6) Project Risk Management
   a) Risk: Factors that may cause a failure to meet the project’s objectives (APM Book), or limits the achievement of your objectives as defined at the outset of the project.
   
   b) Project Risk Management: The systematic processes of identifying, analysing and responding to project risk (PMBOK), throughout the project life-cycle. It includes maximising the results of positive events and minimising the consequences of adverse events.
   
   c) Risk Management Plan: A formal approach to the process as opposed to an intuitive approach (APM Book). It documents how you propose to tackle risk on your project. It includes (DIQDR):
      i) Define Objectives: Define the context of your work and your plan for success.
      ii) Identify Risk: Identify areas of risk, uncertainty and constraints, which may impact on your project.
      iii) Quantify Risk: Evaluate the risks and prioritise the level of risk and uncertainty and quantify their frequency of occurrence and impact.
      iv) Develop Response: Define how you are going to respond to the identified risks, which may be a combination of: eliminate, mitigate, deflect or accept.
      v) Risk Control: The risk control function implements the risk management plan. This may involve training team members, and communication with all stakeholders. As the risks and the work environment are continually changing, it is essential to continually monitor and review the level of risk and your ability to effectively respond.
   
   d) The Risk Management Process: Risk management requires:
      i) To keep risks under review and to make sure they are being addressed;
      ii) A means of identifying the potential risks to the project;
      iii) An assessment of the likelihood of each risk materialising;
      iv) An assessment of the probable impact of each risk;
      v) The formulation of measures to avoid each risk’s occurring;
      vi) The development of fallback measures to reorganize the risks if avoidance actions fail; and
      vii) The determination of the urgency of the risk and of taking appropriate counter-measures.
      And also, someone should be responsible for each risk.
   
   e) Risk Management Responsibility: The Managing Director is ultimately responsible to the board of directors and the shareholders for managing risk within the company. However, this responsibility is usually delegated through the corporate hierarchy with the Project Managers responsible for project risk and the Functional Managers responsible for their department’s risks.
   
   f) Disaster Recovery: For the ultimate unplanned catastrophe, that prevents your company providing its critical business functions for a period of time, and results in significant damage or loss, your company needs to develop a “disaster recovery plan”. Objective is to reduce the consequence of a disaster to an acceptable level.
   
   g) Define Objectives: As risks are mainly things that fail the projects goals and objectives, it’s important to define these goals and objectives, by considering break down of: the Project Brief, Project Charter and Project Proposal etc. And developing Risk Assessment Criteria.
h) Identifying Risk: After defining objectives, next is to identify what areas of risk and uncertainty could prevent you achieving these stated objectives. Hardest and most important part of Risk Mgmt process. Add column to list of objectives; Cause to Effect and Effect Caused by.

i) Techniques to Identify Risk:
   (1) Analysing historical records and closeout reports;
   (2) Structured questionnaires;
   (3) Structured interviews;
   (4) Brainstorming;
   (5) Structured checklists
   (6) Flow charts
   (7) Judgment based on knowledge and experience;
   (8) System analysis; and
   (9) Scenario analysis (what-if?).

ii) Balanced Team incorporates; experience, knowledge, judgment, entrepreneurial innovation, creativity, enthusiasm, internal members and external consultants, stands the best chance of success.

i) Why Projects Fail?
   i) Innovation: If innovation is too low, product may not compete in the market; but, if innovation is too high, you may be forever trying to iron out design problems.
   ii) Concurrency: Developing your product before your client’s requirements are fully defined.
   iii) Stakeholders: Failing to recognise stakeholder’s interests, particularly environmentalists.
   iv) Communication: NASA’s Mars probe crashed because of a mix up between imperial and metric units
   v) Scope of Work: Misinterpreting the scope of work is a common cause of project failure

vi) OTHER COMMON REASONS FOR PROJECT FAILURE:
   (1) Not working closely with the client.
   (2) Poor estimating.
   (3) Inadequate planning.
   (4) Insufficient reviews and control.
   (5) A lack of commitment. Gain commitment by involving the responsible people in the planning.
   (6) Incomplete information
   (7) Poor planning - material and equipment not available on time.
   (8) Lack of understanding of project management techniques.
   (9) Lack of support from team members.

j) Risk Quantification: Having identified the risks, next is to quantify the probability (likelihood) of the risk occurring and the impact or consequence to the project, or to the amount at stake.

i) Probability/Impact Matrix: This matrix plots the probability of the risk occurring against the impact on the project. They are quantified as high, medium, or low – this will give a matrix of nine possibilities.

ii) Priority: The output from risk quantification should be a WBS table, which identifies, quantifies and prioritises the risk. With finite resources it is essential to establish which risks should be addressed first so as to focus your effort.

k) Developing Response to Risk: Define ways to address adverse risk and enhance opportunities before they occur. Range of responses are:

   i) Eliminate Risk: Avoiding the risk completely – by removing the cause or taking alternative course.
   ii) Mitigate Risk: Reducing the risk’s probability and impact, by prototypes, simulating and modelling
   iii) Deflect Risk: Transfers the risk to another party, by contracting, retention, bonding and insurance.
   iv) Accept Risk.
I) **Contracting:** Project contracts are a means of deflecting risk, usually away from the client, and to the contractor. **Types of Contracts are:**

1) **Fixed price ( lump sum) contract:** Requires the contractor to complete the scope of work for a fixed price, which is written into the contract. More popular with clients because it passes much of the project risk onto the contractor.

