

Lecture 3:

Scheduling

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PMG 605

**Project Resources and
Time Management**

Scheduling

Session Outline

- What is Scheduling?
- Planning vs. Scheduling
- Project Scheduling Process
- Baseline
- Project Scheduling Terms
- Summary

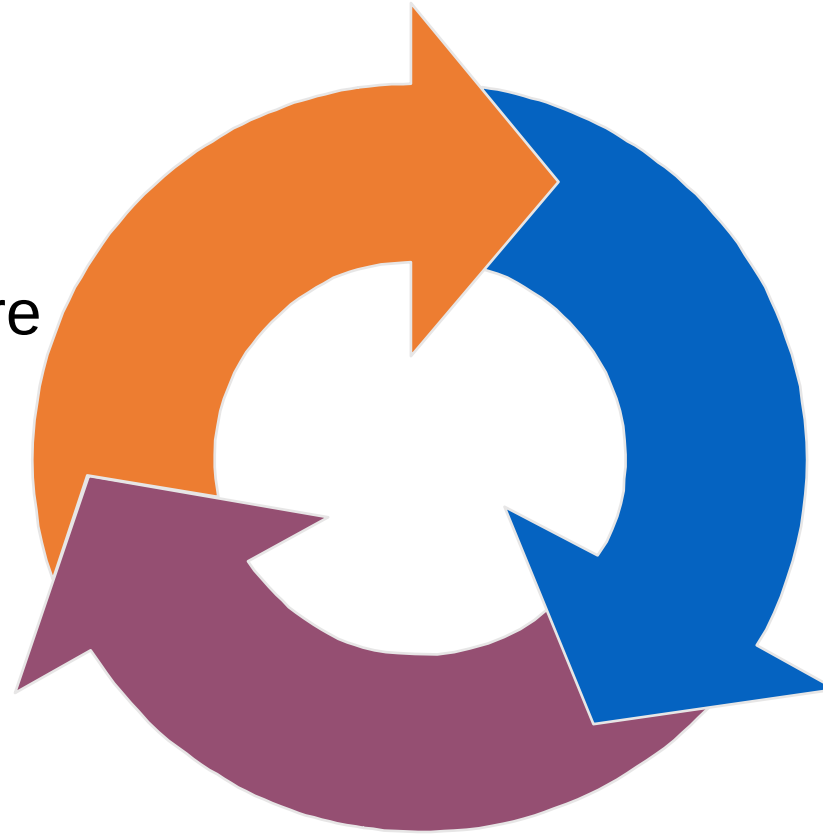
Project Management Activities

▶ Planning

- ▶ Objectives
- ▶ Resources
- ▶ Work break-down structure
- ▶ Organization

▶ Scheduling

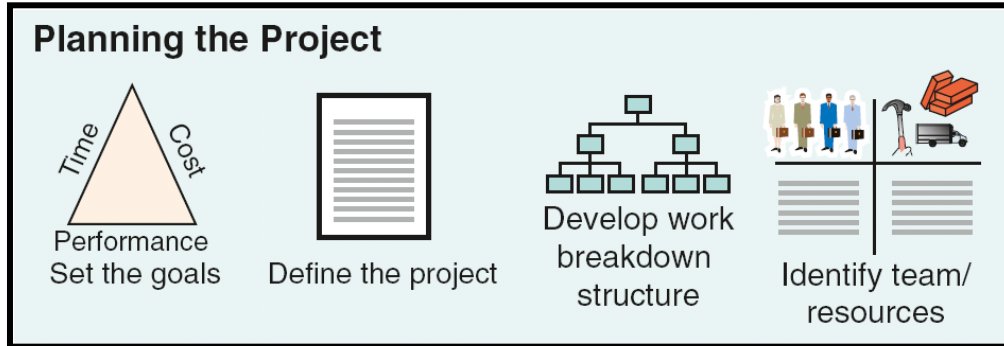
- ▶ Project activities
- ▶ Start and end times
- ▶ Network



