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Software Project Management – A Successive Process That Bring a New System

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Abstract: **Project management is the art of matching a project's goals, tasks, and resources to accomplish a goal as needed. We say "as needed" because one has limited time, money, and resources (human and machinery) with which to accomplish a goal. One can think of a project as a process.**

Preliminary investigation examines project feasibility. A feasibility study is the analysis of a problem to determine if it can be solved effectively. The results determine whether the solution should be implemented or not.

Planning provides a road map for the software development process. It is probably the most time-consuming project management Activity. It is a continuous activity from initial concept through to system delivery. Plans must be regularly revised as new information becomes available.

Schedule is a vital project management attribute in a market driven economy where time to market is critical to success. It takes an important role in the project planning activity.

Individual projects are likely to differ considerably but following some classic project life cycle models. And the planning is pointless unless the execution of plan is monitored.

Keywords: **Project, Management, Feasibility, Planning, Scheduling.**

1. INTRODUCTION OF THE STUDY

Project management is the process and activity of planning, organizing, motivating, and controlling resources, procedures and protocols to achieve specific goals in scientific or daily problems. A project is a temporary endeavor designed to produce a unique product, service or result with a defined beginning and end (usually time-constrained, and often constrained by funding . typically to bring about beneficial change or added value. The temporary nature of projects stands in contrast with business as usual which are repetitive, permanent, or semi-permanent functional activities to produce products or services. In practice, the management of these two systems is often quite different, and as such requires the development of distinct technical skills and management strategies.

The primary challenge of project management is to achieve all of the project goals and objectives while honoring the preconceived constraints. The primary constraints are scope time, quality and budget the secondary and more ambitious challenge is to optimize the allocation of necessary inputs and integrate them to meet pre-defined objectives.

Stages of a Project:

- Defining the Goals of the Project
- Define Project Tasks/Activities
- Determine and Verify Resource Requirements
- Identify Risks and Develop Mitigation (Backup) Plans
- Develop a Schedule
- Execute the Schedule

A Software project is concerned not only with the actual writing of software. In fact, where a software application is bought in 'Off-the-self', there might be no software writing as such. This is still fundamentally a software project because so many of the other elements associated with this type of project are present. Usually, there are three successive processes that bring a new system into being-

- ✓ Feasibility Study
- ✓ Project Planning
- ✓ Project Execution

Feasibility Study:

This activity takes place during the project initiation phase and is made before significant expenses are engaged.
It includes –

- Perform a preliminary study to determine a project's feasibility.
- Research the business problem or opportunity.
- Document the business requirements for a solution.
- Identify all of the alternative solutions available and review each solution.
- List any risk with each solution.
- Choose a preferred solution for implementation.
- Document the result in a feasibility report.

Three tests of feasibility are: Operational, Technical and Financial.

Software Project Planning:

It is a continuous activity from initial concept through to system delivery. Plans must be regularly revised as new information becomes available. Various different types of plan may be developed to support the main software project plan that is concerned with schedule and budget

Objective of Software Project Planning:

The objective of software project planning is to provide a frame work that enables the manager to make reasonable estimates of resources, cost and schedule.

***Project Attributes*:** A Project, by definition, is a group of activities that need to be carried out in order to accomplish a set of objectives in an agreed-upon time with available resources. A project has a start and an end and goes through various phases before its completion. A project has three major attributes - **Scope, Resource & Schedule** - which needs constant monitoring.

Software Scope:

The first activity in software project planning is the determination of software scope. A software project scope must be unambiguous and understandable at the management and technical levels. The software scope means the actual operation that is going to carried out by the software and its plus points and limitations.

Resources:

The second task of software planning is the estimation of resources required. Each resource is specified with the following characteristic. Resourc descriptions, details of availability, when it is required, how long it is required

- Human Resource
- Hardware Resource
- Software Resource

People are the primary software development resource. The planner evaluates the scope and selects the appropriate people for appropriate positions.

Project Schedule:
Schedule is a vital project management attribute in a market driven economy where time to market is critical to success. It takes an important role in the project planning activity. It decides which tasks would be taken up when. Project managers frequently find themselves unable to compromise on schedule while being able to play better with the other two parameters. In order to schedule the project activities, a software project manager needs to do the following:

1. Identify all the tasks to complete the project.
2. Break down large tasks into small ones and determine dependency among them.
3. Estimate effort for each task, and a resource list with availability for each resource (If these are not yet available, it may be possible to create something that looks like a schedule, but it will essentially be a work of fiction).
4. Determine the terminal dates i.e. starting and ending dates.
5. Determine the **critical path**.

