed to the customer's satisfaction.

Let's look at these stages in more detail.

(i) Initiation

- A solid project initiation will not only set your project up for success, but it will also lay the groundwork for all future stages.
- During initiation, you'll get the project team members assigned, brief them on the overall project goals, and ask the client or project owner as many questions as possible so you can plan the project efficiently.
- It is also a great time to build team enthusiasm about the project and collect any last-minute details that might influence project planning. Additional steps include:
 - o Stakeholder analysis
 - o Assignment of an executive sponsor
 - o Charter document development and communication
 - o Formal kick-off meeting

(ii) Planning

- The planning stage depends on the size of your project, how much information you have to organize and how large your team is. The result of planning should be a clear project plan or schedule, from which everyone will follow their assigned tasks.
- Using a project-planning program such as Microsoft Project or Basecamp is extremely helpful when planning a project.
- There are other free options available online, too. Still, even though using a project-planning program is helpful, it's not always necessary. Using Excel and Word to create your plan and communicate it to the team is equally as effective.
- Specific tasks in the planning phase include:
 - o Creating a communication plan for the various stakeholders involved
 - o Developing a detailed work breakdown structure
 - o Identifying the critical path
 - o Plotting resources on the project plan and refining the sequencing of the work based on project dependencies and resource constraints
 - o Developing a detailed schedule

- o Assessing risks and developing a risk prioritization and mitigation plan
- (iii) **Execution**
 - Now that you have a solid project plan, the team can begin executing the project against their assigned tasks. This is the stage where everyone starts doing the work.
 - You'll want to officially kick off the execution stage with in-person meetings to ensure everyone has what they need to begin executing their part of the project.
 - Getting the team started on the right track is integral to a project's success, so articulate the schedule and communications plan clearly.
- (iv) **Monitor and Control**
 - While the project is in the execution phase, you'll begin monitoring and controlling it to ensure it's moving along as planned. There are a variety of ways you can monitor and control a project.
 - Casual check-ins with team leaders, organized daily "stand-ups," or more formal weekly status meetings are effective. The information that comes out of these meetings or communication channels will inform the feedback loop and ultimately any re-planning and adjustments that may be necessary to the project.
 - Additional important activities in this stage include:
 - o Adhering to your pre-established communication plan to ensure stakeholder awareness of the project status
 - o Monitoring work teams and work activities on the critical path
 - o Identifying opportunities to improve schedule performance by fast-tracking or completing activities in parallel or, where necessary, crashing the schedule by adding resources
 - o Monitoring actual vs. planned costs
 - o In some cases, monitoring, calculating and reporting on earned value for the project plan
 - o Monitoring and mitigating risks and refining the risk plan as needed
- (v) **Project Close**
 - Once all the details and tasks of your project are completed and approved by the client or project owner, you can finally close your project. This may seem like a formality, but the closing of a project is just as important as its initiation, planning, and execution.
 - A good project manager will document all the information from the project and organize it neatly so they can go back to it if necessary.
 - This is also a good time to hold a post-mortem on the project so all team members can reflect on what went right or wrong during the project.
 - All important project notes should also be documented so the outcome can be shared with other project members and filed in a project history folder. Finally, it is important to formally adjourn the project team, providing feedback and performance evaluations as indicated by your firm's policy.

Q.2(b) Explain Scrum. What do you understand by the term 'ceremonies' in a Scrum project? Explain different types Of ceremonies observed in a Scrum project. [5]

Ans. : Scrum is an efficient framework within which you can develop software with teamwork. It is based on agile principles. It is a framework for developing and sustaining complex products. **Ken Schwaber** and **Jeff Sutherland** developed Scrum. Together, they stand behind the Scrum Rules. Scrum is not a process or a technique for building products; rather, it is a framework within which you can employ various processes and techniques. Scrum makes clear the relative efficacy of your product management and development practices so that you can improve.

Scrum is:

- Lightweight
- Simple to understand
- Difficult to master

Uses of Scrum:

- Research and identify viable markets, technologies, and product capabilities;
- Develop products and enhancements;
- Release products and enhancements, as frequently as many times per day;
- Develop and sustain Cloud (online, secure, on-demand) and other operational environments for product use; and,
- Sustain and renew products.

Scrum has been used to develop software, hardware, embedded software, networks of interacting function, autonomous vehicles, schools, government, marketing, managing the operation of organizations and almost everything we use in our daily lives, as individuals and societies.

In order to provide transparency and regular communication in the midst of such environments are held. Scrum ceremonies are meetings that are unique to scrum teams.

Scrum is executed in what are called sprints, or short iterations of work lasting usually no more than two weeks.

The scrum ceremonies are outlined below:

- **Sprint Planning:** This is where the team meets and decides what they need to complete in the coming sprint.
- **Daily Scrum:** This is a standup meeting, or a very short – 15-minute mini-meeting – for the team to make sure they are all on the same page.
- **Sprint Review:** This is another type of meeting, but one in which the team demos what they shipped in the sprint.
- **Sprint Retrospective:** This is when the team reviews their work, identifying what they did well and what didn't go as planned, so they can make the next sprint better.

Let's dig a little deeper and explore each scrum ceremony in depth.

- **Sprint Planning**
 - This ceremony helps to set up the entire team for the coming sprint, creating a smooth pathway for a successful sprint. Sprint Planning requires the participation of all the scrum roles: the development team, scrum master and the product owner.
 - The product owner comes to the meeting with a prioritized list of the product backlog items, which is presented to the group. The items on the list, which are also called user stories, are then discussed with the development team.
 - Together, they estimate what it will take to complete the items on the list. From this information, the development team makes a sprint forecast. They will outline how much work the team can complete from the product backlog.
 - Some sprint planning ceremonies will flesh out details of each user story. This will make sure that everyone involved understands the scope of the work. By doing this, the actual sprint planning ceremony is shorter and directed only towards user stories that will be tackled in the upcoming sprint.
- **Daily Scrum**
 - This short scrum ceremony makes sure that everyone knows what's happening. It's a way to ensure transparency across the team.
 - A detailed status meeting this is not, but rather a light and fun informative meeting. It's a space for each team member to answer the following questions: what did you complete yesterday, what are you working on today and are you blocked by anything?
 - The daily scrum is, as it says, a daily occurrence, which usually takes place each morning with the development team, scrum master and product owner. The ceremony is short, usually 15 minutes, which is why it's also called a standup meeting.
 - The great thing about the daily scrum is that it demands accountability. People report honestly on what they did, what they plan on doing and how they might be getting blocked in the process, and this is all done in front of their peers.
 - Daily scrum is not limited to teams that share a physical location. If the teams are working remotely, the ceremony can be conducted with video conferencing or another group chat.

- **Sprint Review**
 - After the sprint has been completed, it's time to get the team together to demo or showcase their work. Each team member reviews the newly developed features or whatever it was that they worked on during the sprint.
 - This provides a space for the team to congratulate themselves on a successful sprint, which is important for morale. It also demonstrates the finished work for the entire team, so they can provide feedback and also get feedback from the stakeholders in the project.
 - Here, unlike other ceremonies, the review can last as long as it takes to demo all the work done by the team. Again, the participants are the development team, scrum master and product owner, but also in this instance, other teams involved in the project and the stakeholders.
- **Sprint Retrospective**
 - The last scrum ceremony is called the sprint retrospective. It occurs at the end of a sprint, after the review, and is usually an hour in duration. The retrospective includes the development team, scrum master and product owner.
 - Because scrum is part of an agile process, it is all about change, which includes getting feedback and quickly acting on it. Scrum seeks continuous improvement and the retrospective is a method to make sure that the product and development culture is constantly improving.
 - The retrospective is a way for the team to understand what has worked well and what didn't come together over the previous sprint. The retrospective is a way for the team to understand what has worked well and what didn't come together over the previous sprint.
 - But, if the mantra of scrum is to always seek to improve, then the retrospective must be critical, too, but only as a steppingstone to improvements.

Q.2 (c) Discuss eight core Atern principles.

[5]

Ans. : **DSDM** (formally known as **Dynamic System Development Method**) is an Agile method that focuses on the full project lifecycle. **Dynamic System Development Method** was created in 1994, after project managers using **RAD (Rapid Application Development)** sought more governance and discipline to this new iterative way of working. The eight principles of **DSDM** are:

1) Focus on the business need

- Establish the business case through the business need perspective. Create a sound and justified business case
 - Align the business case to organizational goals and priorities. Seek continuous business sponsorship.
 - Validate the business commitment through results. Seek managerial/business input to align goals.
- Guarantee Minimum Usable Subset(MUST)**
- Aim for the minimum usable state. Create a foundation to be built on it later iterations.