2) **Cost plus (reimbursable, plus-fee) contract:** Most flexible type of contract, where the client pays all the direct costs to the contractor plus an agreed fee or percentage profit. It is criticised as the contractor has less reason to control costs and increase productivity, since their fee is proportional to the total cost of the project. Client has to closely monitor the performance.

3) **Unit rates (billed rates, parameter costs or schedule of rates) contract:** Negotiated rates for specific work. All payments based on measurement of the work completed using the unit rates.

4) **Turnkey (design and construct) contract:** Contractor is responsible for the project, from the design phase right through to the commissioning phase.

5) **Partnership (Joint Venture) contract:** Client and contractor share the risks and benefits on the project.

6) **Build Own Operate and Transfer (BOOT) ( BOT (build, operate and transfer) or ROT (refurbish, operate and transfer), or PPP (public private partnership) ) contract:** Transfers the risk completely to the contractor, not only to design and build a facility, but also to finance the building and operation of the facility. The contractor then operates the facility – for a period of time and charges the users for the product.

ii) **Retention:** The client retains a percentage of the contractors’ income against the contractor failing to complete their contractual obligations.

iii) **Bond:** The contractor offers the client a bond through a large organisation (bank). The bond could be held against lack of performance or poor quality of work. If the contractor fails to perform, the client is compensated by the bond company, who in turn will take agreed assets from the contractor to cover the bond.

1) **Insurance:** A third party accepts insurable risks for the payment of a premium. The premium is now the quantified impact of this risk on the project. Insurance could cover; Direct property damage, Indirect consequential loss (business interruption), Legal liability; and, Personnel liability.

iv) **Acceptance:** Here you accept the consequence of risk occurring, also called self- insurance. However, you may develop a contingency plan to protect your business from the risk event.

1) **Contingency Plan:** defines actions you will take ahead of time – if A happens we will do B.

v) **Risk Management Plan:** The risk management plan documents the output from the previous sections; identify, quantify and respond, and assigns responsibility for implementation.

m) **Risk Control:** Implements the risk management plan to make it happens – this is the most important part, but surprisingly is often neglected!

n) **Disaster Recovery Planning:** Follows the same process as the risk management plan, except now you are focusing on the **major risks,** which cannot be eliminated, mitigated or deflected.

i) **Disaster:** A sudden, unplanned catastrophe that prevents your company providing its critical business functions for a period of time and could result in a significant damage or loss. Eg. A fire, flood, earthquake, or hurricane etc.

ii) **Time Factor:** Determines whether a problem or service interruption is an inconvenience or a disaster

o) **Critical Success Factors:** Those few essential **activities** that **must go right** if the project is to be **successful.**
7) **Project Scheduling**

a) **Schedule:** Conversion of a *project action plan* into an *operating timetable*. Serves as the basis for monitoring and controlling project activity and, taken together with the plan and budget, is probably the major tool for the management of projects. Attention to scheduling is one primary feature that distinguishes between general management and project management.

b) **Scheduling Considerations:**
   i) In developing our schedule we cannot necessarily take an activity of n days effort and divide it between two people to produce an elapsed time of n/2. (Eg. Ten people digging a small hole)
   ii) Whether the activities we have identified in our work breakdown structure are all that need to go on the schedule.
   iii) **Resource Availability**
   iv) **Project Milestones:** The control points at which we can evaluate the project progress and adjust our project plan. They can also be used to illustrate progress to the customer. Importance of milestones:
      (1) Provide useful control points at which we can evaluate progress and adjust our plans for the rest of the project as necessary.
      (2) They can be used to illustrate progress to the customer.
      (3) There may be intermediate sign-offs or stage payments linked to the achievement of milestones.
   v) **Overhead tasks:** Supporting activities, such as project management, administration works to complete timesheets and regular team meetings.

c) **Gantt chart:** Can be drawn by plotting into a graph with Time Duration on the X-axis, and Activities on the Y-axis. The chart consists of several horizontal bars – each bar represents each activity in the project. The length of each bar is proportional to the time duration in the project that has been planned.
   i) **Advantage:** Simplicity to be drawn and to be understood by ordinary persons.
   ii) **Disadvantage:**
      (1) Does not show the *interdependence* of activities.
      (2) No guide on the effect of a delay on one activity over the entire project.

d) **Critical Path Method:**
   (1) **Advantage:** Reveals the *interdependence* of activities.
   (2) **Disadvantage:**
      (a) Current status of the project not shown clearly
      (b) There is often a need to include dummy activities.
      (c) Difficult to maintain and keep up-to-date manually
   ii) **Simple Network** (network diagram): Arrows represent project activities, while circles represent the start and end of such activities. The directions of arrows indicate directional flow of activities.
   iii) **Analysis of Network:**
      (1) **Critical Path Activities:** Have the same “early start” and “late start”, and the same “early finish” and “late finish”. These have to be closely monitored and controlled if the project were to complete on time.
      (2) **Non-Critical activities:** there are times of rest for them.
      (3) **Dummy Activities:** This activity is only a logical link between the two nodes. Does not represent any specific operation, and it does not utilise any resource
iv) **Complex Network Notation:** To avoid looking at the analysis in the table form. Nodes have four compartments (or three).