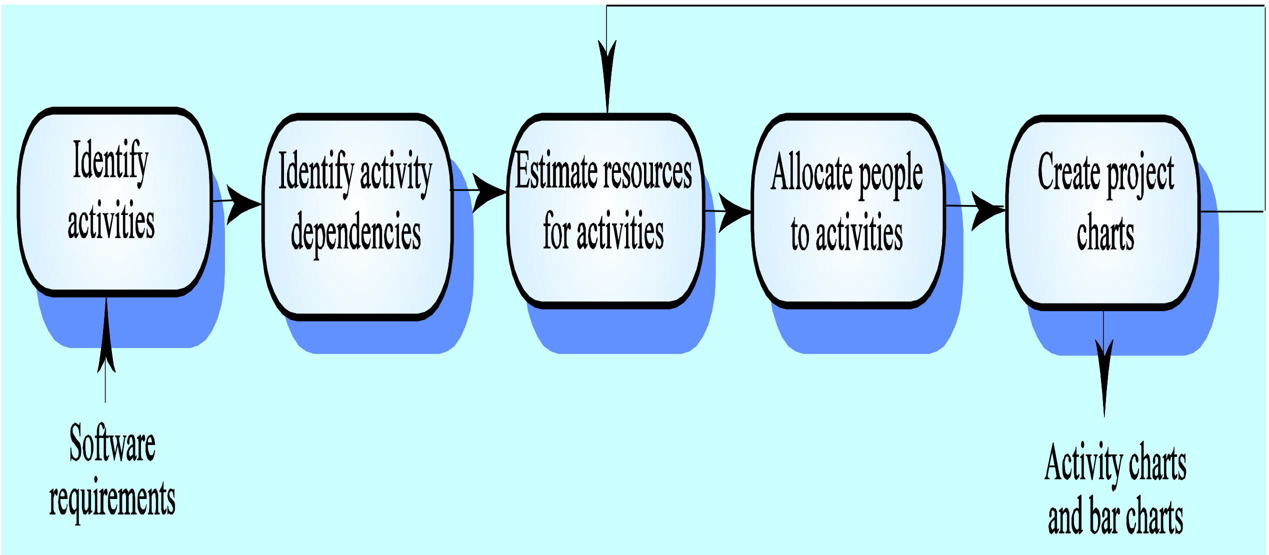

Fig. 2.1 Project Scheduling

2. WORK BREAKDOWN STRUCTURE

Before a project schedule can be created, a project manager should typically have a work breakdown structure (WBS). The work breakdown structure is **a simple tool that gives the manager a framework for breaking down large tasks into more manageable pieces**. **Once these manageable pieces have been identified, they can be used as units of work assignment**. The goal of a work breakdown structure is to identify all the activities that a project must undertake. The tasks can be broken down into as fine as level of details as is desired or necessary.

WBS is the logical starting point for subsequent planning networks. Another advantage is that a cost allocation can be given to each task in the WBS and, if required, a risk factor can be added. This will assist in building up the total project cost and creates a risk register for a subsequent, more rigorous risk assessment. **The objective of all this is to be able to control the project by allocating resources (human, material and financial) and giving time constraints to each task.**
In developing a WBS, one must realize that there are multiple ways to develop a WBS for any given project. Some ways might be better than others, but the two most important items to remember are that the **WBS must contain all approved scope and the Project Manager must develop the WBS to reflect the way he/she intends to manage the project**.
Basic Principles for Creating WBSs.

1. A unit of work should appear at only one place in the WBS.
2. The work content of a WBS item is the sum of the WBS items below it.
3. A WBS item is the responsibility of only one individual, even though many people may be working on it.
4. The WBS must be consistent with the way in which work is actually going to be performed; it should serve the project team first and other purposes only if practical.
5. Project team members should be involved in developing the WBS to ensure consistency and buy-in.
6. Each WBS item must be documented to ensure accurate understanding of the scope of work included and not included in that item.
7. The WBS must be a flexible tool to accommodate inevitable changes while properly maintaining control of the work content in the project according to the scope statement.