2) Deliver on Time

- Time box work activities / Always hit deadlines. Allocate time periods to complete work. Time boxing fixed periods of time for each planned activity.
- Hitting deadlines builds trust in a process. Develop priority conversations with a focus on what is needed.
- Hold conversations with business and project stakeholders to help determine timelines. Focus on what the business needs first to help meet organizational goals.

3) Collaborate

- Involve the right people at the right time. Bring in SME's and experts at points within the project when their experience can be best utilized.
- Actively involve business representatives. Gain business support through open communication.
- Invite business leaders to meetings and inquire about their thoughts on the current state and progress. Build a unified team through empowerment.
- Remove the top-down approach to project decisions. The project manager is there to serve as a guide to the process and a facilitator of communication, not the core decision maker.

- 4) **Never compromise quality**
 - Build in quality at the beginning. Decide as a team the minimum level of acceptable quality.
 - Test early, test often, test continuously, test throughout the process to quality is being met.
 - Continuously review quality goals and current level of quality. Review with the team on a regular basis the current level of quality and the current quality goals.
 - Adjust goals as needed, but never sacrifice quality for time or extra features.
- 5) **Build incrementally from firm foundations**
 - Confirm that solution is correct and meeting expectations. Hold conversations regularly to show the current solution state and allow for input from project stakeholders.
 - Ensure the project is on right track and adjust as needed. Adjust and re-assess priorities and project viability. Decide on and focus on the priorities needed to build a firm foundation.
 - Building a firm foundation will more easily allow for expansion of the project later in other iterations of the development process. Recognize that change may occur and adapt to it instead of fighting against it.
- 6) **Develop iteratively**
 - Create the strong foundation, a strong solid base is easier to expand on later – you wouldn't want to build a house on top of a broken foundation.
 - Try new things or look at things from a different perspective. Take others suggestion into consideration, recognize that the process is fluid and not locked in, try things first, experiment, be open to changes.
 - Allow detail to merge later, rather than a strong detailed definition at the beginning. The project is being rough sketched in, as it progresses the sketch will become more detailed.
- 7) **Communicate continuously and clearly**
 - Encourage effective and informal meetings, focus on the quality of the communication, encourage additional input and suggestions and engage in more collaborative practices.
 - Use visual communication practices, use modeling or visual aids to help explain your point.
 - Keep documentation lean, lots of documentation will never get read. Document enough to let others understand the basics.
- 8) **Demonstrate control**
 - Results oriented project tracking. Rather than focus on completing each activity, focus on results, measure progress through delivery.
 - Keep project state transparent and open to anyone who cares. Make planning documents available to all, project state should be openly and freely discussed.
 - Proactively manage the project, continuously evaluating process, keep expectations in check, use an appropriately level of formatting when reported.

Q.2(d) Discuss Caper Jones estimating rules of thumb.

[5]

Ans. : Caper Jones in the year 1996 formulated simple rules based on his experience in estimating various parameters of large software projects.

- The objective behind formulating these rules was to provide the project manager with estimating rules which would be easy to use and yet provide him with a fairly good idea of the various aspects of the project.
- As these are thumb rules they are not supposed to provide the project manager with an accurate estimate and hence should not replace the more rigorous techniques while working out contracts.
- However, these rules can be used for getting an insight into the various aspects of the project.

→ **Rule 1: SLOC Function Point Equivalence**

- When it comes to estimating the size of the project the function point analysis is used on account of its advantages. Thus, it becomes necessary for the project manager to determine SLOC measure from its function point measurement.
- Jones through his experience determined the equivalent between SLOC and function point.

- SLOC function point equivalence varies across different programming languages so it would take about 320 lines of assembly code to implement one function point. In C language to express one SLOC several instructions of assembly language are needed.
- **Rule 2: Project Duration Estimation**
 - Function points raised to the power 0.4 predicts the approximate development time in calendar months.
 - E.g. if the size of a project is estimated by 325 function points i.e. approximately 40,000 SLOC then the completion time for the project would be approximately 17 months.
- **Rule 3: Rate of Requirement Creep**
 - Requirement creep is the increase in the requirements of the user and these keep on increasing for a variety of reasons as the project progresses. Basically, the rule states that the creep takes between the requirements phase till the testing phase and therefore only that part of the project should be considered.
 - Going with previous example, if the size of the project is estimated to be 325 function points then the duration for the project is estimated to be 17 months. Since we need to exclude the duration of requirements and testing phase then the requirement creep will occur for 11 months.
 - As per the rule 3 the original requirement will grow by three function point every month. So, the total requirements creep would be approximately 33 points and the total size of the project would be $325+33 = 358$ function points.
- **Rule 4: Defect Removal Efficiency**
 - Each software review, inspection or test step will find and remove 30% of the bugs that are present.
 - Defect removal steps at various stages of the project development ensure that the final product is reliable.
- **Rule 5: Project Manpower Estimation**
 - The size of the software in function points divided by 150 predicts the approximate number of personnel required for developing the application.
 - Going by this rule when we have 358 function points for the projects the number of personnel required for the project would be 2.5 i.e. 3. However, while estimating the manpower requirement the complexity of the project, language used and the level of usage of CASE tools are not considered.
- **Rule 6: Software Development Effort Estimate**
 - The approximate number of staff members of staff months required to develop software is given by the software development time multiplied by the number of personnel required.
 - Function points divided by 500 predicts the approximate number of personnel required for regular maintenance activities.

Q.2(e) What are the problems generally faced due to effort estimation?

[5]

Ans. : One of the most efficient parts of IT project management is the estimation of effort. The IT industry is very volatile and dynamic with fluctuations in software and hardware happening every now and then.

- The largest expenditure in IT projects is time. If the team is not technically ready to implement the technology they are naturally going to require more time.
- Hence, while estimating the effort the project manager has to take into account the learning curve to implement and manage the new technology.
- Therefore, the project manager should select his team as per the technical requirements of the project. Team members should be familiar with the software and hardware components of the project.
- This will ensure that less time is lost in learning the new technology. However, the effort of imparting training to the team should be included in the estimate.

Q.2(f) Explain briefly Albrecht/IFPUG function points and solve the following :-

For an organization, the following table summarizes the weightings to be used for computing function points measures of a software development project. The organization has undertaken the development of a software having the following characteristics:-

- Number of user inputs - 10(simple)
- Number of user outputs - 7 (simple)
- Number of user inquiries - 3 (average)
- Number of files - 6 (average)
- Number of external interfaces - 1 (complex)

Calculate unadjusted function point measure of the size of the software system?

[5]

Ans. : Function point metrics provide a standardization method for measuring the various functions of a software application.

It measures the functionality from the user's point of view, that is, on the basis of what the user requests and receives in return. Function point analysis is a standard method for measuring software development from the user's point of view.

Function units	Simple	Average	Complex
EI	3	4	6
EO	4	5	7
EQ	3	4	6
I L F	7	10	15
E L F	5	7	10

- The unadjusted function point
 $UPP = (10 * 3) + (7 * 4) + (3 * 4) + (6 * 10) + (1 * 10)$
 $= 30 + 28 + 12 + 60 + 10$
 $= 140$
- Thus, the unadjusted function point measure of the size of the software is 140.

Q.3 Attempt the following (any THREE)

[15]

Q.3(a) Using the data in the following table, answer the questions given below.

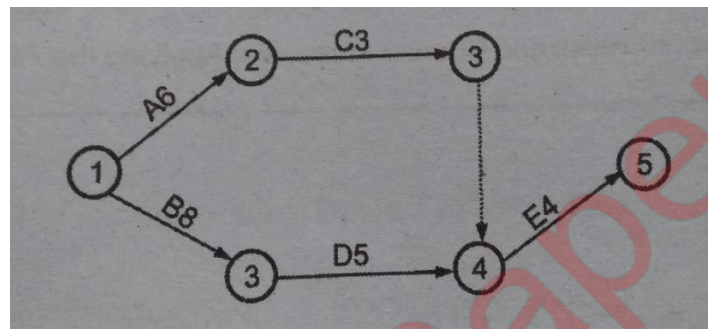
[5]

Activity	Duration	Predecessors
A	6	-
B	8	-
C	3	A
D	5	B
E	4	C, D

- i) Create a precedence activity network
- ii) What is the total project duration?
- iii) Calculate earliest start date, latest start date and float of all the events.
- iv) Identify the critical path.