   **(1) Critical Path:** Thick arrows along which the slack = 0.

v) **Network Evaluation:** The network diagram and analysis approach is a powerful tool for supporting this possible change to the plan. Changes that can be made to the network are:

   **(1) Reduce Activity Durations:** By concentrating only on those activities on the critical path.

   **(2) Change Activity Sequence:** Requires a review of the logical sequence of activities in the initial plan. Some activities may be undertaken in parallel. Others can start when only parts of the preceding activities have been completed. These and other possibilities should focus on activities that lie on the critical path. They may involve breaking up or merging together of activities.

e) **Job Progress Chart (JPC):** An alternative for the compromise between the need for a simple tool as the Gantt chart as well as the flexibility of the network, the Job Progress Chart (JPC) can be. It is more like a modified Gantt chart.

8) **Resource Management & Allocation**

a) **Resource:** Any item or person that is needed to run the project. **Seven categories:** (Imagine a Construction Site)

   i) **Labour:** Refers to the project development team members.

   ii) **Equipment:** Includes the computing and office equipment to run the project.

   iii) **Materials:** Items being consumed during project execution.

   iv) **Space:** The area needed to accommodate the people and items during the project.

   v) **Services:** Referring to services such as telecommunications services, etc.

   vi) **Time:** The timescale is dependent on other resources. The time will be shortened if other resources utilisation increases and the time frame will be longer if other resources utilisation decreases.

   vii) **Money:** For buying other resources and will be consumed when those resources are used.

b) **IT Project Resources:**

   i) **Three Broad Categories**

      **(1) Hardware Resource:** This provides the platform that supports the software tools required to produce the required products – e.g. PC, Mainframes, OS, etc.

      **(2) Software Resource:** This consists of the reusable software components such packages, existing codes and specifications, test data, etc.

      **(3) Human Resource:** This consists of IT professionals of various types together with resourceful users who can contribute effectively in projects.

   ii) **Infrastructure needed to execute the project effectively and efficiently includes:**

      **(1) The office space of reasonable size;**

      **(2) Efficient administrative support;**

      **(3) Access to the right hardware and software;**

      **(4) Standards and guidelines;**

      **(5) Access to training in the required skills;**

      **(6) Re-usable components (if any) from previous projects; and**

      **(7) Resources external to the project team – such as vendors, support groups, users, and contract staff.**
c) Group Resources:

i) Project Team: A typical project team consists of mostly the system analysts and programmers. There may be a network specialist, a database administrator (DBA), or even a Web designer as well.

(1) Reasons to consider matching professional manpower to the right pieces of jobs in the IT project:
   (a) The person has the right knowledge, the right skills, and the length of experience to perform on the job effectively.
   (b) Project team members are developed and are given the right challenge on a range of new areas so as not to become bored.
   (c) The experts and the expensive staff are fully utilised, and they should not be wasted on tasks that other people can do.

ii) User Group:

(1) End Users: People who make use of the system on a regular basis.
(2) User Group meetings provide a very good forum for the joint review and appraisal of latest developments within the project.

iii) Steering Committee: A high-level advisory committee with the power to set priorities and steer the project in the direction of corporate objectives.

(1) A typical project steering committee consists of the following parties:
   (a) Members of senior management;
   (b) Executive or project sponsor;
   (c) IT manager;
   (d) Project manager and project leaders; and
   (e) User representatives.

(2) Key roles of the steering committee can be described as follows:
   (a) To provide a forum for discussion of major user’s concerns;
   (b) To review the current status of the project;
   (c) To review deviations from plan and the alternative corrective actions;
   (d) To recommend changes to the project to reflect user’s requirements; and
   (e) To provide advice on policy formulation on system operation.

d) Key Players: Some of the people associated with projects are key individuals who are very resourceful. They play more important roles than others in terms of project executions. Key players are project resources that must be recognised and exploited. Their absence could affect project executions, and so their positions need to be created and filled.

i) Executive Sponsor: The key stakeholder who has the overall responsibility for ensuring that the project meets the expectations of all stakeholders. In addition, to ensure that project objectives are compatible with the organization’s strategy and long-term objectives. Also provides a channel of communication between the project manager and the senior management.

ii) Project Manager: The person responsible for organising and building the project. Skills he needs to have are: Management Related Skills, Technical Related Skills, Human Relations and Related Skills.

iii) Team Leader: Act as intermediate persons between the project manager and a large number of project members.

iv) Systems Analyst: Has a good knowledge of both the business processes and IT. Should be skilful getting and extracting user requirements and converting them into models for computerisation.

v) Programmer: Implement the design prepared by the system analysts.

vi) Programming Analyst: Has a blend of system analysis and programming skills. Save lots of time on communication between Systems Analyst and Programmer.

vii) Database Administrator: Responsible for the smooth operation, integrity and efficiency of databases

viii) Network Specialist: Responsible for the smooth operation of the telecommunications network.

e) Critical Path: The path activity that the developer must follow against the job due to follow the schedule.
f) **Resource Allocation:** Needs to be done as accurately as possible to ensure that projects can be completed on time and to prevent any unexpected event from occurring. This can help managers to control the situations wisely.

g) **Factors that Affect Human Factor Allocations:**
   i) **Availability:** Project manager must always be aware of a particular individual’s availability.
   ii) **Resource Working Duration:** Activity Duration ÷ Percentage of Resource Availability
   iii) **Criticality:** When more experienced personnel are allocated to activities on the critical path, this has the possibility in shortening project duration or can help to reduce overrun’s risk.
   iv) **Risk:** Allocating more experienced personnel to the highest risk activities.
   v) **Training:** The organisations can gain a lot if junior staffs are given training to develop their skills.
   vi) **Team Building:** Individuals selection for a project team must take into consideration the cohesiveness, cooperation and expertise of individuals of the project team.