The following figures are the examples of **Sample Intranet WBS Organized by Product** and **Sample Intranet WBS Organized by Phase** respectively

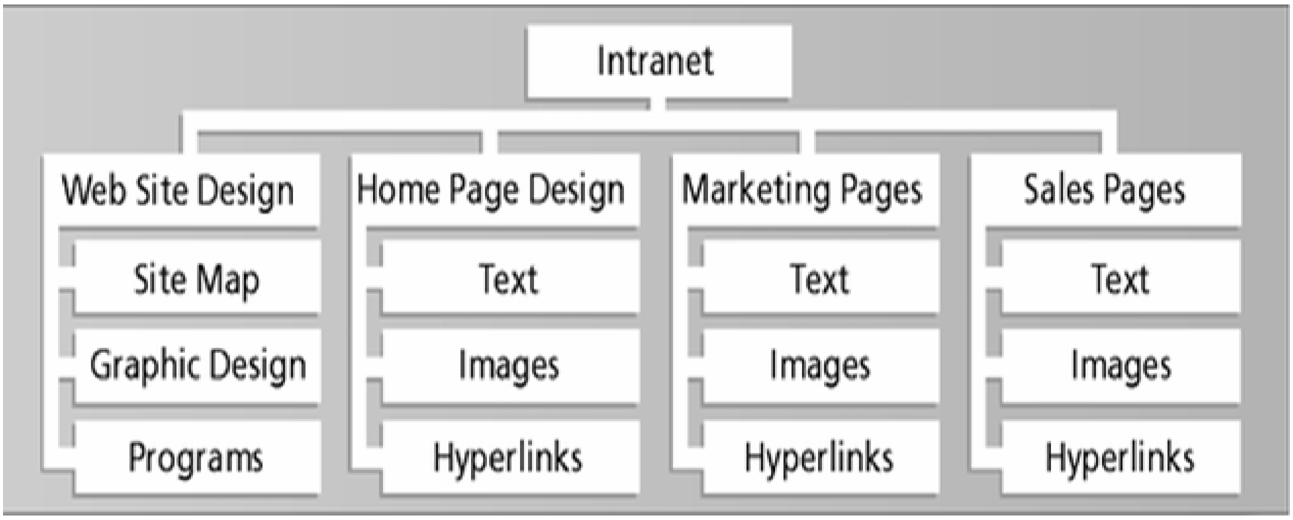

Fig. 2.2 Sample Intranet WBS Organized by Product

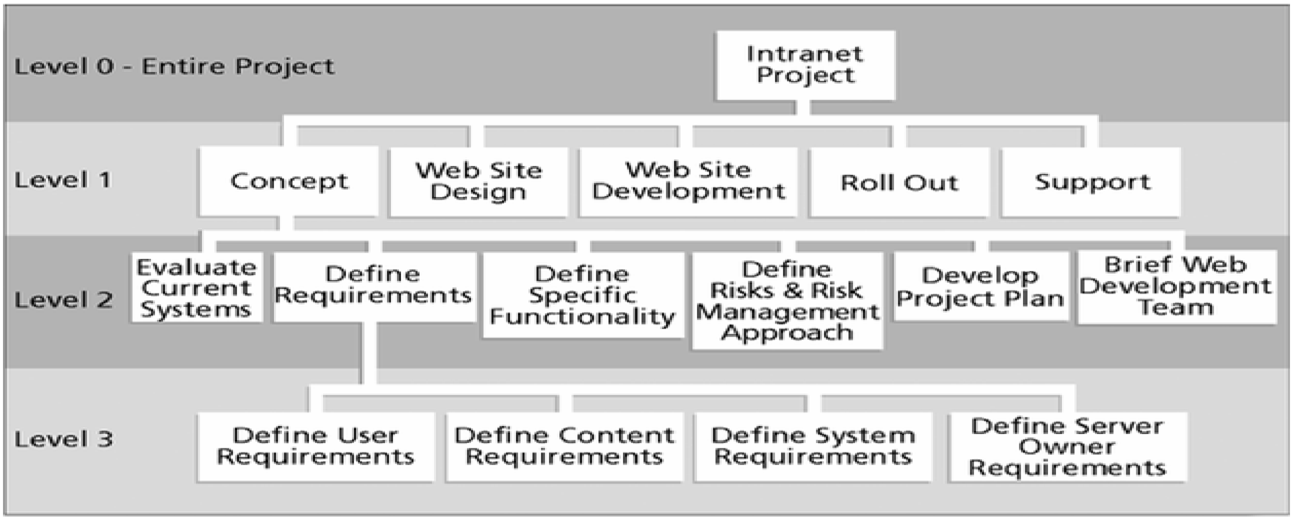

Fig. 2.3 Sample Intranet WBS Organized by Phase

One or more resources must be allocated to each task. To do this, the project manager must first assign the task to people who will perform it. For each task, the project manager must identify one or more people on the resource list capable of doing that task and assign it to them. Once a task is assigned, the team member who is performing it is not available for other tasks until the assigned task is completed. While some tasks can be assigned to any team member, most can be performed only by certain people. If those people are not available, the task must wait.