Ans. : Draw a procedure activity network based on the following activity:

ACTIVITY	DURATION	PREDECESSORS
A	6	-
B	8	-
C	3	A
D	5	B
E	4	C, D



- i) Critical positive
 A C E
 $1-2-3-5 = 6 + 3 + 4 = 13$ days
 $1-3-4-5 = 8 + 5 + 4 = 17$ days
- ii) Total project duration is 17 days and is the critical of the project.
- iii) The earliest start date for activities A, B shall be 0 i.e. the first day of the project. While the earliest start date for C and D shall be 6 and 8 respectively. The Es for active by E shall be B which the earliest finish time for activity D.

Q.3(b) Define activity. Discuss three approaches to identify the activities. [5]

Ans. : Activity definition refers to the process of parsing a project into a number of individual tasks which must be completed before the deliverables can be considered completed. It relies on a number of specific input processes. These include enterprise environmental factors, organizational process assets, the project scope statement, the work breakdown structure, the WBS dictionary, the project management plan (which consists of the project scope management plan and the schedule management plan). Essentially there are three approaches to identifying the activities or tasks that make up a project - we shall call them **the activity-based approach, the product-based approach and the hybrid approach.**

(i) The Activity-based approach

- The activity-based approach consists of creating a list of all the activities that the project is thought to involve. This might involve a brainstorming session involving the whole project team or it might stem from an analysis of similar past projects.
- When listing activities, particularly for a large project, it might be helpful to subdivide the project into the main life style stages and consider each of these separately.
- Rather than doing this in an ad hoc manner, with the obvious risks of omitting or double-counting tasks, a much favored way of generating a task list is to create a **Work Breakdown Structure (WBS)**. This involves identifying the main (or high-level) tasks required to complete a project and then breaking each of these down into a set of lower-level tasks.

- When preparing a **WBS**, consideration must be given to the final level of detail or depth of the structure. Too great a depth will result in a large number of small tasks that will be difficult to manage, whereas a too shallow structure will provide insufficient detail for project control.
- Advantages claimed for the **WBS** approach include the belief that it is much more likely to result in a task catalogue that is complete and is composed of non-overlapping activities. Note that it is only the leaves of the structure that comprise the list of activities comprising the project - higher-level nodes merely represent collections of activities.

(ii) The Product-based approach

- It consists of producing a **Product Breakdown Structure** and a **Product Mow Diagram**. The **PFD** indicates, for each product, which other products are required as inputs.
- The **PFD** can therefore be easily transformed into an ordered list of activities by identifying the transformations that turn some products into others.
- Proponents of this approach claim that it is less likely that a product will be left out of a **PBS** than that an activity might be omitted from an unstructured activity list.

(iii) The Hybrid approach

- The **WBS** is based entirely on a structuring of activities. Alternatively, and perhaps more commonly, a **WBS** may be based upon the project's products as, which is in turn based on a simple list of final deliverables and, for each deliverable, a set of activities required to produce that product.
- The degree to which the structuring is product-based or activity-based might be influenced by the nature of the project and the particular development method adopted.
- As with a purely activity-based WBS, having identified the activities we are then left with the task of sequencing them.

Q.3(c) Suppose four risks namely R1, R2, R3 and R4 have been identified and assigned the probabilities of occurrence of 0.1, 0.2, 0.3 and 0.4 respectively. The likely damages due to the four risks are Rs. 50, 000; Rs. 1, 00,000; 70,000; 60,000 respectively. Calculate the risk exposure of all the risks. [5]

Soln. :

Risks	Probability	Damages
R1	0.1	50,000
R2	0.2	1,00,000
R3	0.3	70,000
R4	0.4	60,000

The risk exposure of all risk shall be the likely damages * probability of their occurrence.

Thus

$$R1 = 0.1 * 50,000 = 5,000$$

$$R2 = 0.2 * 1,00,000 = 20,000$$

$$R3 = 0.3 * 70,000 = 21,000$$

$$R4 = 0.4 * 60,000 = 24,000$$

Q.3(d) Define Risk and discuss the ways of dealing with them. [5]

Ans. : An uncertain event or condition that, if it occurs, has a positive or negative effect on the project objectives. The systematic process of identifying, analyzing and responding to project risk. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse

events.

The Risk Management Framework specifies accepted best practice for the discipline of risk management. It is implementation independent – it defines key risk management activities, but does not specify how to perform those activities.

In particular, the framework helps provide a foundation for a comprehensive risk management methodology basis for evaluating and improving a program's risk management practice.

The main phases of **RISK MANAGEMENT FRAMEWORK** are:

1. Phase I: Prepare for Risk Management

- The first phase, prepare for Risk Management, of the framework lays the groundwork for the other two phases. In this phase, preparation activities for risk management are performed.
- This phase determines who is sponsoring the risk management, plan for conducting risk management, and the resources required to effectively conduct risk management.

2. Phase II: Perform Risk Management Activities

- The second phase, Perform Risk Management activities, specifies the activities that are to be used for managing risk. This phase is performed continually till the overall risks to the key objectives of the project are eliminated
- In this phase, activities of management are performed as planned. First and foremost the phase identifies the risks that could affect the achievements of the key program objectives.
- This phase also specifies to ensure that each risk is maintained within tolerable limits over the entire duration of the project. This phase also determines whether the mitigation plan is having the desired effect.

3. Phase III: Sustain and Improve Risk Management

- The third phase, Sustain and Improve Risk Management, is performed on a periodic basis to ensure that the risk management practice remains effective over the entire course of the project.
- In this phase, activities are performed to sustain and improve risk management effort over the entire duration of the project. This phase specifies the risk management assets and work products that need to be under configuration, lessons learnt while preparing for risk management and conducting risk management and how the entire risk management exercise can be improved.

Q.3(e) Explain the process of scheduling resources.

[5]

Ans. : Once all the resources required for the completion of the project have been identified and the requirement list is prepared it is time to map that on the activity plan to assess the distribution of resources required over the duration of the project.

This can be done by representing the activity as a bar chart and use this to produce a resource histogram for each resource.

The output of the process of resource identification is the resource histogram.

Resource Allocation identifies what resources are needed to complete activities and critical path calculates when the activities can be performed.

Combining these two sets of data allows the demand for each type of resource to be aggregated over time. This information is typically represented as a resource histogram.

The diagram below illustrates a number of activities on a Gantt Chart. The numbers represent the amount of a specific required each day. The numbers are summed and shown graphically at the bottom of the diagram as a resource histogram.

	M	T	W	T	F	Sa	Su
A	2	2					
B		2	2	2			
C	2		2				
D		2	2	2	2		
E							
F	2	2	2	2	2		
	6	8	8	6	4		
8							
7							
6							
5							
4							
3							
2							
1							

Resource Histogram

The resource histogram helps us identify where the demand for a resource exceeds the supply.

Q.3(f) Discuss the factors to be taken into account while allocating individuals to task.

[5]

Ans. : The methods and tactics applied for managing projects depend on the kind of project you deal with. The project structure, processes involved varies based on the kind of products or services you offer, and the market it is concerned with. For example, the project management tactics applied in a product manufacturing firm will be different from that of a construction firm. Here is a look at few factors which need to be consider while allocating task to individuals:

- I. **Deadline**
- II. **Budget**
- III. **Stakeholders**
- IV. **Project Members**
- V. **Demand**
- VI. **Supply**
- VII. **Price**

Now, let's discuss them one by one.

I. Deadline

- Deadline is one of the key aspects that determine how a project is managed. Missing a deadline creates a bad impression for your team. However, completing a project on deadline does not mean that you compromise on quality.
- You have to be both alert about time and have a keen eye on quality. If the project has narrow deadlines with strict clients or stakeholders, project manager should be alert to all possible hindrances from before and take appropriate precautions, so that on-time delivery of quality products or services can be ensured.
- Not only should the manager be on their toes but they should instill the same kind of attitude among the team members. Team members should flag issues, problems and hindrances the moment being faced so that solutions can be looked out for immediately.

II. Budget

- Budget is another critical factor that determines a project's progress and management. In case the budget is high, then the number of days for completion of the project is also more and so is the number of resources allocated to it.
- Do not rush in such situations; rather focus completely on delivering products or services that are of best quality, with maximum utilization of resources. However, if the budget is less you have to adjust with limitations such as unavailability of resources, lack of time, and money.
- However, you cannot compromise on quality which means the stress level of you and your team increases. You may have to motivate your irritated overworked team members by encouraging them for their good performance and recognizing their efforts through rewards.

