MODULE-4

ACTIVITY PLANNING AND RISK MANAGEMENT

Planning includes all the activities required to select a systems analysis team, assign members of the team to appropriate projects, estimate the time required to complete each task, and schedule the project so that tasks are completed in a timely fashion.

A plan must be stated as a set of targets, the achievement or non-achievement of which can be unambiguously measured. The activity plan does it by providing a target start and end date for each activity

Objectives of Activity Planning:

- **Feasibility assessment:** Is the project possible within required timescales and resource constraints? It is not until we have constructed a detailed plan that we can forecast a completion date with any reasonable knowledge of its achievability.
- **Resource allocation:** What are the most effective ways of allocating resources to the project? When should the resources be available? The project plan allows us to investigate the relationship between timescales and resource availability
- **Detailed costing:** How much will the project cost and when is that expenditure likely to take place? After producing an activity plan and allocating specific resources, we can obtain more detailed estimates of costs and their timing.
- **Motivation**: Providing targets and being seen to monitor achievement against targets is an effective way of motivating staff, particularly where they have been involved in setting those targets in the first place.
- **Coordination:** When do the staff in different departments need to be available to work on a particular project and when do staff need to be transferred between projects? The project plan, particularly with large projects involving more than a single project team, provides an effective vehicle for communication and coordination among teams.

Project Schedules

A project plan is developed to the level of showing dates when each activity should start and finish, when and how much of each resource will be required. Once a plan has been refined to this level, it is known as a project schedule.

- A stage of a larger project, the project plan must be developed to the level of showing dates when each activity should start and finish and when and how much of each resource will be required.
- It is an activity that distributes estimated effort across the effort to specific software engineering tasks.
- Once the plan has been refined to this level of detail we call it a projectschedule
- It is the culmination of a Project Planning activity that is a primarycomponent of Software Project Management.

Four Major Steps involved:

- **First step** in producing the plan is to decide what activities need to be carried out and in what order they are to be done.
- **Second step:** The ideal activity plan will then be the subject of an activityrisk analysis, aimed at identifying potential problems. This might suggest alterations to the ideal activity plan and will almost certainly have implications for resource allocation.
- **Third step is resource allocation**. The expected availability of resources might place constraints on when certain activities can be carried out
- **Final step Schedule Production:** once resources have been allocated to each activity, a project schedule can be drawn and published. It indicates the planned start and completion dates and resource requirements statement for each activity.

ACTIVITIES

- An activity is typically one stage of a project management plan.
- Each activity consists of one or more actions that, upon completion, will lead to the next project stage.
- Taken together as a series, the activities will result in the final deliverable.
- Each activity has a defined start and end, as well as a deadline or timeperiod within which it must be completed.

There are 3 most common approaches or methods for the identification of activities in any software project:

1. Activity based approach:

- It consists of creating a list of all the activities that theproject is supposed to involve in its life cycle.
- It can be done by using a brainstorming process which includes the completeproject team and analyzing of the past projects.

- **Work Breakdown Structure (WBS)** is created for the same purpose.

- It involves dividing a complex and big scale project into simpler, manageable, independent and smaller tasks which can be completed in approximately few weeks by a single development team working on the project.

- The root of the project tree is labelled by the project name itself. Each node (activity) is recursively decomposed and divided into smaller sub-activities, until at the leaf level, the activities require approximately two weeks to develop and can be given to a single development team. It follows top-down approach.

2. Product based approach:

- It consists of producing a **Product BreakdownStructure and a Product Flow Diagram.**
- A product based structure is very much similar to the work breakdown structure which includes dividing a complex and big scale product into its sub set products until simple, manageable, independent and smaller products are obtained at the leaf level.
- The Product Breakdown Structure is constructed prior to the Work Breakdown Structure and it focuses on generating an ordered list of all the sub products required to successfully complete the project.
- This generated structure helps in the creation of the Work Breakdown Structure, which in turn helps in the identification of the activities required to produce the required sub products.
- There is a very less probability that a product will be left out in a product breakdown structure than that an activity might be left out of a work breakdownstructure.

3. Hybrid approach:

- In this approach, an alternative work breakdown structure is constructed based on
- A simple list of final deliverables.
- For each deliverable, a set of activities required to produce that product.

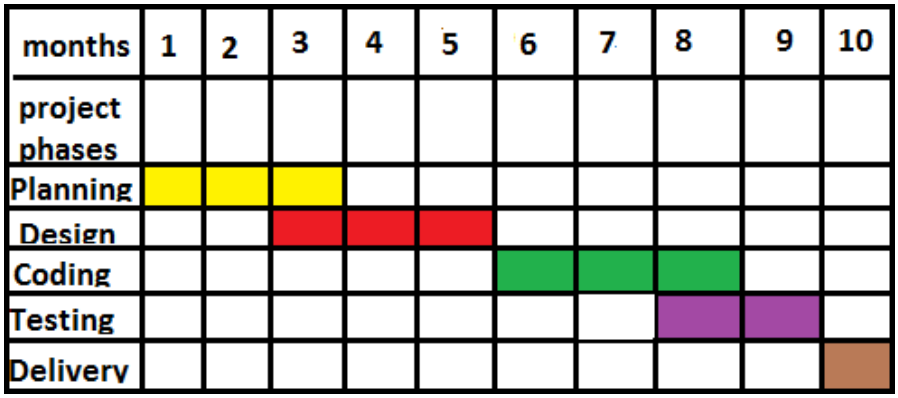
SEQUENCING AND SCHEDULING ACTIVITIES

Sequencing the tasks means identifying the dependencies among activities dictated by the development process.

Scheduled activities means specifying when they should take place. The scheduling has had to take account of availability of staff and the way in which the activities have been allocated to them.

A Gantt chart is a bar chart that provides a visual view of project tasks scheduled over time. A Gantt chart is used for project planning: it's a useful way of showing what work is scheduled to be done on specific days. It helps project managers and team members view the start dates, end dates and milestones of a project schedule in one simple stacked bar chart.

To create a Gantt chart, use the vertical axis to list the tasks that need to be completed, and the horizontal axis to depict a timeline. As you input tasks, their start dates, their end dates and their dependencies, bars on the stacked bar chart will populate, which represent task durations.



NETWORK PLANNING MODEL

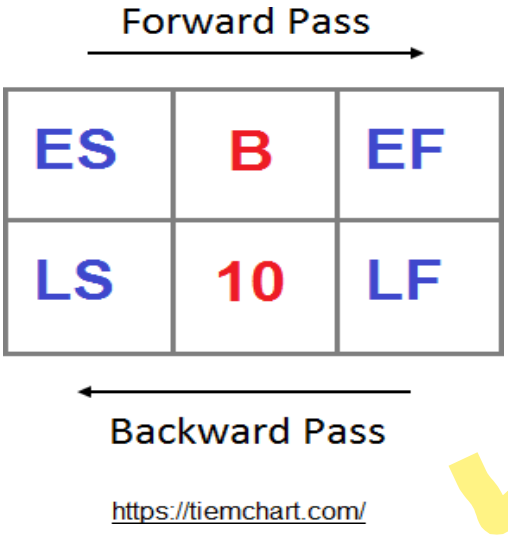
- These project scheduling techniques model the project's activities and their relationships as a network.
- In the network, time flows from left to right.
- These technologies were originally developed in the 1950s.
- **The two best known being CPM (critical path method) and PERT (program evaluation review technique).**
- Both of these techniques used an activity-on- arrow approach to visualizing the project as a network where activities are drawn as arrows joining circles or nodes, which represent the possible start and/or completion of an activity or set of activities.
- Now, precedence networks has become popular which use activity-on-node networks where activities are represented as nodes and the links between nodes represents precedence (or sequencing) requirements.

FORMULATING A NETWORK MODEL

- A project network should have only one start node.
- A project network should have only one end node.
- A node has duration.
- Links normally have no duration.
- Precedents are the immediate preceding activities.
- Time moves from left to right.
- A network may not contain loops.
- A network should not contain dangles.

FORWARDS PASS AND BACKWARD PASS

- Forward pass is a technique to move forward through network diagram to determining project duration and finding the critical path or Free Float of theproject.
- Whereas backward pass represents moving backward to the end result to calculate late start or to find if there is any slack in the activity.
- Early Start (ES) is plotted on the 1st left corner box at the top. Likewise EarlyFinish (EF) is plotted on top right corner box.
- Late Finish (LF) is on the right corner box at the bottom and Late Start (LS) isplotted on the left bottom corner box.
- Example: Activity name "B" is in the 2nd box, duration represented by 10 is on the5th box at the middle.
- Early Start (ES) represents the earliest start of an activity considering the dependency preceding task. If an activity is having more than one dependency predecessor, then ES will be the highest Early Finish (EF) of the dependencytask.
- Early Start = Maximum (or Highest) EF value from immediate Predecessor(s)



How to apply Forward Pass to calculate Early Finish (EF)?

In order to calculate Early Finish, we use forward pass. Means moving from Early Start towards right to come up with Early Finish of the project.