Identify Dependencies:

Once resources are allocated, the next step in creating a project schedule is to identify dependencies between tasks. A task has a dependency if it involves an activity, resource, or work product that is subsequently required by another task. Dependencies come in many forms: a test plan can't be executed until a build of the software is delivered; code might depend on classes or modules built in earlier stages; a user interface can't be built until the design is reviewed. If Wideband Delphi is used to generate estimates, many of these dependencies will already be represented in the assumptions. It is the project manager's responsibility to work with everyone on the engineering team to identify these dependencies. The project manager should start by taking the WBS and adding dependency information to it: each task in the WBS is given a number, and the number of any task that it is dependent on should be listed next to it as a predecessor. The following figure shows the four ways in which one task can be dependent on another.

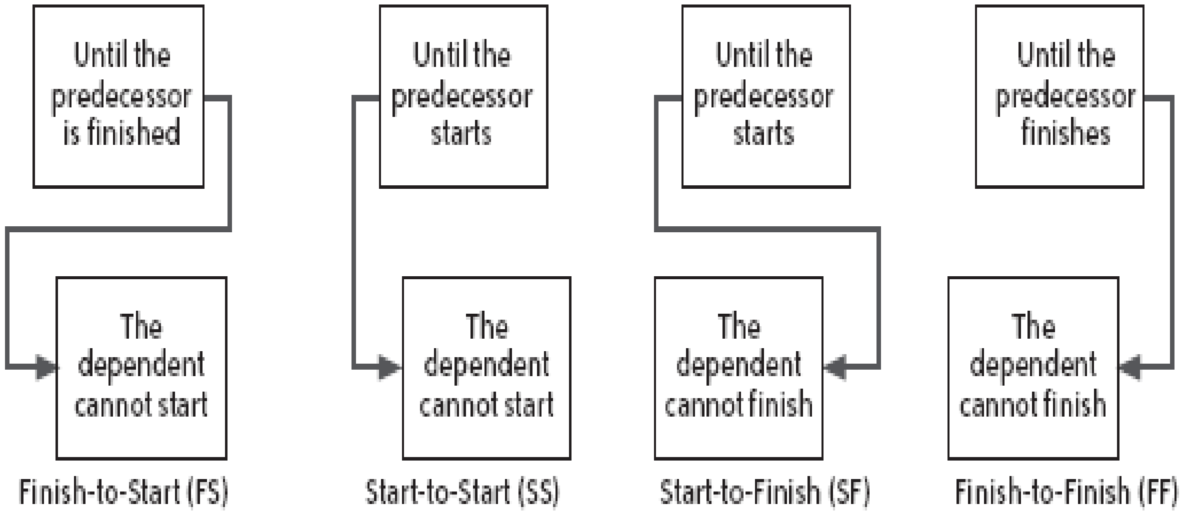

Fig. 2.4.1 Interdependencies of the tasks

Create the Schedule:

Once the resources and dependencies are assigned, the software will arrange the tasks to reflect the dependencies. The software also allows the project manager to enter effort and duration information for each task; with this information, it. can calculate a final date and build the schedule

The most common form for the schedule to take is a Gantt chart.

- Gantt charts provide a standard format for displaying project schedule information by listing project activities and their corresponding start and finish dates in a calendar format
- Symbols include:
  - A black diamond: milestones or significant events on a project with zero duration
  - Thick black bars: summary tasks
  - Lighter horizontal bars: tasks
  - Arrows: dependencies between tasks

The following figure shows an example:

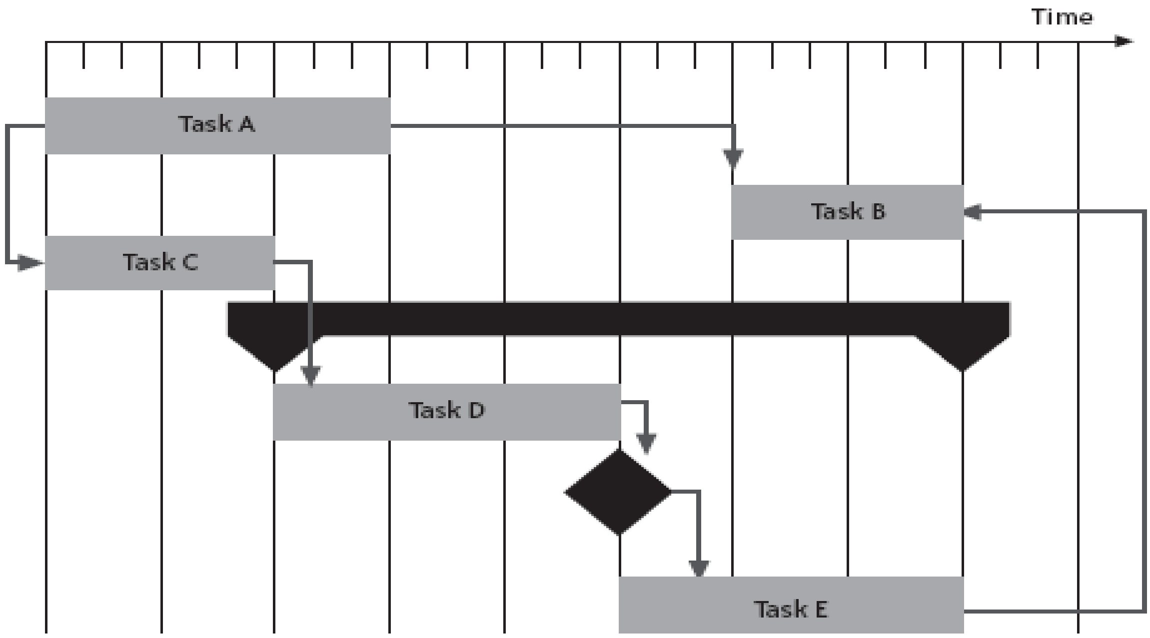

Fig. 2.4.2 Sample Gantt chart

The Gantt chart was invented in the early 1900's by Henry L. Gantt, an American engineer and social scientist. The horizontal axis is (linear) time; each task is given its own horizontal band where the calendar duration of the task is indicated by a box, line, or other object with a variable horizontal dimension. Tasks are often grouped into categories, and each category can be treated as a summary task whose duration spans all the tasks within that category.

Intranet WBS in Tabular Form:

1.0 Concept:

- 1.1 Evaluate current systems
- 1.2 Define Requirements:
  - 1.2.1 Define user requirements
  - 1.2.2 Define content requirements
  - 1.2.3 Define system requirements
  - 1.2.4 Define server owner requirements
- 1.3 Define specific functionality
- 1.4 Define risks and risk management approach
- 1.5 Develop project plan
- 1.6 Brief Web development team

2.0 Web Site Design

3.0 Web Site Development

4.0 Roll Out

5.0 Support

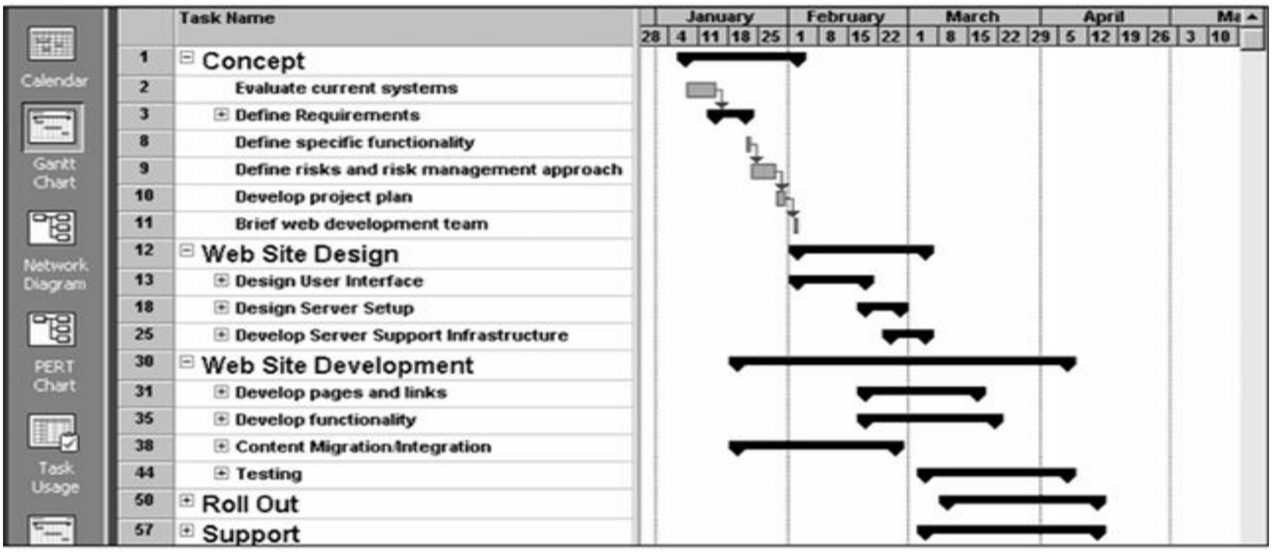

Fig. 2.5 Sample Gantt chart using Microsoft Project (2002). The WBS is on the left, and each task's start and finish date are shown on the right using a calendar timescale. Early Gantt Charts, first used in 1917, were drawn by hand.