III. Stakeholders

- Techniques of managing projects will vary depending upon the kind of stakeholders for the projects. In case a project has multiple stakeholders from different backgrounds, there is a possibility of disagreement between them.
- In such cases, project management becomes extremely challenging as you cannot afford to have unhappy stakeholders and clients.
- Great convincing and negotiation skills are required in such cases to reach a consensus. It can be time consuming and hence the actual time dedicated to resources will reduce.
- The project manager needs to adopt tactful approaches in such cases and get the work done.

IV. Project Members

- Project management techniques are also determined by the challenges faced by a project manager which, in turn, depends on the kind of team he or she is handling.
- If the team consists of members with diverse backgrounds and skills, a gap in terms of team spirit may exist. This obviously impacts work. Therefore, a project manager should apply techniques to bring the team close.
- He should ensure that regular team meets happen which can be both formal and informal. In team meetings and outings people from various backgrounds are bound to interact. This creates a bond between members and they are ready to be there for each other.

V. Demand

- Demand is another key factor that influences project management techniques. Demand itself depends on a few factors such as type of products or services, usability, etc. If the product is a perishable item such as grains or vegetables, the nature of demand will be different from that of garments that can be stocked and used for months.
- Depending on the kind of demand and the nature of the product or services offered, a project manager needs to apply appropriate management techniques ensuring on time delivery of goods and services.
- For example, an app development company is creating a product for a new mobile offering from XYZ which will be released in the market after 6 months.
- Therefore, the app needs to be ready by at least a month before the release. The project manager will have the details in mind, while forming the team and allocating resources.

VI. Supply

- In order to meet the demand within a stipulated date and time (which we came across as deadline), supply of resources is necessary. A project manager needs to ensure that supply is adequate, so that deadline is not compromised for want of resources.
- For example, the company has scheduled a training session with 15 students on a given date. Students have paid fees and they have been given the date, time and venue of the session.
- However, more people started registering for the session and the total number reached 25. The current venue has a capacity of 20 people. Now, the training provider should be in a position to arrange another venue immediately for the training session.
- If the session gets cancelled due to lack of space, it will be a big loss for the company both in terms of money and reputation.

VII. Price

- Price is an important aspect of project management. Price is determined by high level managers in consultation with project sponsors after studying market trends.
- It is an important determinant of the sale and profit and should be determined after careful calculation. The type of product or service is an important factor to be considered when talking about price determination.
- For convenience, we will categorize products into three 3 types: perishable products, non-perishable products, and specialized products. There are two factors that need to be considered here: the quantity that needs to be sold and the price that the buyer is willing to pay for it.

- In case of non-perishable items like cooking oil, grains and pulses, coal, demand is never a limitation. Additionally, being non-perishable, the products can be stored and marketed throughout the year.
- However, it is different for perishable products and seasonal items. These are in the market for a short duration and are in high demand for that period. Owing to the high demand and limited supply, price is usually high.

Q.4 Attempt the following (any THREE)

[15]

Q.4(a) Explain the change control process.

[5]

Ans. : Change control is a methodology used to manage any change requests that impact the baseline of your project. It's a way to capture that change from the point where it's been identified through every step of the project cycle. That includes evaluating the request and then approving, rejected or deferring it.

The purpose of this process is to make sure that you're not changing things in the project that don't need to be changed. The last thing you want to do is disrupt the project for no good reason, wasting valuable time and resources. Any changed that is approved is then documented. The change control process is part of the larger change management plan.

A control process sets delegation limits and guidelines for decision making. It may include forms and templates to be completed. It also outlines the sequential procedures to be followed in respect to project change, which are typically to:

- identify the proposed change.
- assess its potential impact on a project— on factors such as scope, cost, quality, risk and schedules. The extent of rigour applied to this assessment will depend on the nature of the project itself and key stakeholders.
- approve or reject it. Approving it may be beyond the delegation of the Project Manager. If so, it may be referred to the project sponsor or the project Steering Committee, with recommendations based on the assessment.
- advise the party who requested the change of the outcome, with reasons.
- implement the change, if approved, and adjust planning documents to reflect its impact.
- follow up to check that implementation has occurred and been done properly.

It is important that the project change control process is managed expeditiously so that it, in itself, does not become a delay factor in the delivery of the project.

Q.4(b) Define the following:- i) Schedule Variance ii) Cost Variance iii) Earned Value iv) Schedule performance Index v) Cost performance index

[5]

Ans. : i) Schedule Variance

- Schedule Variance (SV) is a term for the difference between the earned value (EV) and the planned value (PV) of a project. It is used a measure of the variance analysis that forms an element the earned value management techniques. An alternative but less common classification of this technique is earned schedule management or analysis.
- The schedule variance indicates whether the performance – i.e. the authorized work performed – exceeds, falls below or is equal to the planned performance.

ii) Cost Variance

- Cost Variance (CV) is an indicator of the difference between earned value and actual costs in a project. It is a measure of the variance analysis technique which is a part of the earned value management methodology.

iii) Earned Value

- Earned value management (EVM) is a systematic process used to measure project performance at various times throughout a project life cycle. EVM helps project managers to determine whether a project is over or under budget, or if the project is on schedule.
- The term earned value (EV) indicates the value of work earned and this is obtained as the cumulative values of the quantum of the work actually expected in the activities multiplied by the corresponding budgeted unit costs of the respective activities.

iv) Schedule performance index

- The Schedule Performance Index is a measure of project efficiency given by Project Management to gauge the progress and efficiency. A Schedule Performance Index score of 1 or greater is an optimum goal since it shows the Project Management that the project is on track and has favorable conditions of meeting the required goals.
- However, a Schedule Performance Index less than 1 is to be avoided since that shows the project is not meeting goals and is showing unfavorable conditions that could lead to project failure if the current course of action is allowed to continue.
- The Schedule Performance Index is a ratio of Earned Value (EV) to the Planned Value (PV). Earned Value is the value of the project at its current timeframe. Planned Value is the overall projected value of the project at the same time as the Earned Value. To determine the project's Schedule Performance Index the Project Management divides the EV by the PV. This can also be shown as a simple formula; $SPI=EV/PV$.

v) Cost performance index

- The cost performance index or CPI is a measure of how well the project is doing in terms of spending the project budget. It is a comparison of the actual expenditures to the work that was accomplished. The index is a value that allows projects of different sizes to be compared.
- The cost performance index is like the cost variance discussed previously with one important difference.
- When we calculated the cost variance, the result was a figure in dollars. If the dollars were a negative number, the variance was considered bad, and if the dollars were positive, the variance was considered good.

Q.4(c) Explain briefly all the stages in Contract Placement.

[5]

Ans. : A contract is a legally binding document that recognizes and governs the rights and duties of the parties to the agreement. A contract is legally enforceable because it meets the requirements and approval of the law. A contract typically involves the exchange of goods, service, money, or promise of any of those.

Contact Placement has taken on a bigger role in day-to-day tasks as businesses work towards increasing productivity without increasing their employee numbers. As the amount of contracts in business transactions grow, it's imperative that contracts save time, not consume more of it.

Stage 1. Contract Preparation – Identify Your Needs, Establish Goals, Set Expectations, and Define Risk

- Contracts should seek to define and mitigate risk in a relationship, looking ahead to any potential scenarios that could occur over the lifetime of the document and accounting for them in the contract.
- For example, the terms of agreement within a contract should address what happens if the client files for bankruptcy, goes out of business, or sells the company, along with any other contingencies that may arise.
- One goal of this document should be to make sure the business is financially protected despite the scenario, and will be paid once the tasks outlined in an agreement are complete. A contract ensures that even if a business relationship is strong, each side is going to obtain exactly what is expressed in the contract.

Stage 2. Author the Contract

- When authoring the terms of the contract, it's also important to pay attention to specific wording. Any ambiguity leaves contracts up for interpretation, even down to a comma.
- State and country laws will also need to be taken into consideration, especially if the two parties are in different locations.

Stage 3. Negotiate the Contract

- No matter how much research, planning, and preparation goes into the first draft of a contract, negotiation almost always follows. Negotiation should begin with transparency and trust.
- Anticipating and researching the other party's needs before the conversation simplifies the process and creates a strong foundation for a lasting relationship.
- As redlining begins, it's easiest to use a contract management platform so both parties can view the working document to make changes and collaborate in real time.
- Email and offline documents can be confusing and cause costly mistakes, but a single source of truth for conversations and contracts will result in quicker negotiations and a contract that provides visibility for both sides.