Early Finish (EF) = ES + Duration

If Early Start is 6 days and duration is 10 days, EF = 6 + 10 = 16 Days

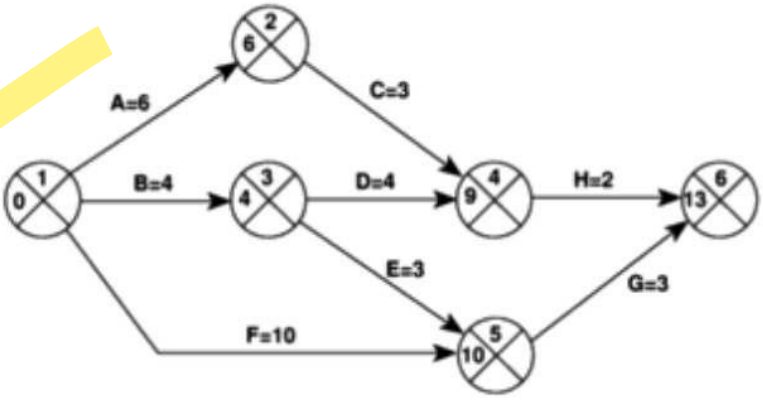
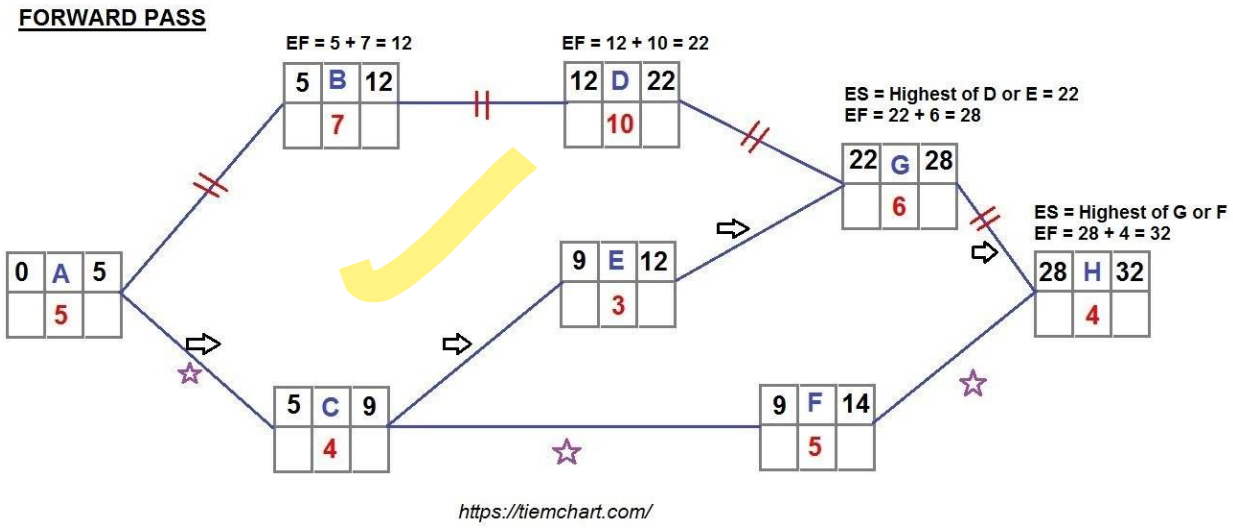


Figure 6.18 *A CPM network after the forward pass.*

Table 6.2 *The activity table after the forward pass*

Activity	*Duration (weeks)*	*Earliest start date*	*Latest start date*	*Earliest finish fate*	*Latest finish date*	*Total float*
A	6	0		6		
B	4	0		4		
C	3	6		9		
D	4	4		8		
E	3	4		7		
F	10	0		10		
G	3	10		13		
H	2	9		11		



v

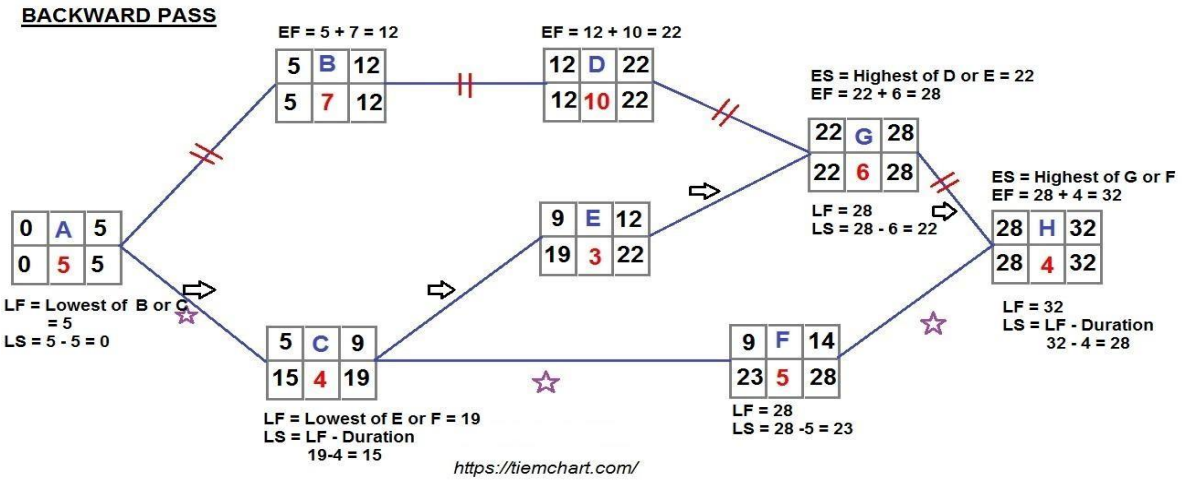
Late Finish (LF): Late finish (LF) is the latest date that the activity can finishwithout causing a delay to the project completion date.

How to apply Backward Pass to calculate Late Start (LS)?

In order to calculate Late Start (LS), we apply backward Pass moving from Late Finish and deducting from activity duration.

LS = LF – Duration

If Late Finish is 30 days and duration is 10 days, LS = 30 – 10 = 20 Days



Critical Path: Critical Path is the longest sequence of activity on a project thatcarry zero free float / slack.

Float Calculation

The whole idea of network diagram and finding the project duration is to identify the critical path and total float. Float represents how much each individual activity can be delayed without delaying successor activities or project completion date.

Total Float = LS – ES or LF – EF

Total Float shows the difference between the Earliest Start (ES) and Latest Start (LS) of an activity before the completion date is delayed.

Free Float = Lowest ES of successors – EF

Free Float represents the amount of time that an activity can be delayed before any successor's activity will be delayed. A zero free float represents the activity isin critical path and there is no space to delay the activity without delaying the entire project.

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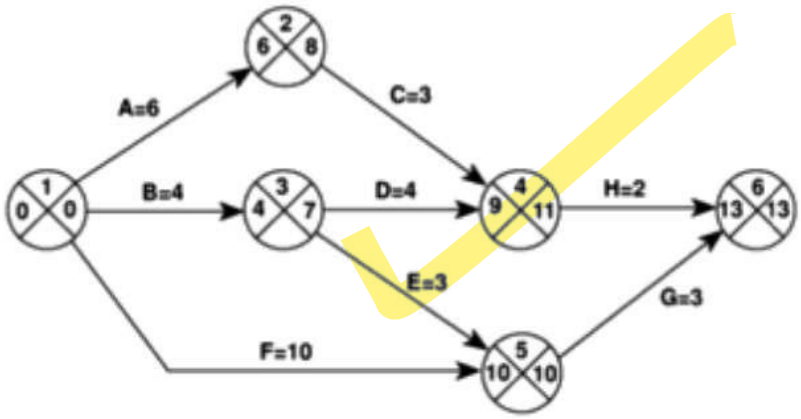


Figure 6.19 *The CPM network after the backward pass.*

Table 6.3 *The activity table following the backward pass*

Activity	*Duration (weeks)*	*Earliest start date*	*Latest start date*	*Earliest finish fate*	*Latest finish date*	*Total float*
A	6	0	2	6	8	
B	4	0	3	4	7	
C	3	6	8	9	11	
D	4	4	7	8	11	
E	3	4	7	7	10	
F	10	0	0	10	10	
G	3	10	10	13	13	
H	2	9	11	11	13	

SLACK: The difference between the earliest date and latest date for an event isknown as the slack of that event. It is a measure of how late an event may be without affecting the end of the project. Any event with a slack of zero is a criticalevent.

ACTIVITY FLOAT: whereas event possess float, activity possess float. It is the difference between the earliest start date of an activity and its latest start or the difference between its earliest finish and latest finish.

Free float: the time by which an activity can be delayed without delaying any subsequent activity. It is calculated as the difference between the earliest completion date of the activity and earliest start date of succeeding activity.

Interfering Float: the difference between total float and free float. The interfering float tells us by how much the activity may be delayed without delayingthe project end date.

Table 6.4 *The activity schedule showing total float for each activity*

Activity	*Duration (weeks)*	*Earliest start date*	*Latest start date*	*Earliest finish fate*	*Latest finish date*	*Total float*
A	6	0	2	6	8	2
B	4	0	3	4	7	3
C	3	6	8	9	11	2
D	4	4	7	8	11	3
E	3	4	7	7	10	3
F	10	0	0	10	10	0
G	3	10	10	13	13	0
H	2	9	11	11	13	2

CRITICAL PATH METHOD (CPM)

- The critical path method is a technique that allows you to identify tasks that arenecessary for project completion.
- The critical path in project management is the longest sequence of activities thatmust be finished on time to complete the entire project.
- Any delays in critical tasks will delay the rest of the project.
- CPM revolves around discovering the most important tasks in the project timeline, identifying task dependencies, and calculating task durations.
- CPM was developed in the late 1950s as a method to resolve the issue ofincreased costs due to inefficient scheduling.
- CPM has become popular for planning projects and prioritizing tasks.
- It helps to break down complex projects into individual tasks and gain a better understanding of the project's flexibility.

- Other scheduled paths might have slack time to avoid delaying the entire project, unlike the critical path.
- There might be multiple critical paths on a project.
- The Critical Path is determined when analyzing a project's schedule or network logic diagram and uses the Critical Path Method (CPM).
- The CPM provides a graphical view of the project, predicts the time required for the project, and shows which activities are critical to maintaining the schedule.