h) **Prioritisation of Activities:** Needs to be done to ensure that resources are allocated appropriately.
   i) **Total Float priority:** Concerns on ordering the float, with the smallest total float having the highest priority.
   ii) **Ordered list priority:** Concentrate on activities that occur at the same time, where the ordering will based on the set of simple criteria.

i) **Resource loading:** Describes the amounts of individual resources an existing schedule requires during specific time periods.
   i) **Resource Overload:** When the resource requirement exceeds the available resources. This delays some activities leading to delay in the completion of project.
   ii) **Resource Underload:** When the resource requirement is lower than the available resources.

j) **Resource Levelling:** Process of shifting the activities that can result in improving the resource loading. Purpose is to balance any overload resources and to create a more balanced distribution of resource usage.

k) **Cost Schedules:** Illustrate the weekly or monthly costs throughout the project, in order to monitor the project progress. The cost schedule is categorised into staff costs (salaries etc), overheads (space, rentals etc) and usage charges (computer time etc).

l) **Scheduling Sequence:** Represents the ideal activity plan to a cost schedule. Thus, it needs to frequently revise activity plan.

9) **Procurement and Contract Management**

a) **Procurement:** Acquisition of goods or services. A process that involves two parties with different objectives who interact in a given market segment.
   i) **Good procurement practices can increase corporate profitability by taking advantage of:**
      (1) Quantity discounts;
      (2) Minimising cash flow problems; and
      (3) Seeking out quality suppliers.
   ii) **Two basic procurement strategies:**
      (1) **Corporate procurement strategy:** The relationship of specific procurement actions to the corporate strategy.
      (2) **Project procurement strategy:** The relationship of specific procurement actions to the operating environment of the project.

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iii) There are **two Environments** (critical factor) for Procurement:

(1) **Macro Environment**: General external variables that can influence how and when we do procurement. These include:

   (a) Recession;
   (b) Inflation;
   (c) Cost of borrowing money; and
   (d) Unemployment.

(2) **Micro Environment**: Internal environment of the firm, especially the policies and procedures imposed by the firm, project, or client in the way that procurement will take place. This includes the **Procurement/contracting system**, which contains **five cycles**:

   (a) **Requirement cycle**: definition of the boundaries of the project.
   (b) **Requisition cycle**: begin requisition process
   (c) **Solicitation cycle**: the bidding process
   (d) **Award cycle**: contractor selection and contract award.
   (e) **Contract administration cycle**: managing the subcontractor until completion of the contract

b) **Requirement Cycle**: definition of the boundaries of the project.

   i) **Requirement Cycle includes**:

      (1) Defining the need for the project;
      (2) Development of the statement of work specifications, and work breakdown structure;
      (3) Performing a make or buy analysis;
      (4) Laying out the major milestones and the timing/schedule;
      (5) Cost estimating, including life-cycle costing; and
      (6) Obtaining authorisation and approval to proceed.

c) **Requisition Cycle**: Once the requirements are identified, a requisition form is sent to procurement to begin the requisition process.

   i) **Requisition cycle includes**:

      (1) Evaluating/confirming specifications (are they current?);
      (2) Confirming sources;
      (3) Reviewing past performance of sources; and
      (4) Producing solicitation package.

d) **Recitation Cycle**: Selection of the acquisition method is the critical element in the solicitation cycle.

   i) **There are three common methods for acquisition**:

      (1) Advertising: when a company goes out for sealed bids
      (2) Negotiation: Negotiation is when the price is determined through a bargaining process
      (3) Small purchases (i.e., office supplies).

e) **Award Cycle**: Results in a signed contract. Negotiate a contract type and price that will result in reasonable contractor risk and provide the contractor with the greatest incentive for efficient and economic performance.

   i) **Basic elements of most contracts**:

      (1) **Mutual agreement**: There must be an offer and acceptance;
      (2) **Consideration**: There must be a down payment; and
      (3) **Contract capability**: The contract is binding only if the contractor has the capability to perform the work.
ii) Two most common Contract forms are

1) Completion contracts: The contractor is required to deliver a definitive end product, after which the contract is considered as completed and make final payment.

2) Term contracts: The contract is required to deliver a specific “level of effort” not an end product.

f) Five types of contracts:

i) Fixed-price (FP) (Lump-Sum): Contractor must carefully estimate the target cost. The contractor is required to perform the work at the negotiated contract value. Provides maximum protection to the owner for the ultimate cost of the project, but has the disadvantage of requiring a long period for preparation and adjudications of bids.

ii) Cost plus-fixed-fee (CPFF): Cost may vary, but the fee remains firm, employed when it was believed that accurate pricing could not be achieved any other way.

iii) Cost plus-percentage-fee (CPPF): Provides maximum flexibility to the owner and permits owner and contractor to work together cooperatively on all technical, commercial, and financial problems. However, it does not provide financial assurance of ultimate cost.

iv) Guaranteed maximum-shared savings (GMSS): Contractor is paid a fixed fee for his profit and reimbursed for the actual cost of engineering, materials, construction labour, and all other job costs, but only up to the ceiling figure established as the “guaranteed maximum”. Savings below the guaranteed maximum are shared between owner and contractor, whereas contractor assumes the responsibility for any overrun beyond the guaranteed maximum price.

v) Fixed-price-incentive-fee (FPIF): Same as fixed-price contracts except that they have a provision for adjustment of the total profit by a formula that depends on the final total cost at completion of the project and that has been agreed to in advance by both the owner and the contractor.

vi) Cost plus-incentive-fee (CPIF): Same as cost plus contracts except that they have a provision for adjustment of the fee as determined by a formula that compares the total project costs to the target cost. This formula is agreed to in advance by both the owner and contractor.