Stage 4. Get Approval before Finalizing the Contract

- After negotiations are complete and both parties agree, next comes approval. In larger companies that need manager approval or have audit procedures, all the requirements for approval will need to be met before finalizing the deal.
- For example, if a company has specific procurement policies, they will need to be met prior to gaining approval for the contract.
- In a contract placement platform, this is as simple as setting up an approval workflow so that whoever needs to approve the contract receives a notification and can view, edit, and comment on the contract in real time.

Stage 5. Execute the Contract

- The signing should be the simplest part of a contract: both parties agree, the wording is exact, and the next step is simply making it official.
- However, many businesses make agreements across the country or even the globe, and getting signatures isn't as straightforward as meeting in person.
- Especially if deadlines are tight or time zones are incompatible, overnight mail or even email may not be the best way to get signatures faster.
- A legally binding online signature (e-signature) can solve all these problems, allowing you to move faster, accelerating signatures and revenue.

Stage 6. Keep up with Amendments and Revisions

- Contracts are rarely stagnant. Revisions and amendments are a common part of the lifecycle of a contract. Tracking changes and the effects for each party can be confusing; however, this is another reason to implement a reliable process, such as a contract lifecycle management platform, to easily record edits and add amendments.
- It's important to stay ahead of the changes and make sure both parties are fully aware and in agreement on any revisions.

Stage 7. Manage after the signature - Obligations, Auditing and Renewals

- Performing regular audits will ensure obligations are met and value is realized. Alerts should be set for deadlines and renewals. Missed renewals mean lost opportunities to continue a relationship, and most importantly for a company, lost revenue.
- Being **aware** and making contact well before the renewal time shows reliability and care for the relationship, and will continue to build trust and loyalty.
- Contract placement can be a time-consuming task, but if properly managed, can be one of the most lucrative areas for building business relationships and generating revenue. A contract lifecycle management platform simplifies contract placement processes, providing the ability to manage and avoid risk and compliance issues through templates and approval workflows, streamline negotiations with online redlining, deliver more revenue and faster with online signatures, and more easily manage documents after their signed helping organizations grab opportunities that may otherwise have been missed.

Q.4(d) Define Contract. Classify contracts on the basis of payment to suppliers.

[5]

Ans. : Contracts are used for establishing business deals and partnerships. The parties involved in the business engagement decide the type of the contract. Usually, the type of the contract used for the business engagement varies depending on the type of the work and the nature of the industry. The contract type is the key relationship between the parties engaged in the business and the contract type determines the project risk. Let's have a look at most widely used contract types.

→ **Fixed Price (Lump Sum)**

- This is the simplest type of all contracts. The terms are quite straightforward and easy to understand. To put in simple, the service provider agrees to provide a defined service for a specific period of time and the client agrees to pay a fixed amount of money for the service.
- This contract type may define various milestones for the deliveries as well as KPIs (Key Performance Indicators). In addition, the contractor may have an acceptance criteria defined for the milestones and the final delivery.
- The main advantages of this type of contract is that the contractor knows the total project cost before the project commences.

→ **Unit Price**

- In this model, the project is divided into units and the charge for each unit is defined. This contract type can be introduced as one of the more flexible methods compared to fixed price contract.
- Usually, the owner (contractor/client) of the project decides on the estimates and asks the bidders to bid of each element of the project.
- After bidding, depending on the bid amounts and the qualifications of bidders, the entire project may be given to the same service provider or different units may be allocated to different service providers. This is a good approach when different project units require different expertise to complete.

→ **Cost Plus**

- In this contract model, the services provider is reimbursed for their machinery, labour and other costs, in addition to contractor paying an agreed fee to the service provider.
- In this method, the service provider should offer a detailed schedule and the resource allocation for the project. Apart from that, all the costs should be properly listed and should be reported to the contractor periodically.
- The payments may be paid by the contractor at a certain frequency (such as monthly, quarterly) or by the end of milestones.

→ **Incentive**

- Incentive contracts are usually used when there is some level of uncertainty in the project cost. Although there are nearly-accurate estimations, the technological challenges may impact on the overall resources as well as the effort.
- This type of contract is common for the projects involving pilot programs or the project that harness new technologies. There are three cost factors in an Incentive contract; target price, target profit and the maximum cost.
- The main mechanism of Incentive contract is to divide any target price overrun between the client and the service provider in order to minimize the business risks for both parties.

→ **Retainer (Time and Material - T&M)**

- This is one of the most beautiful engagements that can get into by two or more parties. This engagement type is the most risk-free type where the time and material used for the project are priced.
- The contractor only requires knowing the time and material for the project in order to make the payments. This type of contract has short delivery cycles, and for each cycle, separate estimates are sent of the contractor.

- Once the contractor signs off the estimate and Statement of Work (SOW), the service provider can start work. Unlike most of the other contract types, retainer contracts are mostly used for long-term business engagements.
- **Percentage of Construction Fee**
 - This type of contracts is used for engineering projects. Based on the resources and material required, the cost for the construction is estimated. Then, the client contracts a service provider and pays a percentage of the cost of the project as the fee for the service provider.
 - As an example, take the scenario of constructing a house. Assume that the estimate comes up to \$230,000. When this project is contracted to a service provider, the client may agree to pay 30% of the total cost as the construction fee which comes up to \$69,000.
- **Conclusion**
 - Selecting the contract type is the most crucial step of establishing a business agreement with another party. This step determines the possible engagement risks.
 - Therefore, companies should get into contracts where there is a minimum risk for their business. It is always a good idea to engage in fixed bids (fixed priced) whenever the project is short-termed and predictable.
 - If the project nature is exploratory, it is always best to adopt retainer or cost plus contract types.

Q.4(e) Explain general recruitment process.

[5]

Ans. : Recruitment is a process of finding and attracting the potential resources for filling up the vacant positions in an organization. It sources the candidates with the abilities and attitude, which are required for achieving the objectives of an organization. Recruitment process is a process of identifying the jobs vacancy, analyzing the job requirements, reviewing applications, screening, shortlisting and selecting the right candidate. These five practices ensure successful recruitment without any interruptions. In addition, these practices also ensure consistency and compliance in the recruitment process.



→ **Recruitment Planning**

- Recruitment planning is the first step of the recruitment process, where the vacant positions are analyzed and described. It includes job specifications and its nature, experience, qualifications and skills required for the job, etc.

- A structured recruitment plan is mandatory to attract potential candidates from a pool of candidates. The potential candidates should be qualified, experienced with a capability to take the responsibilities required to achieve the objectives of the organization.
 - The first and foremost process of recruitment plan is identifying the vacancy. This process begins with receiving the requisition for recruitments from different department of the organization to the HR Department, which contains –
 - Number of posts to be filled
 - Number of positions
 - Duties and responsibilities to be performed
 - Qualification and experience required
 - When a vacancy is identified, it the responsibility of the sourcing manager to ascertain whether the position is required or not, permanent or temporary, full-time or part-time, etc. These parameters should be evaluated before commencing recruitment. Proper identifying, planning and evaluating leads to hiring of the right resource for the team and the organization.
- **Strategy Development**
- Recruitment strategy is the second step of the recruitment process, where a strategy is prepared for hiring the resources. After completing the preparation of job descriptions and job specifications, the next step is to decide which strategy to adopt for recruiting the potential candidates for the organization.
 - While preparing a recruitment strategy, the HR team considers the following points –
 - Make or buy employees
 - Types of recruitment
 - Geographical area
 - Recruitment sources
 - The development of a recruitment strategy is a long process, but having a right strategy is mandatory to attract the right candidates. The steps involved in developing a recruitment strategy include –
 - Setting up a board team
 - Analyzing HR strategy
 - Collection of available data
 - Analyzing the collected data
 - Setting the recruitment strategy
- **Searching**
- Searching is the process of recruitment where the resources are sourced depending upon the requirement of the job. After the recruitment strategy is done, the searching of candidates will be initialized. This process consists of two steps –
 - **Source activation** – Once the line manager verifies and permits the existence of the vacancy, the search for candidates starts.
 - **Selling** – Here, the organization selects the media through which the communication of vacancies reaches the prospective candidates.
 - Searching involves attracting the job seekers to the vacancies. The sources are broadly divided into two categories: Internal Sources and External Sources.
 - Internal sources of recruitment refer to hiring employees within the organization through –
 - Promotions
 - Transfers
 - Former Employees
 - Internal Advertisements (Job Posting)
 - Employee Referrals
 - Previous Applicants
 - External sources of recruitment refer to hiring employees outside the organization through –
 - Direct Recruitment

- Employment Exchanges
- Employment Agencies
- Advertisements
- Professional Associations
- Campus Recruitment
- Word of Mouth