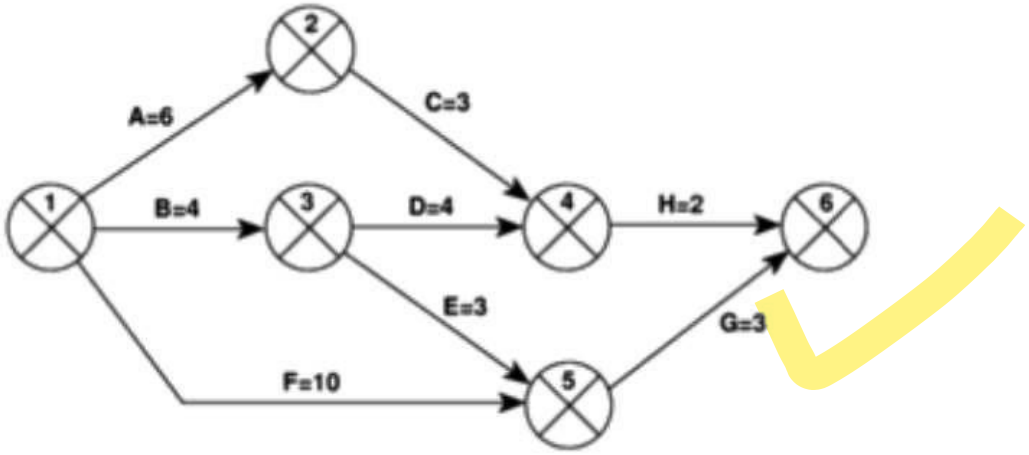


Figure 6.17 *The CPM network for the example project.*

Steps carried out in CPM

1. Activity Specification
2. Activity Sequence Establishment
3. Network Diagram
4. Estimates for each activity
5. Identification of the critical path
6. Critical path diagram to show project measures

Advantages

- Tracking critical activities
- It defines the most important tasks.
- Saves time and helps in the management of deadlines.
- Helps to compare the plan with the real status.
- Identifies all critical activities that need attention.

❖ **Disadvantages**

- In CPM, it is difficult to estimate the completion time of an activity.
- The critical path is not always clear in CPM.
- For bigger projects, CPM networks can be complicated too.
- Does not handle the scheduling of the resource allocation.

PROJECT EVALUATION AND REVIEW TECHNIQUE (PERT)

- Project Evaluation and Review Technique (PERT) is a procedure through whichactivities of a project are represented in its appropriate sequence and timing.
- It is a scheduling technique used to schedule, organize and integrate tasks withina project.
- PERT is basically a mechanism for management planning and control which provides blueprint for a particular project.
- All of the primary elements or events of a project have been finally identified by the PERT.
- In this technique, a PERT Chart is made which represent a schedule for all the specified tasks in the project.
- The reporting levels of the tasks or events in the PERT Charts is somewhat same as defined in the work breakdown structure (WBS).

Characteristics of PERT

The main characteristics of PERT are as following:

- It serves as a base for obtaining the important facts for implementing thedecision-making.
- It forms the basis for all the planning activities.
- PERT helps management in deciding the best possible resource utilizationmethod.
- PERT take advantage by using time network analysis technique.
- PERT presents the structure for reporting information.
- It helps the management in identifying the essential elements for the completion of the project within time.

Advantages of PERT

It has the following advantages:

- Estimation of completion time of project is given by the PERT.
- It supports the identification of the activities with slack time.
- The start and dates of the activities of a specific project is determined.
- It helps project manager in identifying the critical path activities.
- PERT makes well organized diagram for the representation of largeamount of data.

Disadvantages of PERT:

It has the following disadvantages:

- The complexity of PERT is more which leads to the problem in implementation.
- The estimation of activity time are subjective in PERT which is a major disadvantage.
- Maintenance of PERT is also expensive and complex.
- The actual distribution of may be different from the PERT beta distributionwhich causes wrong assumptions.
- It under-estimates the expected project completion time as there is chances that other paths can become the critical path if their related activities are deferred.

MODULE-3

PROJECT MANAGEMENT AND CONTROL

Framework of Management and Control

Creating Framework

- After the project starts its execution, the project must be carefully monitored to ensure the project's progress.
- Monitoring process focuses on comparing the actual output with the expected one and reviews the schedule to fit on target.
- Regular monitoring of the project is needed to have more control over the project. Always the expected outcomes are compared with the actual ones and analyzed whether there is any slack in the planned process.
- Project control is a continuous process of monitoring the progress of the project plan and it also includes re-planning of activities if necessary.
- The experience gained from the current project can be taken as an input over future project establishment of activities.
- Generally, revising the planning strategy is due to:
    - Delay in completion of the project within the target time
    - Quality factors
    - Inadequate functionality in adopting newer techniques
    - Actual estimation is above the estimated one.
- A typical project control cycle is depicted below:

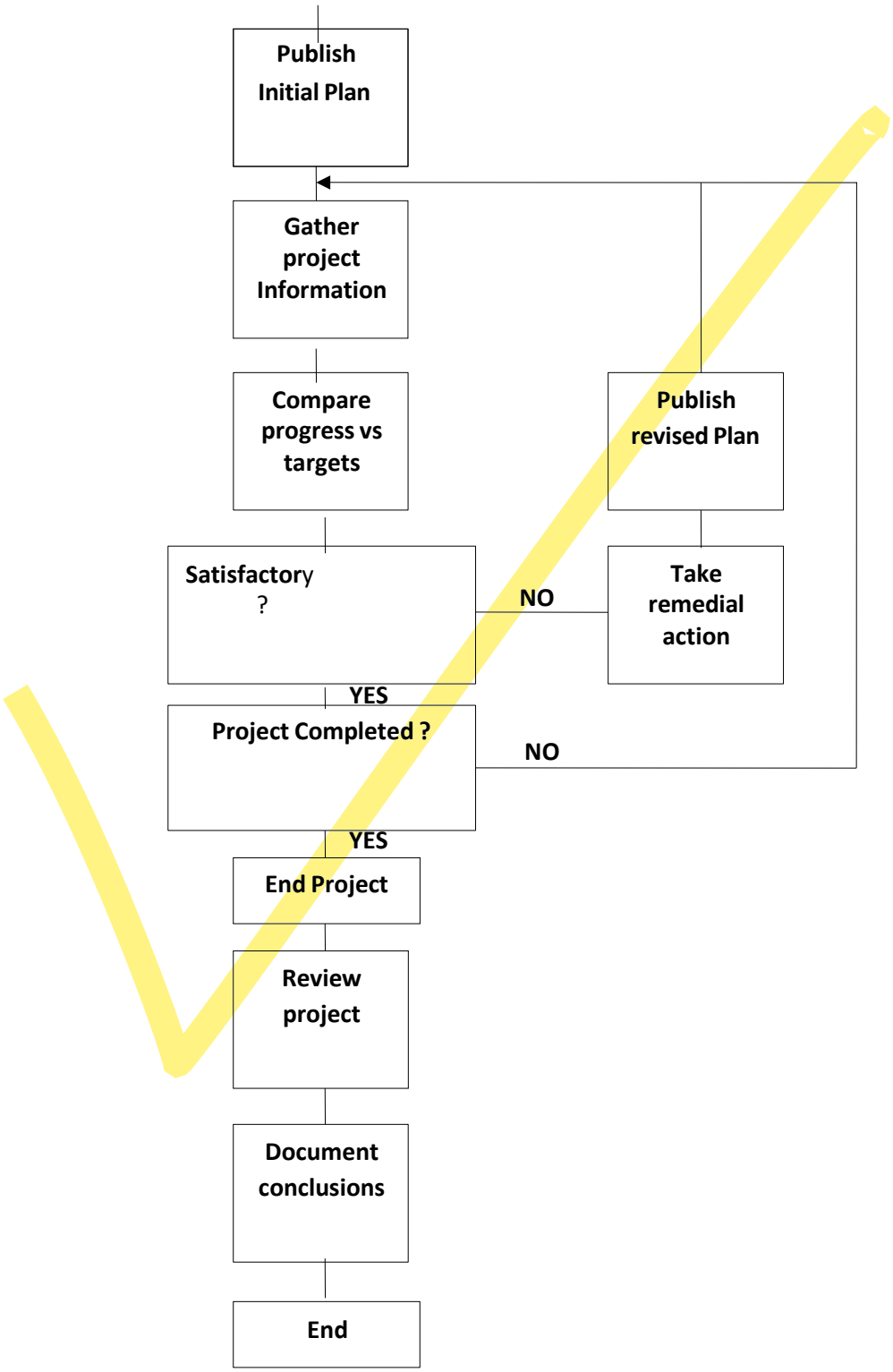
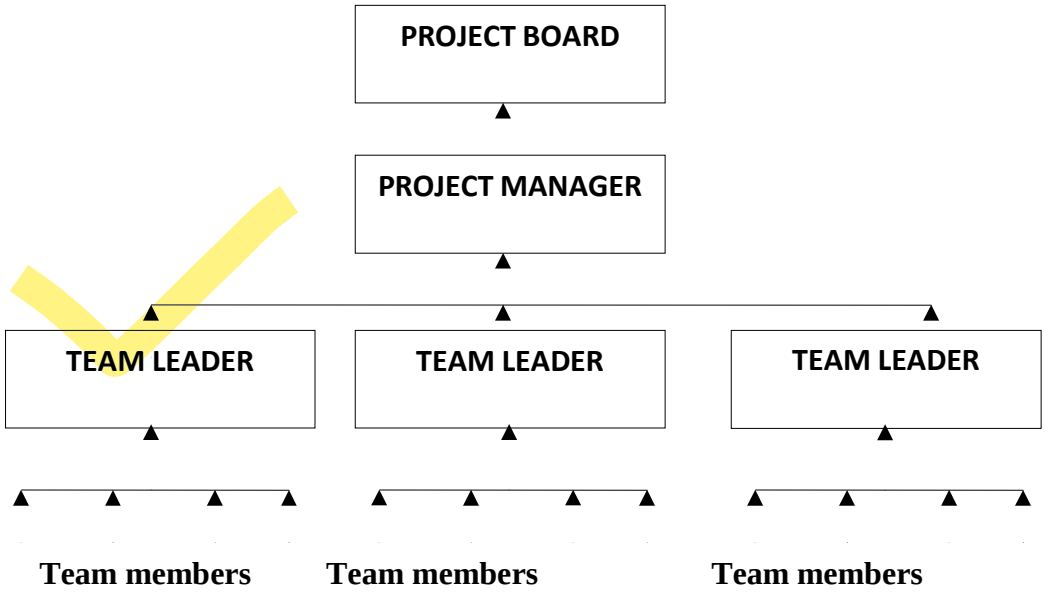


Fig: Project Control Cycle

PROJECT REPORTING STRUCTURES

- Project steering committee or the Project Board has the overall responsibility of the project's progress in achieving the target.
- Project manager has the day-to-day responsibility of governing the development of the project. These managers assign individual responsibilities to different teams under a team leader.