10) Project Monitoring and Control

a) Project monitoring: Process of checking what is happening and collecting data on the progress of a project. Planning is pointless unless the execution of the plan is monitored.

b) Creating the Framework: Exercising control over a project and ensuring targets are met is a matter of regular monitoring, finding out what is happening and comparing it with current targets. If there is a mismatch between the planned outcomes and the actual ones then either re-planning is needed to bring the project back on target, or the target will have to be revised.

i) Data Collection and Monitoring: Managers will try to break down long activities into more controllable tasks of one or two weeks’ duration. However, it will still be necessary to gather information about partially completed activities and forecasts how much work is still left to be completed.

1) Partial Completion Report: Organisations use standard accounting systems with weekly time sheets to charge staff time to individual jobs. Eg: *Weekly time sheets are frequently adapted by breaking jobs down to activity level and requiring information about work done in addition to time spent.*

2) Risk Reporting: To overcome objections to Partial Completion, Avoid asking for estimated completion dates, but to ask the team members’ estimates of the likelyhood of meeting the planned target date. One way of doing this is the traffic-light methods.

ii) Visualising Progress: A manager needs some way of presenting that data to the greatest effect.

1) Gantt Chart: Simplest and oldest. This is essentially an activity bar chart indicating scheduled activity dates and durations. Reported progress is recorded on the chart and a ‘today cursor’ provides an immediate visual indication of which activities are ahead or behind schedule.
(2) Slip Chart: Provides a more striking visual indication of those activities that are not progressing to schedule – the more the slip line bends, the greater the variation from the plan.

(3) Ball Chart: Advantage of ball charts over Gantt and slip charts is that they are relatively easy to keep up to date – only the dates and colours need to be changed.

(4) Timeline Chart: Method of recording and displaying the way in which targets have changed throughout the duration of the project.

iii) Earned Value Analysis: Based on assigning a ‘value’ to each task or work package based on the original expenditure forecasts. A task that has not started is assigned the value zero and when it has been completed it is credited with the value of the task.

(1) Earned Value: The value of the work that has been completed and the budget for that work: \( EV = \% \text{ Complete} \times \text{BAC} \)

(2) Baseline Budget OR Budgeted Cost of Work Schedule (BCES): The value assigned which is the original budgeted cost for the item.

(3) Earned Value OR Budgeted Cost of Work Performed (BCWP): The total value credited to a project at any point. This can be represented as a value or as a percentage of the BCWS.

(4) METHODS OF ASSIGNING AN EARNED VALUE
   a) The 0/100 Technique: A task is assigned a value of zero until such time that it is completed when it is given a value of 100% of the budgeted value. PREFERRED
   b) The 50/50 Technique: A task is assigned a value of 50% of its value as soon as it is started and then given a value of 100% once it is complete. It can give a false sense of security by over-valuing the reporting of activity starts.
   c) The Milestone Technique: A task is given a value based on the achievement of milestones that have been assigned values as part of the original budget plan. Might be appropriate for activities with a long duration estimate but it is better to break that activity into smaller ones.

(5) Creating the Baseline Budget: First step in Earned Value analysis is to Create the Baseline Budget. The first baseline budget is based on the project plan and shows the forecast growth in earned value through time. Earned value may be measured in monetary values but, in the case of staff-intensive projects such as software development, it is common to measure earned value in person-hour or workdays.

(6) Monitoring the Earned Value: Having created the baseline budget, the next task is to monitor earned value as the project progresses. Monitoring the completion of tasks will do this.
   a) Actual Cost of Work Performed (ACWP): Actual cost of each task.
   b) Budget Variance: \( \text{ACWP} - \text{BCWS} \), It indicates the degree to which actual costs differ from those planned.
   c) Schedule Variance: \( \text{BCWP} - \text{BCWS} \), measured in cost terms. It indicates the degree to which the value of completed work differs from that planned. For example, schedule variance in time indicates the degree to which the project is behind schedule.
   d) Cost Variance: \( \text{BCWP} - \text{ACWP} \), Indicates the difference between budgeted cost and the actual cost of completed work. It is also the indicator of the accuracy of the original cost estimates.
   e) Performance Ratios: Two ratios are commonly tracked:
      i) Cost Performance Index (CPI) = \( \frac{\text{BCWP}}{\text{ACWP}} \)
      ii) Schedule Performance Index (SPI) = \( \frac{\text{BCWP}}{\text{BCWS}} \)

This can be thought of as a ‘value-for-money’ index. A value greater than one indicates that work is being completed better than planned whereas a value of less than work is costing more than and/or proceeding more slowly than planned.
iv) **Prioritising Monitoring:** The List of Priorities that Could be Applied in Deciding Levels of Monitoring:

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

(2) **Activities with Less than a Specified Float:** If any activity has very little float it might use up this float before the regular activity monitoring brings the problem to the project manager’s attention. It is common practice to monitor closely those activities with less than one week free float.

(3) **High-risk Activities:** A set of high-risk activities should have been identified as part of the initial risk profiling exercise. If we are using the PERT three-estimate approach we will designate as high risk those activities that have a high estimated duration variance. These activities will be given close attention because they are most likely to overrun or overspend.

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

v) **Getting the Project Back on target:** Almost any project will at one time or another be subject to delays and unexpected events. One of the tasks of the project manager is to recognise when this is happening and with minimum delay and disruption to the project team, attempt to lessen the effects of the problem. Shortening the remaining activity durations or shortening the overall duration of the remaining project can do this. There are two strategies:

(1) **Shorten the Critical Path:** The current critical path determines the overall project duration.