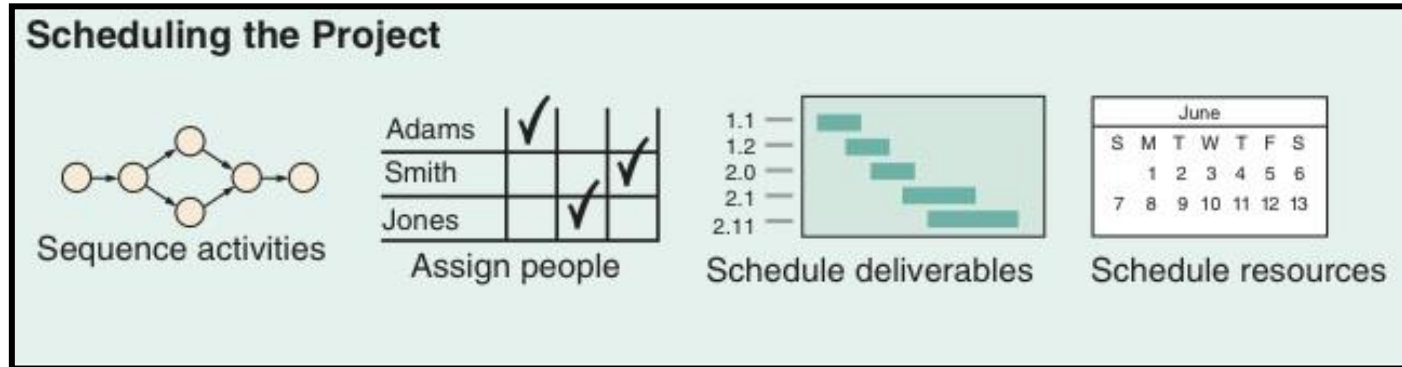
▶ Controlling

- ▶ Monitor, compare, revise, action

Project Planning, Scheduling, and Controlling

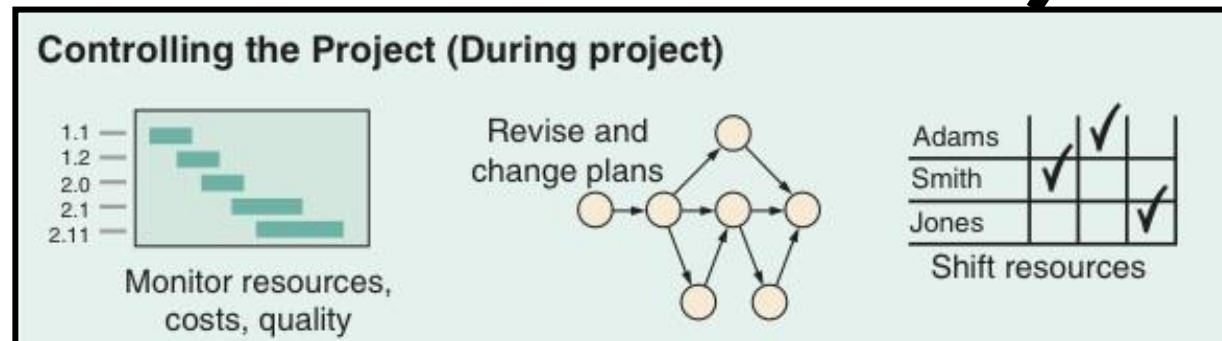


Time/cost estimates
Budgets
Engineering diagrams
Cash flow charts
Material availability details



Budgets
Delayed activities report
Slack activities report

CPM/PERT
Gantt charts
Milestone charts
Cash flow schedules



Why Estimating Project Times and Costs are Important?



To support good decisions.



To schedule work.



To determine how long the project should take and its cost.



To determine whether the project is worth doing.



To develop cash flow needs.