Project Reporting Structures

- The diagram represents a structure for a medium-sized project where team leaders can directly report to the project managers.
- Every team consists of a group of team members assigned with specific tasks. These members represent the respective team according to the work allocated.
- Team leaders organize and collect team related information and report to the project manager.
- The project manager in-turn generates a project-level report of the progress of the project and report to the steering committee.

Categories of Reporting

- Reporting is broadly classified as formal and informal reporting. The basic types of reports associated with formal and informal reporting includes regular and ad hoc types.
- **Formal regular** types can be oral or written. The standard oral communication of minutes are kept whereas written type gets the reporting issues in a separate written format.

formal regular
formal ad hoc
informal regular
informal ad hoc
oral informal ad hoc

- **Formal ad hoc** are mostly received information of different levels towards the end of the project and generate written reports.
- **Informal, oral and ad hoc** provides early warning to the system and must be backed up by formal reporting procedures.

Progress Assessment

- Based on the information collected from various levels at regular intervals during the development of the project measures the progress assessment.
- The information can however, measure the project's objectives in determining whether the project can produce deliverables or not.
- Every single activity will not yield a deliverable work product but a group of activities can achieve the specified tangible product.
- Usually, the assessment process is carried out by the team members who are associated with the project activities.
- **Checkpoints** can be used to check the initial activity plan which may govern specific events in generating report or a deliverable.
- Team leaders will have to assess the project daily while the project leaders can do it on a weekly basis. Higher level members generate less reporting than their subordinates.
- **Review points or control points** can be set at different points in the project life cycle to review the progress of the project.

3.1 Collection of data project termination

- Collecting information of the project progress at regular instances provides much control over the project.
- However, gathering of partial completion of activities can be used to calculate the remaining work needed to complete.
- Intermediate products that are achieved can specify a milestone in the development of theproject.

3.1.1 Partial Completion Reporting

- The staff time related to a specific project indicates the work that has to be carried out by the particular staff.
- Every organization uses an accounting method to calculate the charges of their employees. However, the information related to project schedule is not shown in this report.
- Timesheets can be maintained on a weekly basis to measure the staff involvement in the development process.
- Weekly timesheets contain the breakdown activities and holds information about the scheduled and estimated completion time of individuals and do not contain the project completion dates.

WEEKLY TIME SHEET OF INDIVIDUAL TEAM MEMBER

Staff :_____ **Week Ending : _____**

Worked Hours

Project	Activity Code	Description	Hours this week	Percentage of Completion	Scheduled Completion	Estimated Completion

Total Worked Hours :

Non-worked hours

Code	Description	Hours this week	Comment & Authorization

Total Non- Worked Hours :

Weekly Timesheet

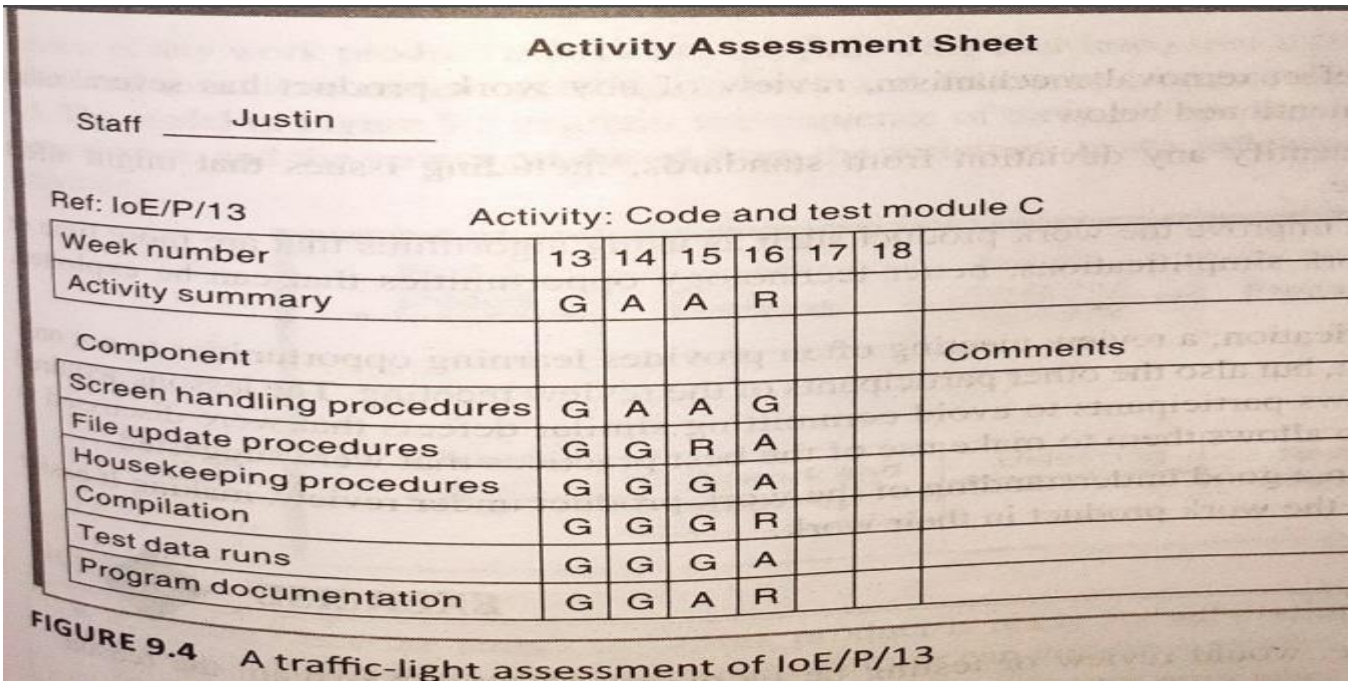
❖ Reporting Risk

- Risk reporting uses a traffic light method concept and consists of the following steps:
  - Identify the first level elements for assessment
  - Break the first level elements into second level elements
  - Assess the second level elements and mark the color as

    Green – on target

    Amber – not on target but recoverable

    Red – not on target and difficult to recover
  - Review all the second level elements to reach the first level assessments
  - Review both first and the second level assessments to produce an overall assessment
- This method only focuses on non-achievement factors and do not mention about any delay in the development process.
- Assessment forms can be used to evaluate the overall status of the project.
- Critical activities denoted by red color must be reconsidered during the revision of project schedule.



Activity Assessment Sheet

Staff Justin

Ref: IoE/P/13 Activity: Code and test module C

Week number	13	14	15	16	17	18	
Activity summary	G	A	A	R			
Component							Comments
Screen handling procedures	G	A	A	G			
File update procedures	G	G	R	A			
Housekeeping procedures	G	G	G	A			
Compilation	G	G	G	R			
Test data runs	G	G	G	A			
Program documentation	G	G	A	R			

FIGURE 9.4 A traffic-light assessment of IoE/P/13

3.2 Visualizing Progress

- Collected data cannot be represented as arrived. It has to be shown visually so that everybody involved in the project work is pleased about its progress. Presenting effectively plays a vital role in the future of the project

3.2.1 Categories of Visualizing Progress

The techniques that are used in visualizing project progress are:

- Gantt chart
- Slip Chart
- Ball Chart

These are explained in detail in the following sections.

1. Gantt Chart Technique

- Gantt chart is the most simple and the oldest form of representing the progress of theproject.
- It consists of an activity bar that indicate the scheduled activity dates and the durationalong with the activity floats.
- The progress reports of the activity are normally represented as a shaded activity bar which indicates the percentage of activity completion.
- For example in the figure, the code and test module activity of X is ahead of thecompletion process whereas the third activity Z is lacking behind in its schedule.