→ **Screening**

- Screening starts after completion of the process of sourcing the candidates. Screening is the process of filtering the applications of the candidates for further selection process.
- Screening is an integral part of recruitment process that helps in removing unqualified or irrelevant candidates, which were received through sourcing. The screening process of recruitment consists of three steps –
- **Reviewing** is the first step of screening candidates. In this process, the resumes of the candidates are reviewed and checked for the candidates' education, work experience, and overall background matching the requirement of the job.
- While reviewing the resumes, an HR executive must keep the following points in mind, to ensure better screening of the potential candidates –
 - Reason for change of job
 - Longevity with each organization
 - Long gaps in employment
 - Job-hopping
 - Lack of career progression
- **Conducting telephonic or video interviews** is the second step of screening candidates. In this process, after the resumes are screened, the candidates are contacted through phone or video by the hiring manager. This screening process has two outcomes –
 - It helps in verifying the candidates, whether they are active and available.
 - It also helps in giving a quick insight about the candidate's attitude, ability to answer interview questions, and communication skills.
- **Identifying** the top candidates is the final step of screening the resumes/candidates. In this process, the cream/top layer of resumes are shortlisted, which makes it easy for the hiring manager to take a decision. This process has the following three outcomes –
 - Shortlisting 5 to 10 resumes for review by the hiring managers
 - Providing insights and recommendations to the hiring manager
 - Helps the hiring managers to take a decision in hiring the right candidate

→ **Evaluation and Control**

- Evaluation and control is the last stage in the process of recruitment. In this process, the effectiveness and the validity of the process and methods are assessed. Recruitment is a costly process, hence it is important that the performance of the recruitment process is thoroughly evaluated.
- The costs incurred in the recruitment process are to be evaluated and controlled effectively. These include the following –
 - Salaries to the Recruiters
 - Advertisements cost and other costs incurred in recruitment methods, i.e., agency fees.
 - Administrative expenses and Recruitment overheads
 - Overtime and Outstanding costs, while the vacancies remain unfilled
 - Cost incurred in recruiting suitable candidates for the final selection process
 - Time spent by the Management and the Professionals in preparing job description, job specifications, and conducting interviews.
- For any organization, recruitment is a crucial part of developing and maintaining an effective and efficient team. A good recruitment strategy will cut down the wastage of time and money, which would have incurred for extensive training and development of unqualified resources.

Q.4(f) Discuss the factors of job satisfaction given by Oldham-Hackman. Also state the methods of improving motivation. [5]

Ans. : The job characteristics model, designed by Hackman and Oldham, is based on the idea that the task itself is key to employee motivation. Specifically, a boring and monotonous job stifles motivation to perform well, whereas a challenging job enhances motivation. Variety, autonomy and decision authority are three ways of adding challenge to a job.

Hackman and Oldham's job characteristics theory proposes that high motivation is related to experiencing three psychological states whilst working:

i. Meaningfulness of work

- That labor has meaning to you, something that you can relate to, and does not occur just as a set of movements to be repeated. This is fundamental to intrinsic motivation, i.e. that work is motivating in an of itself (as opposed to motivating only as a means to an end).
- The work must be experienced as meaningful (his/her contribution significantly affects the overall effectiveness of the organization). This is derived from:

- **Skill Variety:** Using an appropriate variety of your skills and talents: too many might be overwhelming, too few, boring.
- **Task Identity:** Being able to identify with the work at hand as more whole and complete, and hence enabling more pride to be taken in the outcome of that work (e.g. if you just add one nut to one bolt in the same spot every time a washing machine goes past it is much less motivating than being the person responsible for the drum attachment and associated work area (even as part of a group).
- **Task Significance:** Being able to identify the task as contributing to something wider, to society or a group over and beyond the self.

For example, the theory suggests that I will be more motivated if I am contributing to the whole firm's bonus this year, looking after someone or making something that will benefit someone else.

Conversely I will be less motivated if I am only making a faceless owner wealthier, or am making some pointless item (e.g. corporate give-away gifts).

ii. Responsibility

- That you have been given the opportunity to be a success or failure at your job because sufficient freedom of action has given you. This would include the ability to make changes and incorporate the learning you gain whilst doing the job.
- Responsibility is derived from autonomy, as in the job provides substantial freedom, independence and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out).

iii. Knowledge of Outcomes

- This is important for two reasons. Firstly, to provide the person knowledge on how successful their work has been, which in turn enables them to learn from mistakes.
- The second is to connect them emotionally to the customer of their outputs, thus giving further purpose to the work (e.g. I may only work on a production line, but I know that the food rations I produce are used to help people in disaster areas, saving many lives).
- This comes from feedback. It implies an employee awareness of how effective he/she is converting his/her effort into performance.
- This can be anything from production figures through to customer satisfaction scores. The point is that the feedback offers information that once you know, you can use to do things differently if you wish. Feedback can come from other people or the job itself.

Knowing these critical job characteristics, the theory goes, it is then possible to derive the key components of the design of a job and redesign it:

- I. Varying work to enable skill variety.

- II. Assigning work to groups to increase the wholeness of the product produced and give a group to enhance significance.
- III. Delegate tasks to their lowest possible level to create autonomy and hence responsibility.
- IV. Connect people to the outcomes of their work and the customers that receive them so as to provide feedback for learning.

Q.5 Attempt the following (any THREE)

[15]

Q.5(a) What do you mean by team structure? Explain different types of team structures.

[5]

Ans. : A team is a small number of people with complementary skills who are committed to a common purpose, set performance goals and approach for which they hold themselves mutually accountable.

The team can also be defined as a group of individuals which shares a common purpose and develops common understanding of this purpose, common agreement on it and total commitment to it, galvanized into a single functional unit fully oriented and focused on the tasks towards the agreed upon purpose.

As against traditional organizational structures wherein they had different departments for each business function, today the day-to-day activities of a firm revolve around teams.

Whether it's a sales and marketing team or research and development team, teams are flexible and can build products, negotiate prices and strike deals, coordinate projects and provide services etc. There are four important kinds of teams that one would commonly find:

1. Problem – Solving Teams:

- This kind of team basically comprises of a few members, ideally from 5 to 12, belonging to a particular department coming together on a weekly basis to discuss and solve problems of their department functioning.
- Members give their individual suggestions for process improvement and after enough deliberation, present their advice to the higher management for further implementation.
- For example, Merrill Lynch, in the earlier days had created a problem-solving team to figure out a way to reduce the time taken to open a new cash management account.

2. Self – Managed Teams:

- While problem-solving teams were effective in recommending solutions, they didn't have the power to implement them.
- Self-managed teams were built to address this challenge and apart from discussing issues, they were responsible for implementing the solutions and taking responsibilities for their outcomes.
- From making operational decisions to interacting with customers, self-managed teams are highly effective provided the members are motivated and driven to bring about positive change.

3. Cross – Functional Teams:

- When employees from different business functions but belonging to a similar hierarchical level come together to achieve a common task, the team is called a cross-functional team. The members bring their individual expertise from their respective work area and exchange information for a common cause.
- Whether it is finding solution to a development fault or coordinating complex projects, cross-functional teams are very effective if managed well.
- For example, the Boeing Company created a cross-functional team of employees from various departments like production, quality, and design engineering, tooling and information systems to automate shims on the C-17 program.
- Since the members belonged to diverse backgrounds, they were able to give different perspectives to arrive at the best solution. The team's suggestions helped reduce the cycle time and cost, as well as greatly improved the quality of the program.
- While cross-functional teams are highly effective, they need good management skills to build trust and teamwork amongst the members and manage the diverse nature of the team.

4. Virtual Teams:

- In today's world of internet and mobile technologies, it's easier to manage physically dispersed members with the concept of building virtual teams. Members collaborate online, participate in video-conferences and discuss in real-time to realize a common objective.
- While virtual teams are easily manageable, the members sometime lack the motivation to find solutions or fail to trust each other due to absence of any direct interaction.
- These challenges must be addressed by monitoring the efforts of the members and recognizing their individual contributions.

Q.5(b) Explain five basic stages of Team development. Also state the different types of people needed to form a balanced team. [5]

Ans. : Developing teams is not an instantaneous process; it takes time and commitment on the part of the project manager to develop one. A project team is a consideration of people, never may before. Also, as projects are temporary, teams too are viewed as a temporary arrangement and therefore there may be a lack of effort and willingness amongst team members to develop relationships.

The goal of team development is not to develop long lasting relationship but to develop a team that can effectively complete the project. Therefore, the bonus to develop the team lies with the project manager.