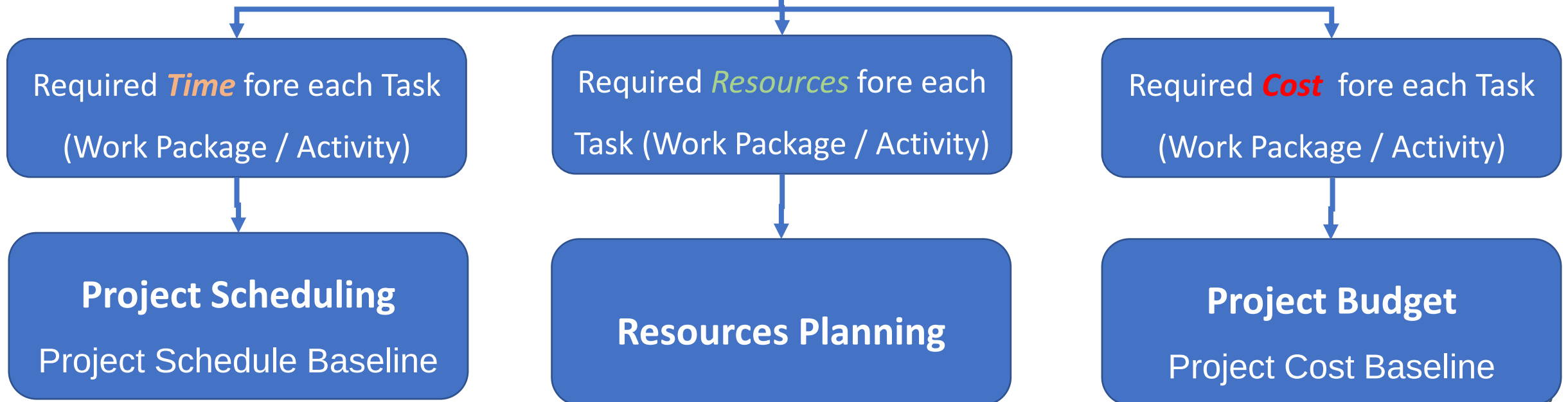
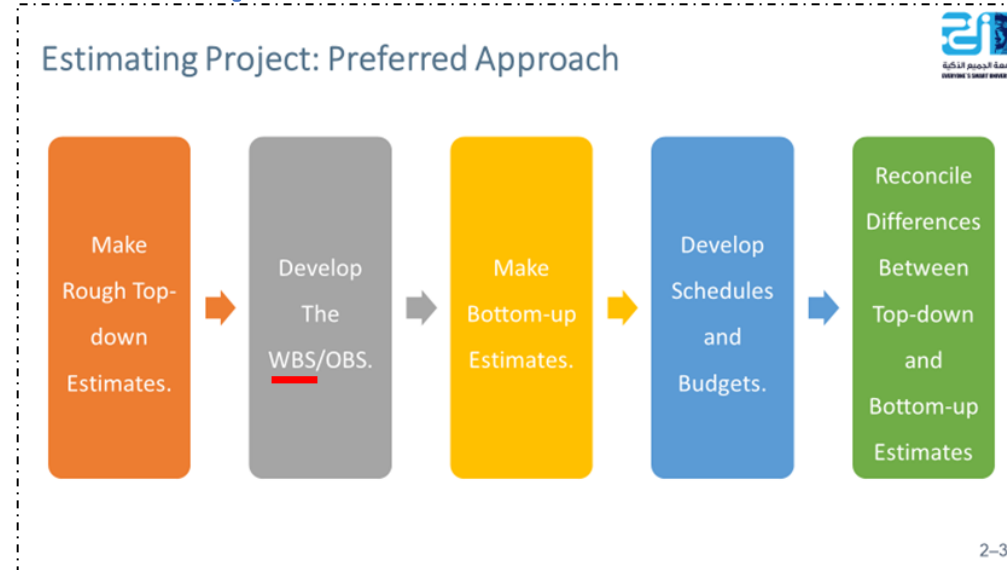


To determine how well the project is progressing.