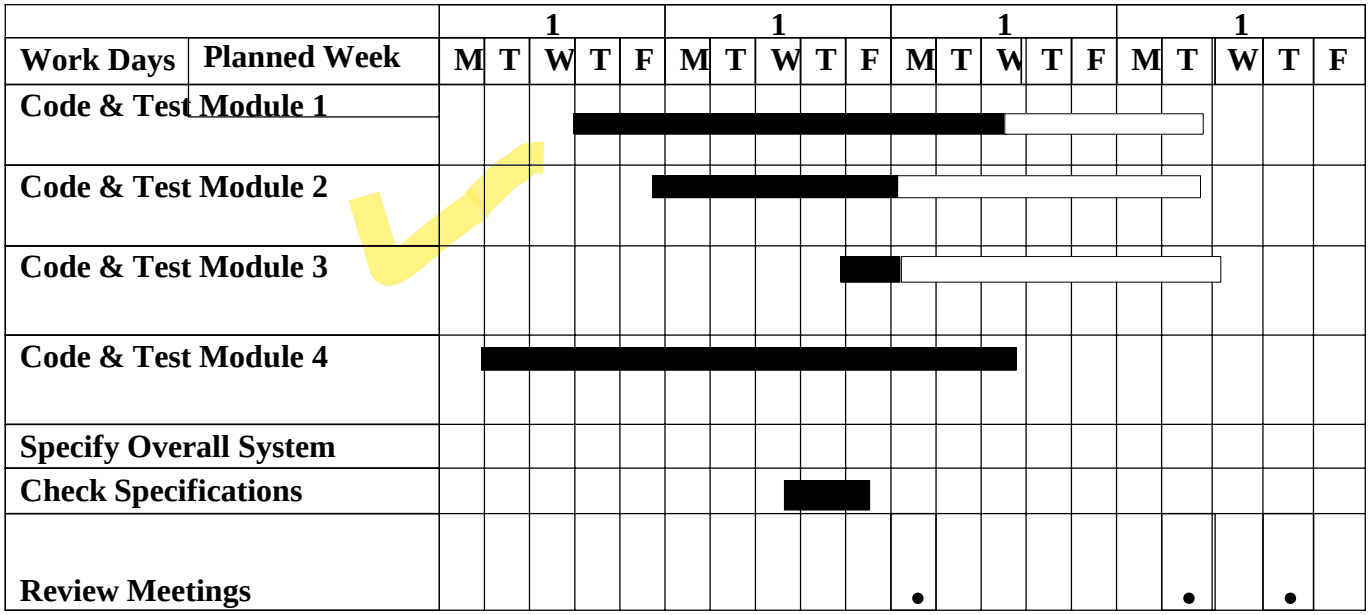


Fig: Sample Gantt Chart

2. Slip Chart Technique

- A Slip chart provides an alternative view of Gantt chart by providing a visual indicationof those activities which are not on schedule.
- The chart indicates that, the more there is a bend in the line the greater the variation in theproject plan.
- If the slip line deviates more towards the non-achievement of project objectives, then ithas to be reconsidered.
- The same figure used to represent Gantt chart is modified to Slip chart and depicted below:
- Additional slip lines can be included at regular intervals as they are build p which provides the project manager a clear idea about the projects progress.

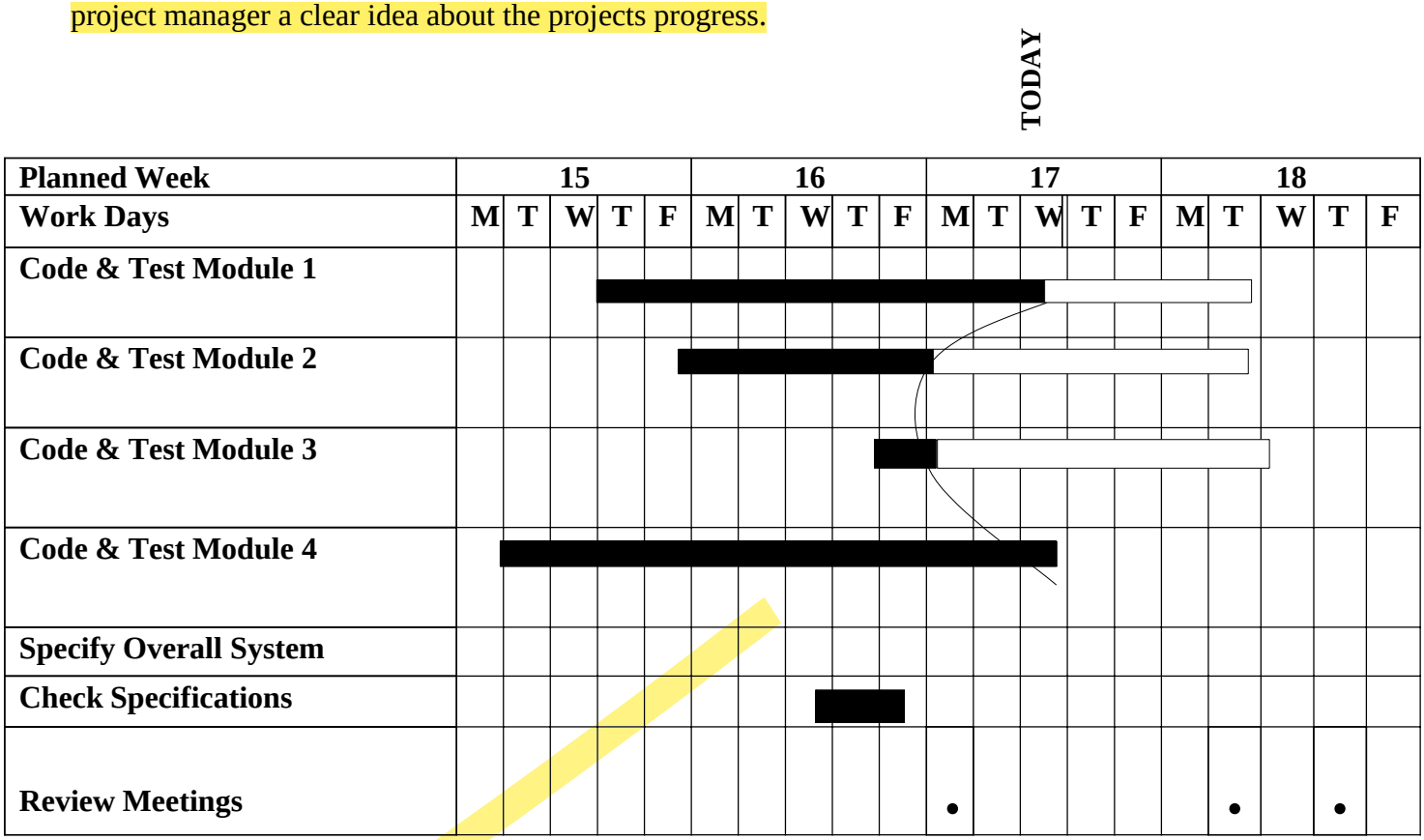
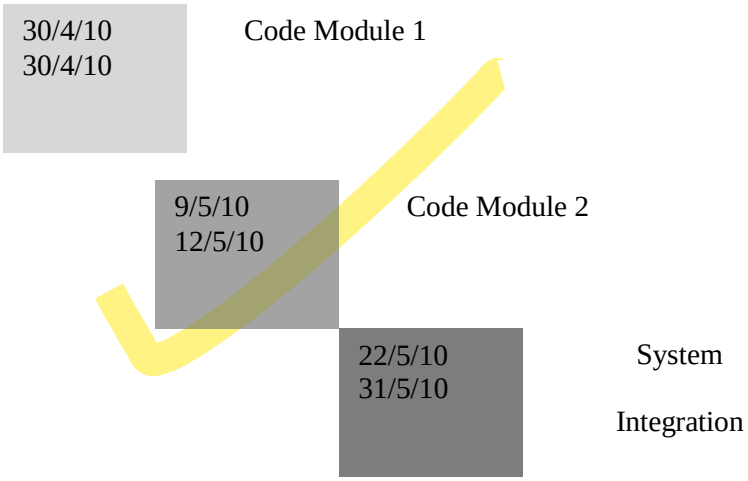


Fig: Slip Chart

3. Ball Chart Technique

- Ball charts are represented in the form of circles that indicate the start and the end point completion of activities.
- Initially, the circles contain the original scheduled dates and when revisions are done, thesecond dates are introduced inside the circle until the activity is started or completed.
- Circles of bar chart will at most contain only two dates the original and the revised one orthe original and the actual dates.
- Ball charts are pictorially shown as below:



Ball Chart

- An activity is denoted by a red circle (colored darker in the figure) when the start and the end dates are later than the target dates whereas green circle (colored lighter in the figure) denotes that the activity is ahead of its schedule.
- The color to the circles reminds the project team about the status of each activity.
- In general, all the three types of chart techniques do not show clearly the slippage in the project completion date for the project life cycle. This is overcome by timeline chart
- .

Timeline Charts

- Timeline usually records and displays the target changes during the project life cycle.
- The chart represents the planned time along the horizontal axis and the actual time along the vertical axis.
- A line down the horizontal axis represents the scheduled activity completion dates and the slip in the line indicates a delay in the respective activities.
- This timeline chart is used to calculate the duration of execution of the project as a part of post-implementation review.

Planned Time / Week Numbers

Actual Time / Week Number

	1	2	3	4	5	6	7	8	9
	MTWTF	MTWTF	MTWTF	MTWTF	MTWTF	MTWTF	MTWTF	MTWTF	MTWTF
1			ing system		User requirements	n offline layout		Draft tender	Issue Tender
2									
3									
4									
5									
6									
7									
8									
9									

Fig: Timeline Chart

❖ Cost Monitoring

- An important component of project control is cost monitoring.
- Cost monitoring provides an indication of the effort that has been given to the project.
- Sometimes, more cost is incurred to complete the activities to keep the project on schedule.
- A cumulative cost chart is depicted below:

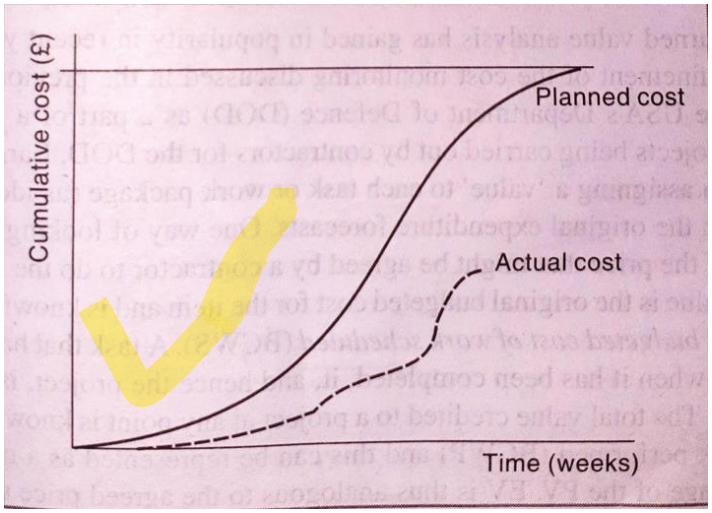


Fig: Cumulative Cost Chart

- The chart does a comparison between the actual and the planned expenditure.
- These charts become more useful for estimating future costs.
- When revision of estimated cost and completion date are done, the same can also be expressed in the revised cumulative chart.