The four stages of development all teams move through over time: **forming, storming, norming, and performing.**

I. Forming

- This is where team members first meet. It's important for team leaders to facilitate the introductions and highlight each person's skills and background. Team members are also given project details and the opportunity to organize their responsibilities.
- Carefully planning each phase of a project helps team members understand their role within the team and what's expected of them. During your first project team meeting, start by explaining specifically what each person will be working on.
- Next, explain the project so everyone is clear on their contribution and expected outcomes. If the goal of the project is to increase customer acquisition, you can explain that month-over-month growth has stalled and your strategy to solve this is to:
 - Find out what's caused growth to plateau
 - Come up with a plan to fix the problem
 - Put the plan into action
- At this point, explain how each team member is expected to help. For example, let the designers know that the user interface will be reviewed to see whether there's an opportunity to make improvements.
- Finally, share the project roadmap so the team can see the starting point, the proposed check-in points, and the end goal. This gives them insight into the bigger goal but also breaks down the timeline into smaller increments.

II. Storming

- At this stage, team members openly share ideas and use this as an opportunity to stand out and be accepted by their peers. Team leaders help teams in this stage by having a plan in place to manage competition among team members, make communication easier, and make sure projects stay on track.
- Disagreements are unavoidable on teams, especially when each person on the team has a different perspective on how to approach the issues the team encounters. When you all work in the same location, it can be easier to hash out problems quickly.
- Instead of letting team members battle it out in private messages select the best solution, be ready to invite them into a chat room to offer advice or ask some key questions. Very few team members will have your perspective on the entire project (or the full scope of your team's segment of the project), so don't be afraid to jump in.
- When you do find a good solution or process to help resolve difficult situations, make sure you document those immediately. The team can consult this record when future problems arise and make adaptations as needed. Your teams will soon learn that conflict is not to be feared, and that they have the tools to find a productive compromise.

III. Norming

- By now, teams have figured out how to work together. There's no more internal competition, and responsibilities and goals are clear.
- Each person works more efficiently because he or she has learned how to share their ideas and listen to feedback while working toward a common goal.
- With remote teams, it's easy to run on assumptions until you're almost up against a deadline — and then you discover that you didn't get the outcome you needed. Help your team check in with each other by holding daily standup meetings or mid-week progress reports to see if everyone is on track and has the materials they need.
- It's easy for everyone — including you — to get in a tunnel and focus on their own lists of tasks. Make sure everyone steps back each day or week to take a look at the larger picture.

IV. Performing

- In the performing stage, teams are in sync and work more efficiently together than at any previous stage. Teams that have been working closely for some time have resolved enough issues to understand what success looks like for them. For example, success can be anything from higher customer acquisition to a positive shift in the metrics they're tracking.
- To get to this point, consistency is key. If you've asked team members to update progress documents weekly, check to make sure it's being done.
- Set reminders for yourself to check in with team members, or send calendar events so that making updates is always top of mind and getting done. The main goal here is to keep the momentum going so that the project wraps up on time.
- Keep reminding the team to check in with each other regularly in person or via instant chat, but stay out of their way. They will waste time and lose their focus if they have to answer frequent, unscheduled questions about what they're working on.
- Encourage team members to develop a schedule filled with large blocks of time that are free from interruptions like meetings or check-ins. In this world of constant notifications, it's easy for people to get derailed and forget which goals are really important. This is especially important for creative and development teams.

V. Adjourning

- Teams complete their project and debrief on what went well and what could be improved for future projects. Afterwards, team members move on to new projects. This is the time for your team to finally step back to see what they've accomplished. Two things happen at this point:
 - Teams review the last few weeks or months to celebrate their successes.
 - Teams take an honest look at what didn't go well and pinpoint where there's room for improvement.
- At the end of the project, set up an online meeting where team members come together to discuss the entire project, from the successes to the frustrations.
- Ask them to prepare examples beforehand outlining what worked and what didn't, and then give each person five minutes to share their thoughts. Document the comments so that it's easy to see which trends emerge and what changes need to be made going forward.
- When looking back to find opportunities for improvement, set up a brainstorming session with your team. Get your team members to prep ideas to share at the meeting.
- For example, ask team members these types of questions to uncover the good and the bad in each project:
 - What would you change about the team and project introduction process?
 - What additional documentation do we need for issue resolution?
 - What kind of support can team leaders offer?
 - What tasks took the most time?

- If you were to do a similar project again, what team members would you add or remove as a way to improve the team's efficiency and expertise?
- Which tools worked best? Which hindered progress?

Working with a team of people can be exhilarating—and challenging. Aside from the chemistry of personalities and work styles that affect a group dynamic, there's also the territorial play. Popular theories say a high-performing team is comprised of both distinctly defined roles and a well-rounded collection of personality archetypes. Here's a short guide to 7 personality types that complete a successful team:

- 1) **The Leader:** This person is responsible for mediating conflicts, facilitating communications between team members, and keeping everyone on course. The leader will schedule and guide the course of meetings, but that doesn't mean being the only speaker, or leading all the meetings. A good leader knows how to delegate and let go of the reins.
- 2) **The Team Player:** Team players are identified by their enthusiasm to work together for a common good. They're usually eager to help, willing to compromise and diplomatic. They might not be the biggest initiators in the world, but you can rely on team players to follow-through on tasks and to willingly settle conflicts with their calming demeanor (they're sort of like the glue of the group).
- 3) **The Researcher:** The researcher types—who show up in sales, IT, support, marketing, content, etc.—are always asking questions and then finding their own answers. If you need more information to complete your project, it's important to have a strong researcher who can get it for you. Researchers ask the overlooked questions that can avert a future impediment. This natural private eye knows the quickest way to the best resources and is the person everyone goes to with the most puzzling questions.
- 4) **The Expert:** This is the person that possesses intimate knowledge in a field that your project encompasses. So, if you're on the marketing team within a group that is working on new mobile software, you need a developer to go to who will explain the necessary technical details and offerings—and make sure you're accurately representing the product in your messaging.
- 5) **The Planner:** If you have a natural planner on your team, trust that their skills will deliver your project in the estimated period of time. Natural planners love lists, charts, and calendars. They're punctual, able to see the curve in the road (and incoming curve balls) and often have strategies for improving a process or increasing team efficiency.
- 6) **The Creative:** Every team benefits from a creative thinker in the group—someone who can deliver fresh ideas and solutions that let the team's work stand out from the crowd. Creative types have a tendency to get caught up in their world of imagination, problem-solving, and conceptualizing. To spot a creative, look for the original thinker, the person willing to turn the status quo on its head and come up with a new approach to a long-standing goal.
- 7) **The Communicator:** Communicators are often thought of as the salespeople, marketers, writers, and leaders. Those are communication jobs. We're talking about the natural communicators—not just the talkative ones (that's often part of it), but individuals who are naturally inclined to reach out to others and share information with the entire team. Your communicator might be the person with the longest list of contacts and knows someone for just about anything you need.

Q.5(c) What is the importance of Software Quality? Discuss six major external software quality characteristics identified by ISO 9126.

[5]

Ans. : Software quality is a nuanced concept that requires a framework that addresses functional, structural and the process of the software delivery. Measurement of each aspect is a key tool for understanding whether we are delivering a quality product and whether our efforts to improve quality are having the intended impact. However, measurement can be costly. To balancing the effort required to measure quality versus the benefit, you first need to understand the reasons for measuring quality. Five of reasons quality is important to measure include:

- I. **Safety:** Poor quality in software can be hazardous to human life and safety. Quality problems can impact the functionality of the software products.
- II. **Cost:** Quality issues cost money to fix. Whether you believe that a defect is 100x more costly to fix late in the development cycle or not, doing work over because it is defective does not deliver more value than doing it right once.
- III. **Customer Satisfaction (Internal):** Poor quality leads stakeholders to look for someone else to do your job or perhaps shipping your job and all your friend's jobs somewhere else. Recognize that the stakeholders experience as the software is being developed, tested and implemented is just as critical as the raw number of defects.
- IV. **Customer Satisfaction (External):** Software products that don't work, are hard to use (when they don't need to be), or are buggy don't tend not to last long in the marketplace. Remember that in today's social media driven world every complaint that gets online has a ripple effect. Our goal should be to avoid problems that can be avoided.
- V. **Future Value:** Avoiding quality problems increases the amount of time available for the next project or the next set of features. Increasing quality also improves team morale, improved team morale is directly correlated with increased productivity (which will increase customer satisfaction and reduce cost).