Allocating more efficient resources to activities on the critical path or swapping resources between critical and non-critical activities can shorten the timescale for critical activities.

(2) **Reconsider the Precedence Requirements:** If attempting to shorten critical activities proves insufficient, the next step is to consider the constraints by which some activities have to be deferred pending completion of others.

vi) **Change Control:** When changes occur, careful control of these changes is needed because an alteration in one document often implies changes to other documents and the system products based on that document.

(1) **Configuration Manager’s/Librarian’s Role:** Responsible for the control of changes and documentation. Among this person’s duty would be:

   (a) The identification of all items that are subject to change control;

   (b) The establishment and maintenance of a central repository of the master copies of all project documentation and software products;

   (c) The setting up and running of a formal set of procedures to deal with changes; and

   (d) The maintenance of records of who has access to which library items and the status of each library items.

(2) **Change Control Procedures:** Steps:

   (a) **First Step:** One or more users might perceive a need for a change request to be passed to the development staff.

   (b) **Second Step:** The user management considers the change request and if they approve it, they will pass it to the development management.

   (c) **Third Step:** The development management delegates a member of staff to look at the request and to report on the practicality and cost of carrying out the change. They would also assess the products that would be affected by the change.
(d) **Fourth Step:** The development management reports back to the user management on the findings and the user management decide whether, in view of the cost quoted, they wish to go ahead.

(e) **Fifth Step:** One or more developers are authorised to take copies of the master products that are to be modified.

(f) **Sixth Step:** The copies are modified. In the case of software components this would involve modifying the code and recompiling and testing it.

(g) **Seventh Step:** When the development of new versions of the product has been completed, the user management will be notified and copies of the software will be released for user acceptance testing.

(h) **Final Step:** When the users are satisfied that the products are adequate they will authorise their operational release. The master copy of configuration items will be replaced.

(3) **Changes in Scope of a System:** A common occurrence with IS development projects is for the size of the system gradually to increase. One cause of this is changes to requirements that are requested by the users.

 vii) **Project Control:** Process and procedures that form the basis for the systematic control of the project.

 1) **Projects Should be of Manageable Size:** Projects are prone to slippages in schedule and budget; it is a good practice to divide systems development work into small projects that are more manageable. It shouldn’t exceed 18 months and also it shouldn’t be too small either as synergy may be lost.

 2) **Start Only After Full Agreement and Commitment:** Goals of the project can be tricky. For effective management, the project goals need to be clearly understood by all parties. They should be documented and fully agreed by the user department and the sponsor.

 3) **Project Leader Must be of Mixed Skills:** The role of a project leader is crucial to the project success. Right mix of knowledge and skills like management related skills, technical related skills, and human relations related skills.

 4) **Planning and Monitoring of Progress:** Careful planning is needed before you can control the project successfully. The main elements to be monitored are:

 a) Activities completed;
 b) Materials and machines being used;
 c) Time spent in man-days or man-weeks; and
 d) Total costs incurred so far.

 If there are deviations from the plan, then corrective actions are required to bring the project back into the plan.

 5) **Applying the Milestone Reviews:** Besides the routine monitoring and control of the progress, at certain strategic points along the project life cycle, there ought to be overall reviews of the project progress. It is better to coincide with the completion of some major activities (milestones).

 6) **Finishing the Project as Soon as it is Accepted:** The key to a project success is users acceptance when they see the system being operational. So, the project should not be allowed to prolong.

11) **Project Quality Management**

 a) **Quality:** Totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs (ISO). Other experts define quality based on:

 i) **Conformance to Requirements:** Project’s processes and products meet written specifications.

 ii) **Fitness for Use:** This term means a product can be used as it was intended.

 b) **Project Quality Management:** Ensures that the project will satisfy the needs for which it was undertaken. **Three main processes** are:
i) Quality Planning: Includes identifying which quality standards are relevant to the project and how to satisfy those standards. Incorporating quality standards into project design is a key part of quality planning.

ii) Quality Assurance: A process in which the overall performance is evaluated to ensure the project meets the relevant quality standards.

iii) Quality Control: Process where work results are monitored to see if they meet related quality standards.

c) Software Quality: The degree to which a system, component, or process meets; specified requirements, or user needs or expectation (IEEE)

d) Importance of Software Quality Management:

i) Increasing Criticality of Software: Organisations have become more dependent on their computer systems and software is used more and more in areas which are safety critical, Eg: To control aircraft.

ii) The Intangibility of Software: This makes it difficult to know whether a particular task in a project has been completed satisfactorily.

iii) Accumulating Errors during Software Development: As computer system development is made up of a number of steps where the output from one step is the input to the next, the errors in the earlier deliverables will be added to those in the later steps leading to an accumulating effect.

e) Software Quality Characteristics (ISO 9126):

i) Functionality: Functions provided by a software product to satisfy user needs.

ii) Reliability: Capability of the software to maintain its level of performance.

iii) Usability: Effort needed to use the software.

iv) Efficiency: Physical resources used when the software is executed.

v) Maintainability: Effort needed to make changes to the software.

vi) Portability: Ability of the software to be transferred to a different environment.

f) Qualifying and Quantifying Software Quality:

i) Reliability: Measured in the following terms:

1) Availability: The percentage of a particular time interval that a system is usable.

2) Mean Time between Failures: The total service time divided by the number of failures.