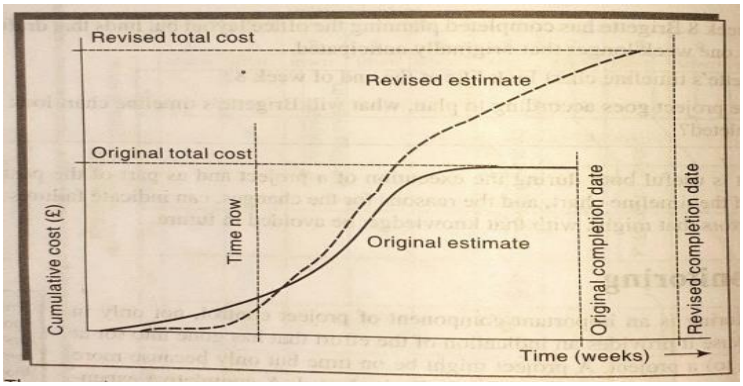


Fig: Revised Cumulative Cost Chart

❖ Earned Value Analysis

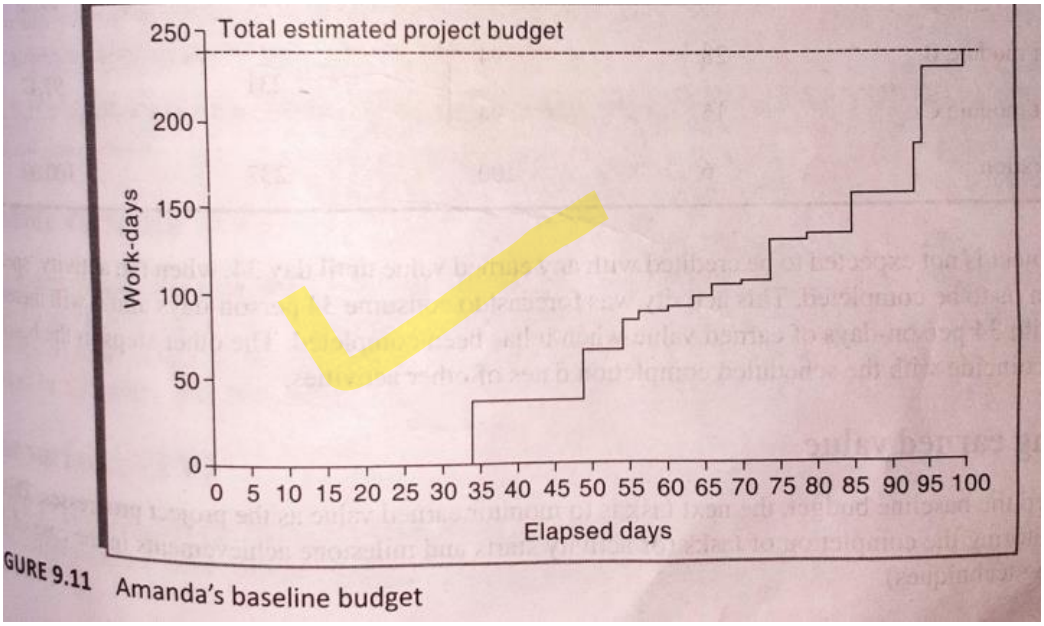
- An assigned value to each task or work package based on original cost forecasts yields earned value for the project.

- The assigned value is the original budgeted cost value and termed as a **planned value (PV)** or **budgeted cost of work schedule (BCWS).**
- **Earned value(EV)**denotes the total value credited to a project at any point. It is also termed as **budgeted cost of work performed (BCWP).**

- Common methods used in assigning an earned value are:
    - **0/100 technique:** Task value is assigned zero till completion and the budgeted value is 100%.
    - **50/50 technique:**Task value is assigned 50% and then increased to 100% once it completes.
    - **Milestone technique:**Task is assigned a value based on the achievement of milestones as part of original plan.
- Out of all these method, the 0/100 technique is used because the other techniques are not suitable for longer duration cost estimation.

❖ Baseline Budgets

- To setup an earned value analysis, the first step is to create a baseline budget.
- The baselinebudget shows the forecast growth of the project plan in earned value with respect to time.
- Common ways of measuring earned value in software development process is persons-hours or work-days.
- A 0/100 technique can be used to get the creditability of earned value.
- A typical baseline budget chart is given below and it depicts the scheduled completion of all activities involved in the development of the project.



GURE 9.11 Amanda's baseline budget

❖ Monitoring Earned Value

- The next step in earned value analysis is to monitor the project progress.
- Monitoring process indicates the completion of tasks and includes the activity start and milestone achievement of the project.
- The **actual cost (AC)** is calculated by the actual cost of each task and is also called as actual cost of work performed (ACWP).
- Certain inferences can be obtained from the earned chart such as:

a. **Schedule variance (SV):** The difference between the earned value and the planned value indicates the degree of the completed work with the planned.

b. **Cost variance (CV):** The difference between the earned value and the actual cost of a completed work results in cost variance. A positive CV value indicated that the project is under control and a negative CV denotes that the actual cost incurred is much more than the planned one.

- The diagram depicts the earned value analysis along with the schedule and cost variance.

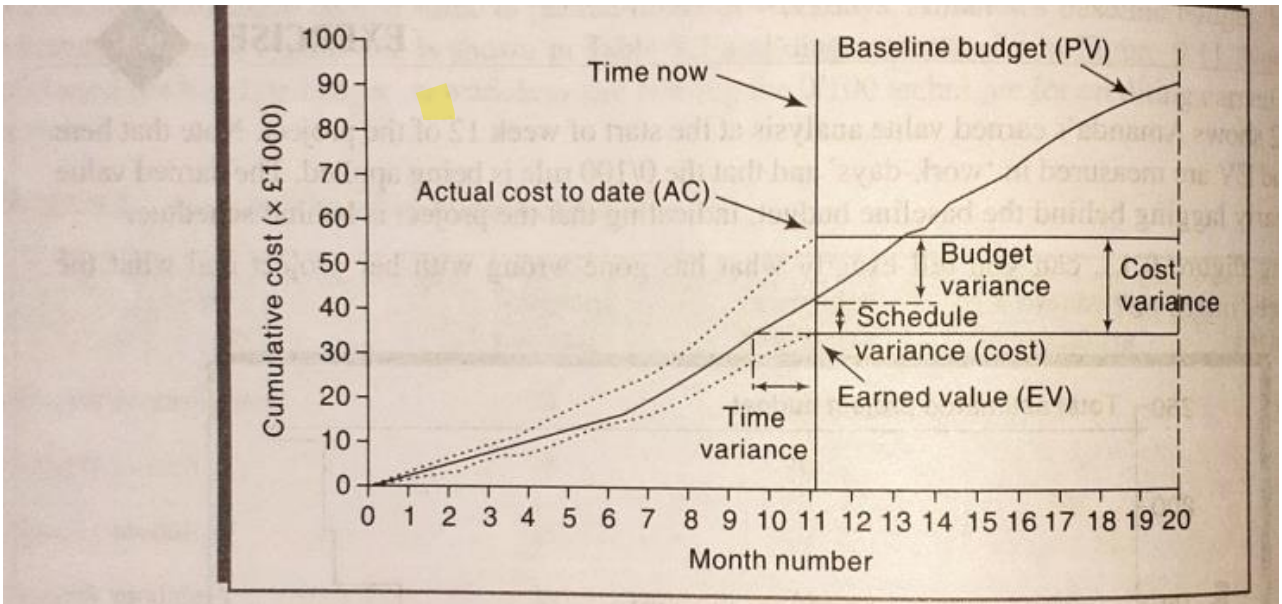


FIGURE 9.13 An earned value tracking chart

❖ Performance Ratios

- Performance ratios defines two index values namely **Cost Performance Index (CPI)** and **Schedule Performance Index (SPI).**
- Cost performance index and Schedule performance index values are calculated by the formulas,

CPI = Earned value / Actual Costs

SPI = Earned value / Planned value

For Forecasting

EAC (Estimated Time at completion)=BAC/CPI

Where BAC= Budget at Completion

TEAC (Time estimate at Completion)= SAC/SPI

Where SAC = Schedule at completion

- When these indices refers to a greater value it means that the work is completed better than planned and if the value is less, it means that the work is more costlier than planned.