ISO 9126 is an international standard for the evaluation of software. The standard is divided into four parts which addresses, respectively, the following subjects: quality model; external metrics; internal metrics; and quality in use metrics.

ISO9126-1 represents the latest (and ongoing) research into characterizing software for the purposes of software quality control, software quality assurance and **Software Process Improvement (SPI)**.

The other parts of **ISO9126**, concerning metrics or measurements for these characteristics, are essential for **SQC**, **SQA** and **SPI** but the main concern of this article is the definition of the basic **ISO 9126 Quality Model**.

The **ISO 9126-1** software quality model identifies 6 main quality characteristics, namely:

- **Functionality:** Functionality is the essential purpose of any product or service. For certain items this is relatively easy to define, for example a ship's anchor has the function of holding a ship at a given location. The more functions a product has, e.g. an ATM machine, then the more complicated it becomes to define its functionality. For software a list of functions can be specified, i.e. a sales order processing systems should be able to record customer information so that it can be used to reference a sales order. A sales order system should also provide the following functions:
 - Record sales order product, price and quantity.
 - Calculate total price.
 - Calculate appropriate sales tax.
 - Calculate date available to ship, based on inventory.
 - Generate purchase orders when stock falls below a given threshold.

The list goes on and on but the main point to note is that functionality is expressed as a totality of essential functions that the software product provides.

A function of the sales order process could be to record the sales order but we could implement a hard copy filing cabinet for the actual orders and only use software for calculating the price, tax and ship date. In this way the functionality of the software is limited to those calculation functions.

The relationship between software functionality within an overall business process is outside the scope of **ISO9126** and it is only the software functionality, or essential purpose of the software component, that is of interest for **ISO9126**.

- **Reliability:** Once a software system is functioning, as specified, and delivered the reliability characteristic defines the capability of the system to maintain its service provision under defined conditions for defined periods of time. One aspect of this characteristic is fault tolerance that is the ability of a system to withstand component failure. For example, if the network goes down for 20 seconds then comes back the system should be able to recover and continue functioning.
- **Usability:** Usability only exists with regard to functionality and refers to the ease of use for a given function. For example, a function of an ATM machine is to dispense cash as requested. Placing common

amounts on the screen for selection, i.e. \$20.00, \$40.00, \$100.00 etc, does not impact the function of the ATM but addresses the Usability of the function. The ability to learn how to use a system (learnability) is also a major sub-characteristic of usability.

- **Efficiency:** This characteristic is concerned with the system resources used when providing the required functionality. The amount of disk space, memory, network etc. provides a good indication of this characteristic. As with a number of these characteristics, there are overlaps. For example, the usability of a system is influenced by the system's Performance, in that if a system takes 3 hours to respond the system would not be easy to use although the essential issue is a performance or efficiency characteristic.
- **Maintainability:** The ability to identify and fix a fault within a software component is what the maintainability characteristic addresses. In other software quality models this characteristic is referenced as supportability. Maintainability is impacted by code readability or complexity as well as modularization.
- **Portability:** This characteristic refers to how well the software can adopt to changes in its environment or with its requirements. The sub characteristics of this characteristic include adaptability. Object oriented design and implementation practices can contribute to the extent to which this characteristic is present in a given system.

Q.5(d) State four popular process of capability models and explain any one of them.

[5]

Ans. : Capability Maturity Model (CMM) is a methodology used to develop, refine maturity of an organizations software development process. It is developed by SIE in mid1980. It is a process improvement approach. It Deals with the what processes should be implemented & not so much with the how processes should be implemented. A maturity model is a structured collection of elements that describe characteristics of effective processes.

- **Place to start**
- **Benefit of a community's prior experience**
- **Common language and a shared vision**
- **Framework for prioritizing action**

Place to start

- The organization usually does not provide a stable environment. Success in these organizations depends on the competence and heroics of the people in the organization and not on the use of proven processes.
- The first phase of process is very initial and important as it is the basic root of the capability models. It needs to be well cleared and error free so that the further process will not suffer any kind of loss or damage.
- This level of process has a basic and consistent project management process to track the overall cost, plan the schedule, and functionality. This phase can allow some iterations in starting, but after when the process starts to build at the 3rd or 4th phase it can't allow any changes to be made in the 1st phase itself.
- All the activities should be planned in the first process itself, which can allow other processes to perform their allotted tasks efficiently and smoothly without any kind of disturbance. This phase is more valuable as compared to others because, in this process it indicates half of the idea of the capability model which is to be made.

Q.5(e) Give a brief explanation of the main activities involved in Software Testing.

[5]

Ans. : Testing is the process of evaluating a system or its component(s) with the intent to find whether it satisfies the specified requirements or not. In simple words, testing is executing a system in order to identify any gaps, errors, or missing requirements in contrary to the actual requirements.

It depends on the process and the associated stakeholders of the project(s). In the IT industry, large companies have a team with responsibilities to evaluate the developed software in context of the given requirements.

Moreover, developers also conduct testing which is called Unit Testing.

An early start to testing reduces the cost and time to rework and produce error-free software that is delivered to

the client. However, in Software Development Life Cycle (SDLC), testing can be started from the Requirements Gathering phase and continued till the deployment of the software.

Quality Assurance: QA includes activities that ensure the implementation of processes, procedures and standards in context to verification of developed software and intended requirements. Focuses on processes and procedures rather than conducting actual testing on the system.

Quality Control: It includes activities that ensure the verification of a developed software with respect to documented (or not in some cases) requirements. Focuses on actual testing by executing the software with an aim to identify bug/defect through implementation of procedures and process.

Testing: It includes activities that ensure the identification of bugs/error/defects in a software. Focuses on actual testing.

Audit: It is a systematic process to determine how the actual testing process is conducted within an organization or a team. Generally, it is an independent examination of processes involved during the testing of a software.

Inspection: It is a formal technique that involves formal or informal technical reviews of any artifact by identifying any error or gap. Inspection is a formal evaluation technique in which software requirements, designs, or codes are examined in detail by a person or a group other than the author to detect faults, violations of development standards, and other problems.

Debugging: It involves identifying, isolating, and fixing the problems/bugs. Developers who code the software conduct debugging upon encountering an error in the code. Debugging is a part of White Box Testing or Unit Testing. Debugging can be performed in the development phase while conducting Unit Testing or in phases while fixing the reported bugs.

Types of Testing

- **Manual Testing:** includes testing a software manually, i.e., without using any automated tool or any script.
- **Automation Testing:** is used to re-run the test scenarios that were performed manually, quickly, and repeatedly. The tester writes scripts and uses another software to test the product.

Methods of Testing

- **Black-Box Testing:** The technique of testing without having any knowledge of the interior workings of the application is called black-box testing. In Black-Box Testing, tester will interact with the system's user interface by providing inputs and examining outputs without knowing how and where the inputs are worked upon.
- **White-Box Testing:** It is the detailed investigation of internal logic and structure of the code. In order to perform white-box testing on an application, a tester needs to know the internal workings of the code.
- **Grey-Box Testing:** It is a technique to test the application with having a limited knowledge of the internal workings of an application. Grey box testers don't rely on the source code; instead they rely on interface definition and functional specifications.

Testing Levels:

- Functional Testing
- Unit Testing
- Integration Testing
- System Testing
- Regression Testing
- Acceptance Testing
- Alpha Testing
- Beta Testing
- Non-Functional Testing
- Usability Testing
- Security Testing
- Portability Testing

Q.5(f) Discuss the main reasons for project closure.

[5]

Ans. : The final task of project closure comprises: channel financial records distribute resources, reassign project Personnel, and produce a final report that incorporates a discussion about the project's successes and shortcomings to be given to the senior management.

The planning for project closure should be top priority and should be planned for in the inception stages of a project as it elevates the chances of a successful completion.

The main reasons for project closure are:

- I. Project is closed when it has reached its stated objectives i.e. it has been successfully implemented and been handed over to its user. A successful project is simply deployed to its customer.
- II. A project may be closed when it is transferred to another organizational division to take the work forward. Such a decision may be taken if the management feels that the current project team is not in a position to reach the project objectives.
- III. Another reason for project closure or rather premature project closure is when the project manager reaches the conclusion that the project is unfeasible and that the objectives are out of reach, resulting in a prematurely closed down project.
- IV. A project on perfect course may face closure on changed requirements of the user making the project redundant and forcing to call of the project.
- V. Crises within the organization or customer may force the closure of a project. Sudden and unanticipated changes in technology may force the closure of a project.
- VI. Budgetary issues may force the closure of a project. Absence of key project personnel may force project closure.