3) Failure on Demand: The probability that a system will not be available at the time required or the probability that a transaction will fail.

4) Support Activity: The number of fault reports that are generated.

ii) Maintainability: Closely related to flexibility, the ease with which the software can be modified.

iii) Extendibility: Productivity needed to incorporate a new feature into an existing system expressed as a percentage of the normal productivity when developing the software from scratch.

g) Product vs Process Quality Management: Most of the qualities that are apparent to the users of software can only be tested for when the system is completed. What would be more helpful are measurements taken during development, which can help control what the final application will be like.

i) Errors detected at an early stage are more expensive to be corrected at later stages because:

1) The later the error is found the more rework at more stages of development will be needed

2) Increased complication to rectify the error due to the complexity of the program.

ii) Errors should be eradicated by examination of the deliverables of each stage before they are passed on to the next. To do this, the following process requirements should be specified for each activity:

1) Entry requirements: Have to be in place before an activity can start.

2) Implementation requirements: Define how the process is to be conducted.

3) Exit requirements: Have to be fulfilled before an activity is completed.
h) Quality Management Standards:
   i) IEEE: Institute of Electrical and Electronics Engineers, Computer Society.
   iii) DOD: US Department of Defence.
   vi) EIA: Electronic Industries Association.

i) Eight Principles of ISO 9000-3 Standard
   i) Customer Focus: Organisations depend on their customers and therefore should understand current and future customer needs.
   ii) Leadership: Leaders establish the organisation’s vision. They should create and maintain an internal environment in which people can become fully involved in achieving the organisation’s objectives via the designated route.
   iii) Involvement of People: People are the essence of an organisation, their full involvement at all levels of organisations, enables their abilities to be applied for the organisation’s benefit.
   iv) Process Approach: A desired result is achieved more efficiently when activities and resources are managed as a process.
   v) System Approach to Management: Identifying, understanding and managing processes.
   vi) Continual Improvement: Ongoing improvement of overall performance should be high on the organisation’s agenda
   vii) Factual Approach to Decision Making: Effective decisions are based on the analysis of information.
   viii) Mutually Supportive Supplier Relationships: An organisation and its suppliers are interdependent, a mutually supportive relationship enhances the ability of both to create added value.

j) Capability Maturity Model: (CMM assessment) is based on the following concepts and principles:
   i) Application of more elaborate management methods based on quantitative approaches increases the organisation’s capability to control the quality and improve the productivity of the software development process.
   ii) The vehicle for enhancement of software development is composed of the five-level capability maturity model. The model enables an organisation to evaluate its achievements and determine the efforts needed to reach the next capability level by locating the process areas requiring improvements.
   iii) Process areas are generic, they define the “what”, not the “how”. This approach enables the model to be applied to a wide range of implementation organisations because:
      (1) It allows use of any life cycle model;
      (2) It allows use of any design methodology, software development tool and programming language;
      (3) It does not specify any particular documentation standard

12) People Management & Organisation
   a) Three basic objectives Taylor had on Organisational Behaviour:
      i) Select the best person for the job
      ii) Instruct them in the best methods
      iii) Incentives given in the form of higher wages to the best workers

b) McGregor’s Theory of X and Y: This theory states that “X” people are lazy, do not want to work and need to be micromanaged. “Y” people are self-led, motivated and strive to succeed.
c) Recruitment Process:
   i) Create a job specification;
   ii) Create a job holder profile;
   iii) Obtain applicants;
   iv) Examine CVs;
   v) Interviews; and Other procedures.

d) Motivation: People may be motivated by money, but they are motivated by other things as well.
   i) The Taylorist Model: Taylor’s viewpoint is reflected in the use of piece-rates in manufacturing industries and sales bonuses amongst sales force.
   ii) Maslow’s Hierarchy of Needs: A theory that states that there are five layers of humans: physiological, safety, social, esteem and self-actualisation. The motivation of individuals varies. Money is a strong motivator when you do not have it. However, as the basic need for money is satisfied, other motivators are likely to emerge. Abraham Maslow, an American psychologist, suggested a hierarchy of needs. As a lower level of needs is satisfied, then gradually a higher level of needs emerges.

e) Methods of Improving Motivation:
   i) Set Specific Goals: These goals need to be demanding and yet acceptable to staffs. Involving staffs in the setting of goals helps to gain acceptance for them.
   ii) Provide Feedback: Not only goals have to be set, but staffs have to have regular feedback about how they are progressing.
   iii) Consider Job Design: Jobs can be altered to make them more interesting and give staffs more feeling of responsibility. Two measures used are:
      (1) Job Enlargement: The person doing the job carries out a wider variety of activities.
      (2) Job Enrichment: The jobholder carries out tasks normally done at managerial or supervisory level.

f) Working in Groups
   i) Team Work: Five Basic Stages of Development of teams
      (1) Forming: The members of the group get to know each other and try to set up some ground rules about behaviour.
      (2) Storming: Conflicts arise as various members of the group try to exert leadership and the groups’ methods of operation are being established.
      (3) Norming: Conflicts are largely settled and a feeling of group identity emerges.
      (4) Performing: The emphasis is now on the tasks at hand.
      (5) Adjourning: The group will separate.
   ii) Group Performance: One way of Categorising Group Tasks are; Additive Tasks, Compensatory Tasks, Disjunctive Tasks, Conjunctive Tasks.