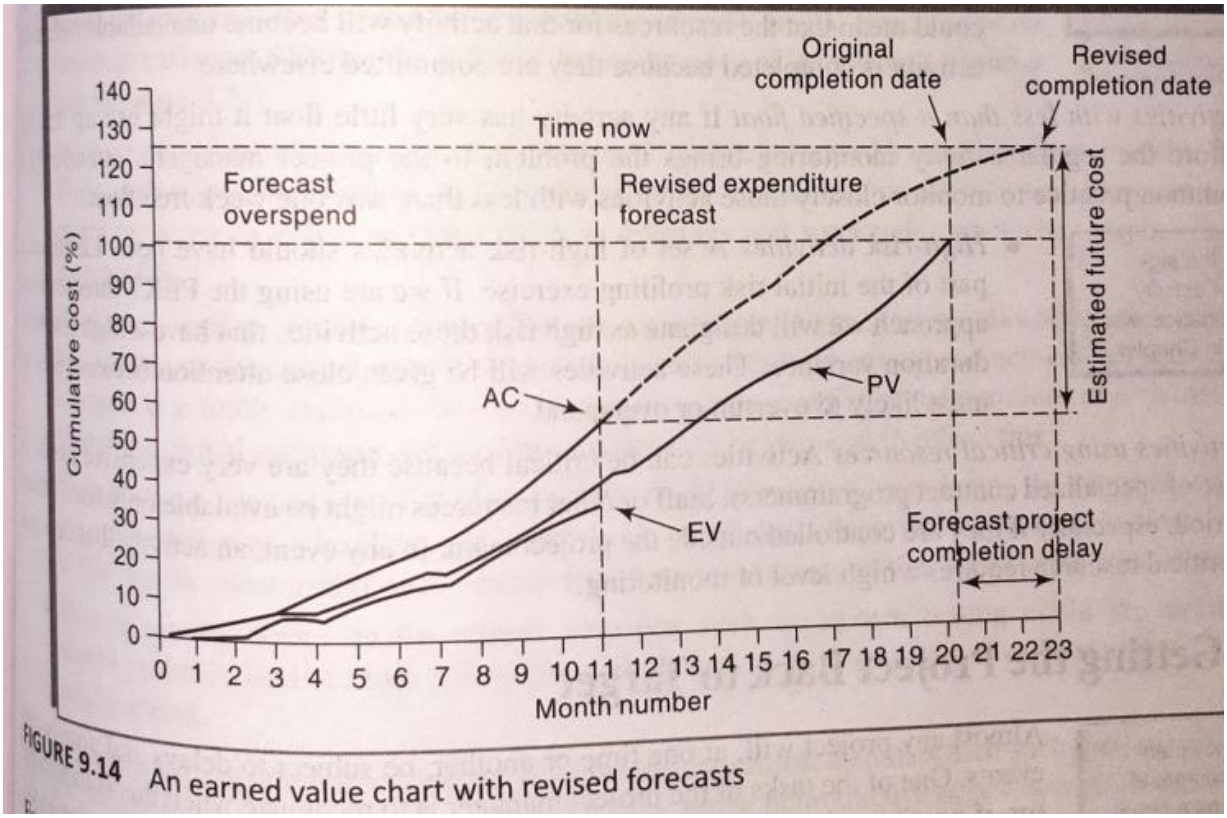


FIGURE 9.14 An earned value chart with revised forecasts

❖ Project Tracking

i. Prioritizing Monitoring

The list of priorities defined in the level of monitoring are:

- **Critical path activities:** These denote those activities in the critical path that are delayed in project completion date.
- **Activities with no free float:** These delayed activities will have a delay in subsequent ones but still stick on target. These activities can have a serious effect on the resource schedule because the subsequent activities have to wait for its completion.
- **Activities with less than a specified float:** If there is a very little float in the activity say less than one week, these activities must be monitored very closely.
- **High risk activities:** These high risks are identified in the risk management plan itself and these results in over spending.
- **Activities using critical resources:** Critical activities are very expensive and are available only for a limited period and require high level of monitoring.

ii. Getting back Project on Target

- Projects are subjected to delays and unexpected events.
- The project manager must ensure that the project scheduled end dates are unaffected at any circumstances.
- To maintain the project within the completed time, duration of some activity of the project can be delayed or shorten to fit into the time limit.
- The strategies involved in getting back the project to target are;
    - Critical path shortening
    - Reconsidering precedence requirements

❖ **Critical Path Shortening**

- Delayed projects can often be brought back on track by shortening activity times on the critical path.
- Critical path is determined by the overall duration of the project.
- By increasing the resources for the critical path activities results in completion of the activity before time and the resources can be prolonged for a longer duration.
- At the same time, the resources used must be effectively allocated to all the activities so that no resources are idle at any point of time.
- Swapping of critical and non- critical activities can also be used to shorten the time limit and bring the project back to target.
- One disadvantage of shortening critical path is that, it produces many more paths while shortening which can become critical.

❖ **Reconsidering Precedence Requirements**

- The project can be brought back to target by defining constraints to certain activities that affect the other activities for its completion.
- A precedence constraint activity can be sub-divided into a component that can start immediately.
- Altering these constraints would have a major impact on the quality factors, the risk involved, which can cause a delay in carrying out the activities.

❖ Change Control

- Change control implies the authority to approve and rank the changes. It combines the automated tool with human to provide a mechanism for control of change.
- Any changes or alteration done to a single document often implies changes to other documents as well.
- Change request is evaluated to assess the technical aspect of configuration items and the budget.

i. Role of Change Control Manager

The responsibilities of change control manager or the configuration librarian are:

- Identification of configuration items that are subjected to change control.
- All project documentation and software products must be maintained in the central repository.
- A formal set of procedures have to be setup to have control over changes.
- Maintenance of library items in the repository

ii. Change control Procedures

Change control authority (CCA) makes the final decision on the status and the priority ofthe change based on the change report.

Guidelines of a change control procedures includes:

1. One or more users might perceive a need for a modification to a system and ask for a change requestto be passed to the development staff.
2. The user management consider the change request and if they approve it pass it to the developmentmanagement.
3. The development management delegate a member of staff to look at the request and to report on thepracticality and cost of carrying out the change. They would, as part of this, assess the products that would be affected by the change.
4. The development management report 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.
5. One or more developers are authorized to take copies of the master products that are to be modified.
6. The copies are modified. In the case of software components this would involve modifying the codeand recompiling and testing it.

7. 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.

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

iii. System Scope Changes

- Any changes done leads to changes in the size of the system which gradually increases.
- The changes can be either from the management or from the user.
- For every change that is implemented, the scope of the developing project must be very carefully monitored and controlled.
- The changes made should not make the system to be inconsistent by affecting theestimating factors.

❖ Software Configuration Management

Throughout development, software consists of a collection of items (such as programs, data and documents) that can easily be changed. During software development, the design, code, and even requirements are often changed, and the changes occur at any time during the development. This easily changeable nature of software and the fact that changes often take place require that changes be done in a controlled manner.

Software configuration management (SCM) is the discipline for systematically controlling the changes that take place during development. Software configuration management is a process independent of the development process largely because most development models cannot accommodate change at any time during development. SCM can be considered as having three major components:

- Software configuration identification
- Configuration control
- Status accounting and auditing

i. Software Configuration identification

The first requirement for any change management is to have clearly agreed-on basis for change. That is, when a change is done, it should be clear to what changes has been applied. This requires baselines to be established. A baseline change is the changing of the established baseline, which is controlled by SCM.

After baseline changes the state of the software is defined by the most recent baseline and the changes that were made. Some of the common baselines are functional or requirements baseline, design baseline, and product or system baseline. Functional or requirement baseline is generally the requirements document that specifies the functional requirements for the software.Design baseline consists of the different components in the software and their designs. Product or system baseline represents the developed system.

It should be clear that a baseline is established only after the product is relatively stable. Though the goal of SCM is to control the establishment and changes to these baselines, treating each baseline as a single unit for the purpose of change is undesirable, as the change may be limited to a very small portion of the baseline.

ii. Configuration control

Most of the decisions regarding the change are generally taken by the configuration control board (CCB), which is a group of people responsible for configuration management, headed by the configuration manager. For smaller projects, the CCB might consist of just one person. A change is initiated by a change request.

The reason for change can be anything. However, the most common reasons are requirement changes, changes due to bugs, platform changes, and enhancement changes. The CR for change generally consists of three parts. The first part describes the change, reason for change, the SCIs that are affected, the priority of the change, etc.

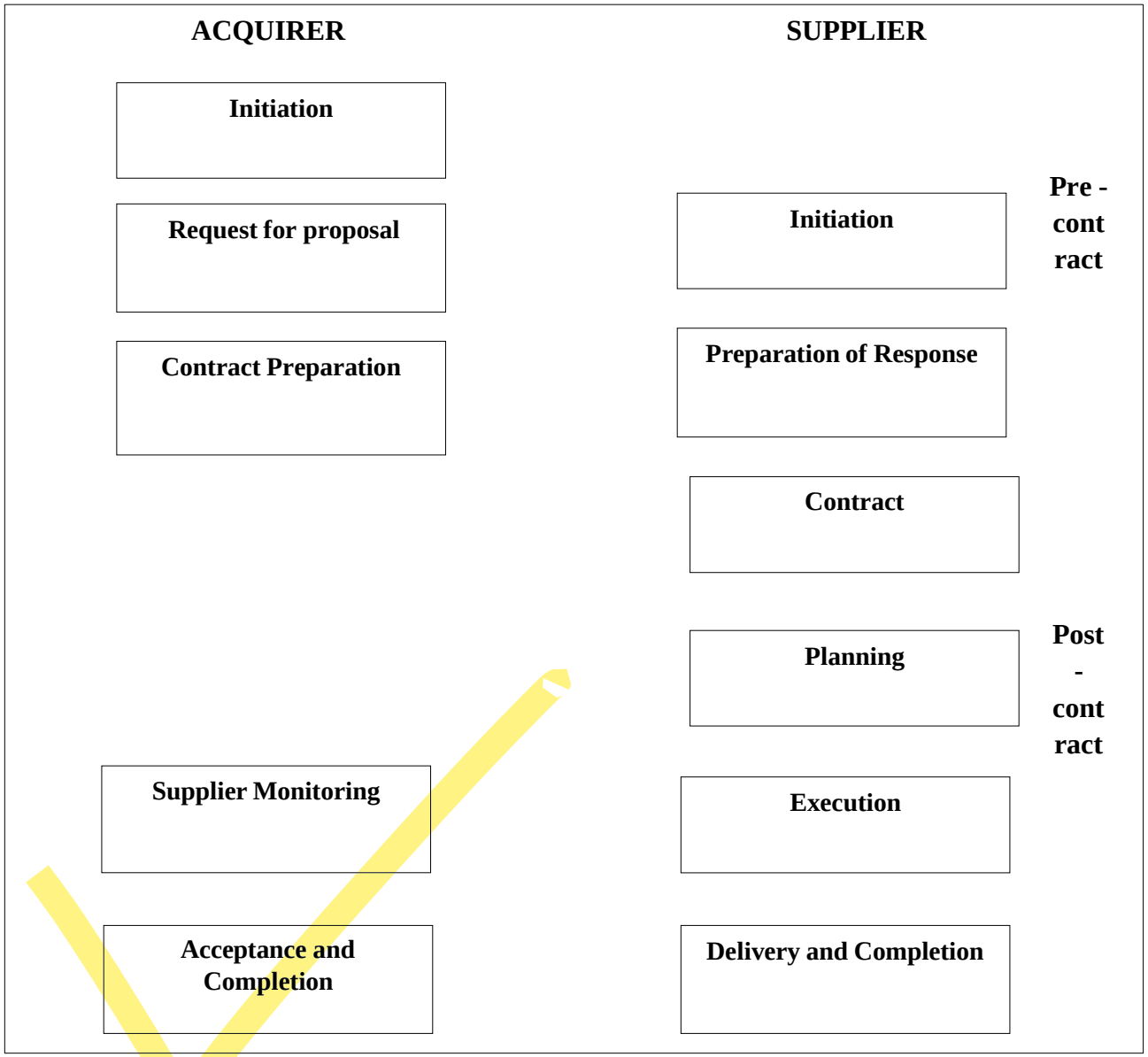
The second part, filled by the CM, describes the decision taken by the CCB on this CR, the action the CM feels need to be done to implement this change and any other comments the CM may have. The third part is filled by the implementer, which later implements the change.