Activity Network:

WBS representation of a project is transformed into an activity network by representing activities identified in WBS along with their interdependencies.

WBS structure can be refined into an activity network representation:

- Network of boxes and arrows
- shows different tasks making up a project
- Represents the ordering among the tasks.

It is important to realize that developing WBS and activity network requires a thorough understanding of the tasks involved.

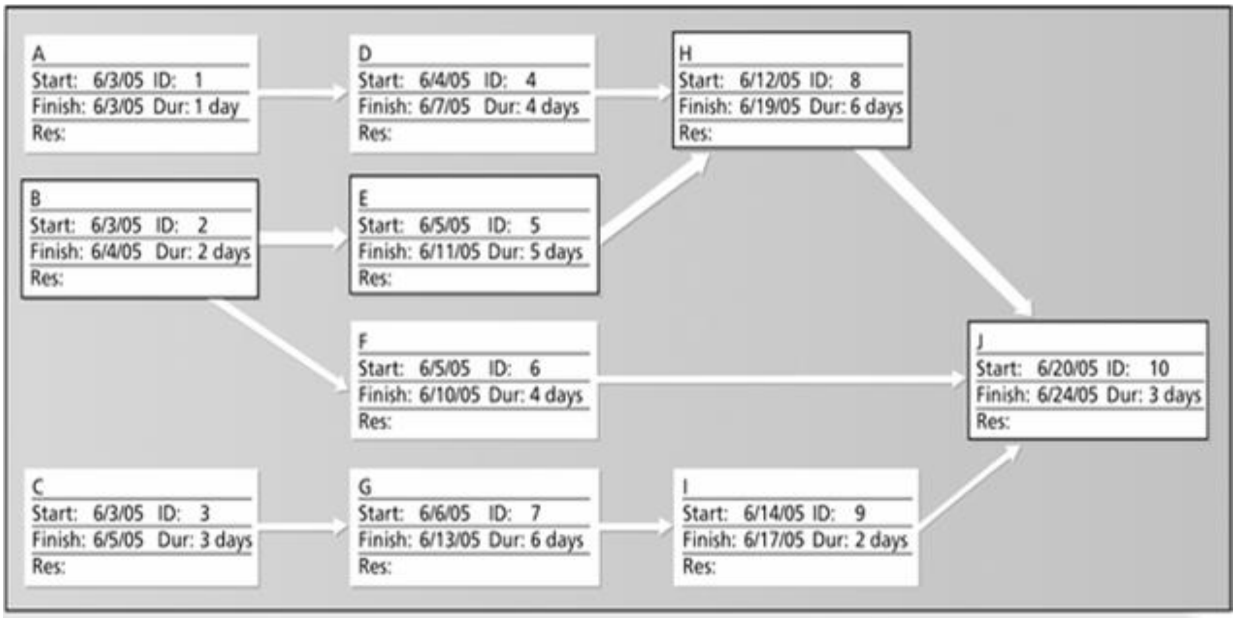

Fig. 2.6 Sample Network Diagram in Microsoft Project Project Network Diagrams

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- Project network diagrams are the preferred technique for showing activity sequencing
- A project network diagram is a schematic display of the logical relationships among, or sequencing of, project activities.

Critical Path Method (CPM) and PERT Charts:

A Critical Path is a chain of tasks that determine the duration of the project. A critical path is sequence of tasks such that a delay in any of the tasks will cause a delay to the entire project.

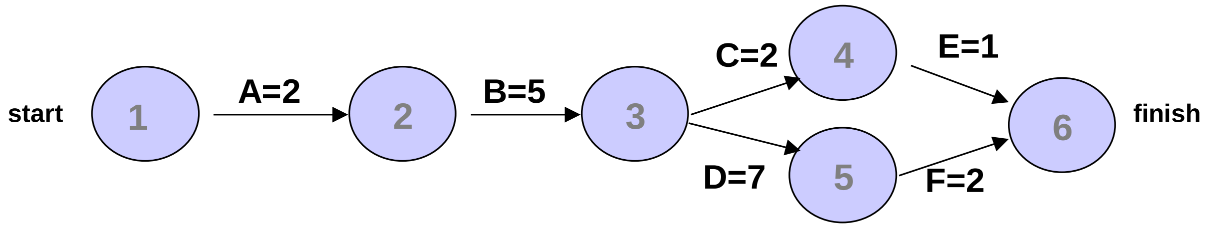
- There can be more than one critical path in a project.
- It is important for the project manager to be aware of the critical paths in a project can ensure that tasks on these paths are completed on time.
- **CPM** is a project network analysis technique used to predict total project duration
- A critical path for a project is the series of activities that determines the *earliest time* by which the project can be completed.
- The critical path is the *longest path* through the network diagram and has the least amount of slack or float

Finding the Critical Path:

- First develop a good project network diagram
- Add the durations for all activities on each path through the project network diagram
- The longest path is the critical path

Simple Example of Determining the Critical Path:

- Consider the following project network diagram. Assume all times are in days.



a. How many paths are on this network diagram?

b. How long is each path?

c. Which is the critical path?

d. What is the shortest amount of time needed to complete this project?