g) Decision Making:
   i) Structured: Usually simple, routine decisions where rules can be applied in a fairly straightforward way.
   ii) Unstructured: More complex and often requiring a degree of creativity.
   iii) Mental Obstacles to Good Decision Making:
      (1) Faulty Heuristics: Heuristics or ‘rules of thumb’ can be useful but there are dangers:
         (a) They are based only on information that is to hand which might be misleading.
         (b) They are based on stereotypes.
      (2) Escalation of Commitment: This refers to the way that once you have made a decision, it is increasingly difficult to alter it.
      (3) Information Overload: It is possible to have too much information that you are not able to differentiate the degree of importance of the information.
iv) **Obstacles of Good Group Decision Making:**

1. Time consuming;
2. Can stir up conflicts; and
3. Decisions can be influenced by dominant personalities.

v) **Measures to Reduce Disadvantages of Group Decision Making** (Delphi Method: Without bringing them face to face):

1. The co-operation of a number of experts is enlisted.
2. The problem is presented to the experts.
3. The experts record the recommendations.
4. These recommendations are collated and reproduced.
5. The collected responses are re-circulated.
6. The experts comment on the ideas of others and modify their recommendations.
7. If the leader detects a consensus then the process is stopped. Otherwise, the comments are re-circulated to the experts.

h) **Leadership:** The ability to influence others in a group to act in a particular way to achieve group goals.

i) **Types of Power:**

1. **Coercive Power:** The ability to force someone to do something by threatening punishment.
2. **Connection Power:** Having access to those who have power.
3. **Legitimate Power:** A person’s title conferring a special status.
4. **Reward Power:** Power holder gives rewards to those who carry out tasks to his or her satisfaction.

i) **Organisational Structures:**

i) **Formal vs Informal Structures:** The formal structure is expressed in the staff hierarchy chart. It is concerned with authority, about who has which boss. It is backed by an informal structure of contacts and communication that grows up spontaneously between members of staff during the course of work.

ii) **Hierarchical Approach:** The traditional management structure is based on the concept of the hierarchy – each member of staff has only one manager, while a manager will have responsibility for several members of staff. Authority flows from the top down through the structure.

iii) **Staff vs Line:** Staff in organisations can often be divided into line workers who actually produce the end product and support staff who carry out supporting rules.

iv) **Departmentalisation:** Very often organisations are departmentalised, based whether on staff specialisations, product lines, categories of customer or geographical location. Having separate departments could lead to communication problems, especially if the developer is unfamiliar with an application area. There will also be problems with software maintenance.

j) **Project Management Structures:**

i) **Older Management Structure:** Places an IT professional to head the project team. The post is called “Project Manager”. Normally, the person is a senior system analyst, or an experienced system analyst, depending on the size of the project.

1. **Advantage:** Entire company can delegate most of the work to the project manager. Staff of the user department is not so much disturbed by the project because the project manager is supposed to do most of the things. Thus, time can be saved.

2. **Disadvantage:** Product delivered being less than satisfactory to the end-users, due to the lack of communication, involvement and participation from the user side.

ii) **New Management Structure:** places a user manager or the system owner as the nominal head of the project team. The post is called (nominal) “Project Manager”. So, a businessperson would be leading the project. He is to be assisted by a resourceful project leader, being an IT professional person, who would be very competent technically.
k) Project Team Organisation:

i) **Pure project structure** (hierarchical structure): The structure is good when speed is of the essence of product development. Many building construction projects adopt this structure, where unskilled and semi-skilled people in big numbers are involved. It is fast because of the simple structure with a strong command throughout the hierarchy.

ii) **Matrix structure**: General Manager heads the day-to-day operations of the company. He has several functional managers dealing with various functional areas. To launch a project, you need a project manager with a temporary organisation to be staffed by a number of people inside the company. Project team members are drawn from various functional departments of the company with different skill sets.

iii) **Centralised control structure**: Based on a hierarchical structure. In IT projects, it is often called the “Chief Programmer Team”, because of this being the way a chief programmer organises his team. In this set-up generally, several supervisors (or third-level managers) report to a second-level manager, and so on up to the president of the organisation.

iv) **Decentralised control structure**: Programmers share decision-making and reporting to the project manager. There is no management hierarchy here.

v) **Mixed control structure**: Mixed control team structure attempts to combine the benefits and minimise the disadvantages of both the centralised and the decentralised control teams.

l) Assessment of Team Organisation

i) **Decentralised control** team is best when communication among engineers is necessary for achieving a good solution. In this organisation, team members would communicate well since they are equals.

ii) **Centralised control** is best when speed of development is the most important goal and the problem is well understood.

iii) **Matrix structure** is very good in the sense that you can start and get the project organised very quickly. That advantage however can be over-shadowed by the relative ease that it can slip through the deadlines.

m) **Team Size**: It is appropriate for organisations to try to limit the amount of communication between team members for achieving the project goals – neither more nor less. Thus, a very large team is highly discouraged, as more time would be spent on talking. On the contrary, a very small team may not be productive for lacking the synergy between members.

n) **Other Goals of Development**:

i) **Lower Life Cycle Cost**: not just the development cost, but the cost of maintenance as well

ii) **Reduced Personnel Turnover**: the organisation structure that ensures staff satisfaction in life

iii) **Repeatability of The Process**: the team organisation that enables the development process to be repeated in future, thus giving a sense of great benefits for future projects

iv) **Development of Junior Engineers into Senior Ones**: the kind of organisation that enables training to take place simultaneously

v) **Wide-spread Dissemination of Knowledge and Expertise**: the kind of team organisation that transfers knowledge and skills to the staff of the host organisation