iii. Status accounting and auditing

For status accounting, the main source of information is the CRs and FRs themselves. Generally, a field in the CR/FR is added that specifies its current status. The status could be active, complete,or not scheduled. Information about dates and efforts can also be added to the CR, the information from the CRs/FRs can be used to prepare a summary, which can be used by the project manager and the CCB to track all the changes.

❖ Managing Contracts

- The acquisition and supply process are depicted for pre-contract and post-contract as follows:
- The success of a contract requires considerable amount of time management.
- An ISO 12207 standard defined for acquisition and supply of software defines five majorprocesses namely,
    i. Acquisition
    ii. Supply
    iii. Operation
    iv. Maintenance
    v. Development



ISO 12207 Acquisition and Supply process

- The initiation activity starts with the acquirer describing the preparation for the invitation to tender.
- System requirements are broader and are not related to software alone but depends on the changes in the organizational environment.
- Software requirements specifically relate to the software components within the delivered system and can be extracted from broader system requirements.
- Request for proposal of the project contains the system requirements, scope of thesystem, instruction for the bidders, list of software products, subcontractors detail and other technical constraints.

- The criteria for selecting the supplier will have to done very carefully by the acquirer done by joint reviews, verification and validation.
- As the supplier delivers, the acquirer conducts the review tests and is satisfied accepts the software and sign-off as completed.

❖ Supply Process

The supplier process activities will need to undertake in response to the request of supplier.

Initiation: The process is started when a request for a proposal from an acquirer and the supplier initiates the work.

Response Preparation: The response is prepared with expert knowledge drawn from various people.

Contract: Every activity is handled well, then the acquirer accepts the supplier and the details of the contract are negotiated and signed.

Planning: A detailed plan is developed of how the work has to be carried out.

Execution and Control: The detailed plan can be executed and the development process is invoked. The supplier must monitor and have control over the product quality in identifying, analyzing and providing resolutions.

Review and Evaluation: The acquirer reviews the progress of product information which are needed to be accessed.

Delivery and Completion: Post-delivery process has to be defined in view of the management plans.

TYPES OF CONTRACT

- Services are the external resources that are required for setting up a new system.
- **Based on the supply of a completed software package** the contracts can be classified as
  - **Bespoke system:** This kind of system is developed for an individual that is created from scratch.
  - **Off-the-shelf:** This package denotes what the user buys as it is and called as shrink-wrapped software.
  - **Customized off-the-shelf:** This system represents a basic core system that is modified based on the requirements of the client.

Based on how the payment is made to the supplier, the contracts can be classified as,

i. **Fixed price contracts:** Here, the price is fixed when the contract is signed. There will be no changes in the contract terms and the payment must be made towards theend of the work.

Advantages of Fixed price contracts

- Customer expenditure is well-known.
- Motivation of the supplier towards delivering the product with cost- effective.

Disadvantages of Fixed price contracts

- Supplier absorbs the risk in original estimate and allows higher prices toallow contingency which is added as a margin quoted in the tender.
- Requirements once defined are difficult to modify which can causefriction between supplier and customer.
- Initially, the supplier will quote low price but as requirements are putforward, the supplier demands a higher price
- Threat to the quality of the system can occur if the price is fixed.

ii. Time and Materials contracts: Here, the customer is charged with a fixed rate perunit of effort. This also estimates the overall cost based on the customer's requirements and it is not based on the final payment.

Advantages of Time and Materials contracts

- Changing requirements can be done very easily.
- The customer is not worried about the price pressure.

Disadvantages of Time and Materials contracts

- Customer cannot include all the requirements needed by them.
- The supplier will not like to work in a system where the scope defined is out of control.

iii. Fixed price per unit delivered contracts: This type of contract is based on function point counting. Along with the size of the system which includes LOC, a price per unit is also quoted. In this system, the scope grows during the development process.

Advantages of Fixed price per unit delivered contracts

- Unlike the time contract, the customer can understand the changing requirements
- Pricing schedules can be compared.
- Supplier does not get affected by risk increasing functionality.
- Supplier has efficiency to deliver the cost-effective manner.
- Development contract includes both the analysis and design stages of the project.

Disadvantages of Fixed price per unit delivered contracts

- It is very difficult to measure the software size.
- The requirement changes sometimes affect the transactions that are not included in the function point count.

Based on the approach used in contractor selection the contracts can be classified as

- **Open tendering process:** The request for proposal must be considered and evaluated with the original conditions. Every supplier can bid to supply the goods and services. The evaluation process can be time-consuming and also expensive in open tendering process.
- **Restricted tendering process:** Here, bids can be made only by suppliers who have been invited by the customer. This is an better approach than the open tendering but has some risk factors.
- **Negotiated procedure:** In particular instances, the restricted tendering process fails because of the defects which lead to additional payment towards the completion of the project.

Stages in Contract Placement

- The main stages in contract placement are given below:
  - **Requirement analysis**
  - **Evaluation plan**
  - **Invitation to tender**
  - **Evaluation of proposals**

Requirement analysis

- Preparation of an requirement document containing the following:
  - Introduction
  - Description of the existing system
  - Current environment of the system
  - Customer's future plans
  - System requirements based on either mandatory or desirable
  - Deadlines have to be defined
  - Additional information requires from the potential suppliers

Evaluation plan

- The evaluation plan contains:
  - Preparing a plan to evaluate the submitted proposals.
  - Checking for the mandatory requirements that have been defined to meet the objectives.
  - Evaluating the desirable requirements
  - Validating the quality of the software system
  - Cost incurred for the lifetime of the proposed system

Invitation to tender

- This is also termed as request for proposal and contains:
  - System requirements
  - Defining the scope of the system
  - Instruction to the bidders
  - List of the software products
  - Control of the subcontractors resulting in MoA
  - Technical constraints

Evaluation of proposals

- This evaluation has to be done in a planned manner. The process of evaluation includes:
  - Scrutiny of the proposal documents
  - Questioning supplier representatives
  - Giving demonstrations
  - Visiting the site of the development process
  - Conducting practical tests.

Typical Terms of Contract

The contents of a typical terms of contract are listed below:

- **Definitions:** The exact meaning of who is a supplier and who is a customer.
- **Forms of agreement:** Categorizing whether the contract is sale, a lease, or a license.
- **Goods and services to be supplied:** This contains the actual list of individual pieces of equipment that has to be delivered with specific model numbers. The services includes proper training, documentation, installation, conversion of existing files, maintenance of agreements and insurance related issues.
- **Ownership of the software:** There are two possible ownership that can exists; one with the customer and the other with the supplier. Supplier provides a license to the user to use but that does not mean the ownership changes. Any assignment of copyright must be in writing.
- **Environment:** The basic working environment facilities have to be provided by the supplier and the customer such as electricity supply.
- **Customer commitments:** Customers have to provide with the basic accommodation facilities even though the work is carried out by external contractors.
- **Acceptance procedures:** Various tests are conducted and the system is accepted after the procedure for signing off the testing process is completed.
- **Standards:** Every product that is supplied must abide by the standards relating to its development and its documentation.
- **Project and quality management:** The quality that is expected by the management for the project can be influenced by conducting review meetings and obtaining the progress information of the project.
- **Timetable:** A schedule is drawn to describe the different tasks and activities that has to be carried out during the development process.

- **Price and payment method:** Payment must be made based on the price that has been defined in the agreement ensuring that the goods and services are satisfactory.
- **Miscellaneous legal requirements:** A contract must be defined within the legal jurisdiction stating the liabilities that are applied to subcontractors involved in the process. Liquidated damages can cause financial losses where the customer suffersif the supplier is not able to oblige.

Contract Management

- Contract management studies and monitors the conversation between the supplier and the customer while the contracted work is being carried out.
- Customer can make changes to the future direction of the project and make decisions.
- The entire project will require representative of the supplier and the customer to interact with each other at different points in the development process.
- Activities involved in contract management include:
  - Identifying customer approval;
  - Negotiating successfully;
  - Project deliverables;
  - Managing change;
  - Decision making;
  - Legal obligations;
  - Business laws.

Accepting the Contract

- Customer has to undergo acceptance testing towards the end of the process.
- Every contract would have defined a time limit for the acceptance testing and the result has certain software suppliers are concerned with pre-acceptance testing where the user tests the system than the developer.
- The supplier will not like to retain their staff to a specific project after its completion.
- Customer finds that the modifications needed by them are handled only by the junior level staffs that are not aware of the delivered product.
- All the payment to the supplier solely depends on the acceptance testing.
- Every bug that is raised must be fixed within the period of warranty to be produced before the time expires