Determining the Critical Path for Project X:

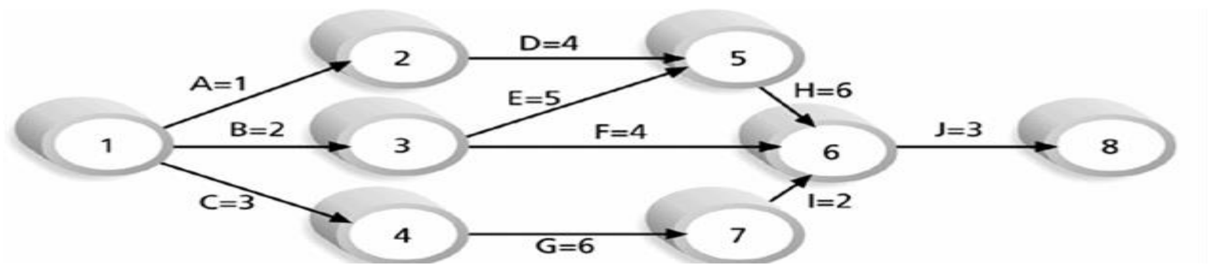


Fig. 2.8 Critical Path for Project X

Note: Assume all durations are in days

In the above figure,

Path 1: A-D-H-J Length = 1+ 4+6+3 = 14 days

Path 2: B-E-H-J Length = 2+5 +6+3 = 16 days

Path 3: B-F-J Length = 2+4+3 = 9 days

Path 4: C-G-I-J Length = 3+6+2+3 = 14 days

Since the critical path is the longest path through the network diagram, Path 2, B-E-H-J , is the critical path for the project.

- If one or more activities on the critical path takes longer than planned, the whole project schedule will slip *unless* corrective action is taken
- Misconceptions:
  - The critical path is not the one with all the critical activities; it only accounts for time.
  - There can be more than one critical path if the lengths of two or more paths are the same
  - The critical path can change as the project progresses

More on the Critical Path:

- If one or more activities on the critical path takes longer than planned, the whole project schedule will slip *unless* corrective action is taken
- Misconceptions:
  - The critical path is not the one with all the critical activities; it only accounts for time.
  - There can be more than one critical path if the lengths of two or more paths are the same
  - The critical path can change as the project progresses

How do we work out the various start and finish times for tasks?

PERT (*Program Evaluation and Review Technique*) is a variation of CPM incorporates uncertainty about duration of tasks.

- Gantt charts can be derived automatically from PERT charts.
- Gantt chart representation of schedule is helpful in planning the utilization of resources, while PERT chart is more useful for monitoring the timely progress of activities.
- While Gantt charts show the different tasks and their durations clearly, they do not show intertask dependencies explicitly. This shortcoming of Gantt charts is overcome by PERT charts.

The following figure shows an **Activity-on-Arrow (AOA) Network Diagram or Pert Chart for Project X** (*Assume all duration are in one days; A=1 means Activity A has a duration of 1 day*).

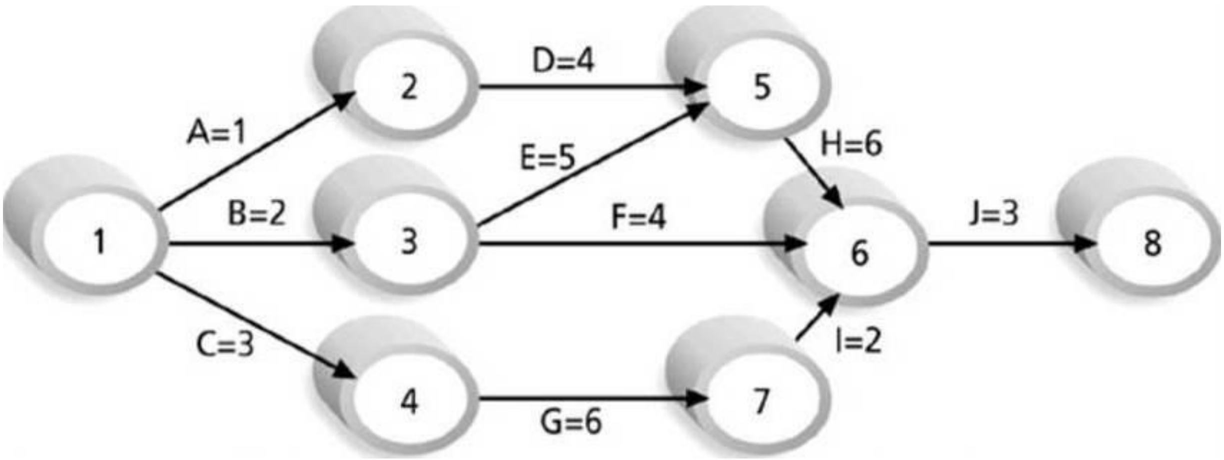


Fig. 2.7 Sample Activity-on-Arrow (AOA) Network Diagram or Pert Chart for Project X

Although the *activity-on-arrow* diagram ("PERT Chart") is still used in a few places, it has generally been superseded by the activity-on-node diagram, where each activity is shown as a box or node and the arrows represent the logical relationships going from predecessor to successor as shown in the following diagram Activity-on-node diagram showing critical path schedule, along with total float and critical path drag computations.

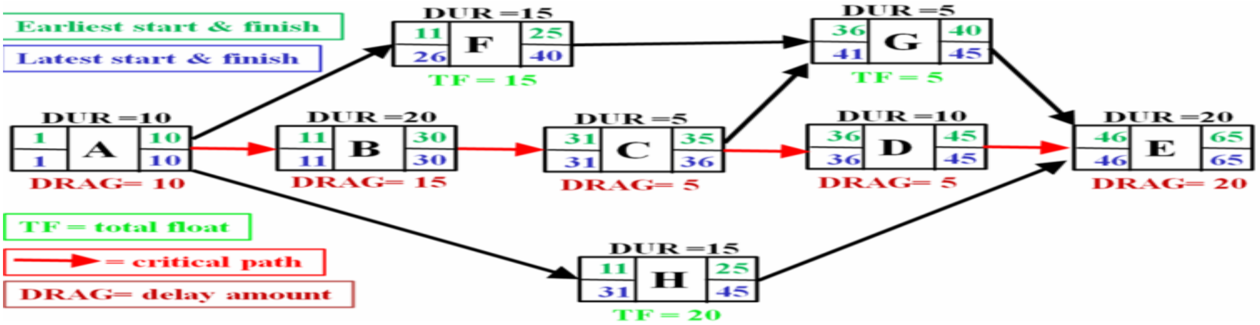


Fig. 2.8 Activity-on-node diagram showing critical path schedule, along with total float and critical path drag computations

In this diagram, Activities A, B, C, D, and E comprise the critical or longest path, while Activities F, G, and H are off the critical path with floats of 10 days, 5 days, and 20 days respectively. Whereas activities that are off the critical path have float and are therefore not delaying completion of the project, those on the critical path will usually have critical path drag 7, i.e., they delay project completion. The drag of a critical path activity can be computed using the following formula:

1. If a critical path activity has nothing in parallel, its drag is equal to its duration. Thus A and E have drags of 10 days and 20 days respectively. 2. If a critical path activity has another activity in parallel, its drag is equal to whichever is less: its duration or the total float of the parallel activity with the least total float. Thus since B and C are both parallel to F (float of 15) and H (float of 20), B has a duration of 20 and drag of 15 (equal to F's float), while C has a duration of only 5 days and thus drag of only 5. Activity D, with a duration of 10 days, is parallel to G (float of 5) and H (float of 20) and therefore its drag is equal to 5, the float of G.

These results, including the drag computations, allow managers to prioritize activities for the effective management of project completion, and to shorten the planned critical path of a project by pruning critical path activities, by "**fast tracking**" (i.e., performing more activities in parallel), and/or by "**crashing the critical path**" (i.e., shortening the durations of critical path activities by adding resources).

In many industries, such as engineering and construction, the development and maintenance of the project schedule is the responsibility of a full time scheduler or team of schedulers, depending on the size of the project. And though the techniques of scheduling are well developed, they are inconsistently applied throughout industry. Standardization and promotion of scheduling best practices are being pursued by the Association for the Advancement of Cost Engineering (**AACE**), the Project Management Institute (**PMI**). In some large corporations, scheduling, as well as cost, estimating, and risk management are organized under the department of project controls.

Project execution:

The project can now be executed. Individual projects are likely to differ considerably but following some classic project life cycle models. And the planning is pointless unless the execution of plan is monitored.

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