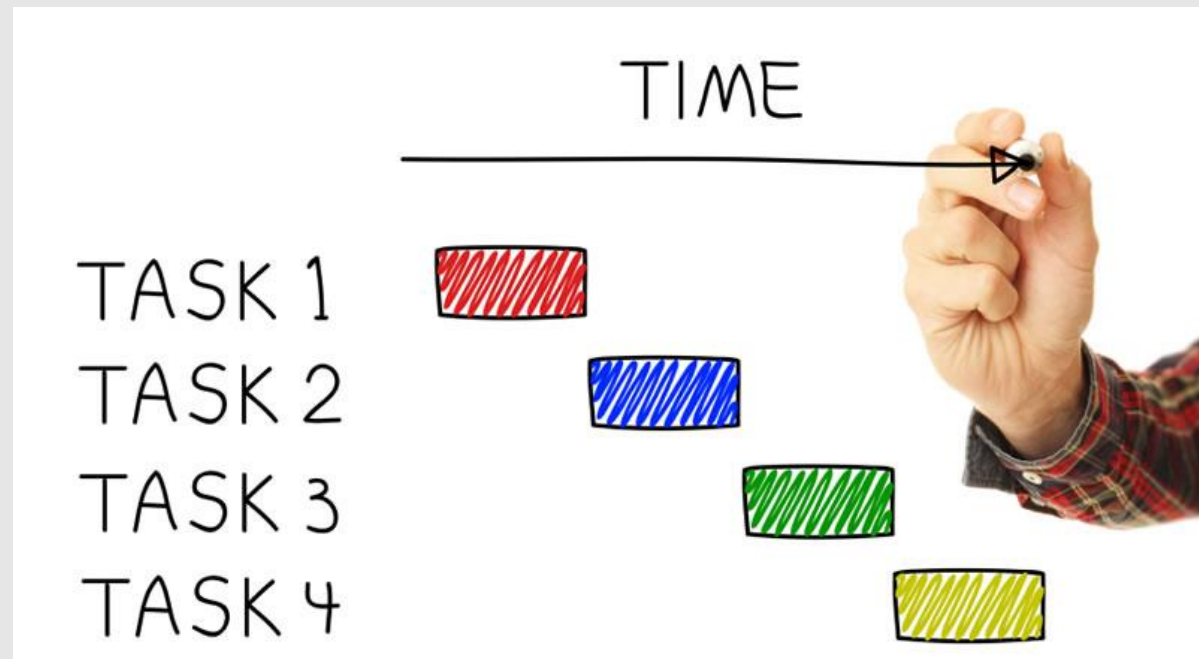


To develop time-phased budgets and establish the project baseline.

Estimating Process Output



What is Scheduling?



What is Scheduling?

- There are multiple ways of defining scheduling. Scheduling is:
 - Planned completion of a project based on the logical arrangement of activities, resources...
 - Placing the project and its activities in a workable sequenced timetable...
 - A detailed outline of activities/tasks with respect to time...

- While scheduling is all of these things, the main thing to remember is that

scheduling is the development of planned dates

for performing project activities and meeting milestones.

- By looking at the abovementioned definitions of scheduling, do you see a difference between planning and scheduling?

Project Planning, as it relates to the scheduling process, has been defined by the PMBoK as:

The identification of the project objectives and the ordered activity necessary to complete the project including the identification of resource types and quantities required to carry out each activity or task.

Project Scheduling requires us to follow some carefully laid-out steps, in order, for the schedule to take shape.

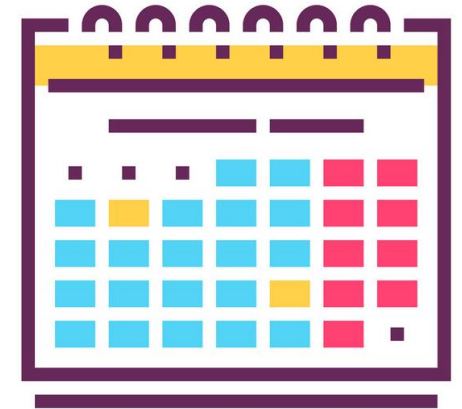
PMBoK states,

“an output of a schedule model that presents linked activities with planned dates, durations, milestones, and resources.”

Planning vs. Scheduling



PLANNING



SCHEDULE

Planning vs. Scheduling

“I keep six honest serving men (they taught me all I knew); their names are **What** and **Why** and **How** and **Where** and **Who** and **When**.” --- Rudyard Kipling

- Planning involves making decisions with the objective of influencing the future. Another way to consider planning is as the “thinking” phase. Defining activities, their logical sequence, and their relationship to each other are all planning functions. In planning you answer the following questions:
 - **What** will be performed?
 - This question is answered by determining the final project product necessary for achieving project success. This is done in the initiation phase before the development of your WBS.
 - **Why** it will be performed?
 - This question is answered by determining the project objective.

Planning vs. Scheduling

- **How** will it be performed?
 - This question is answered by determining the processes, procedures, and methodologies used to complete the project.
- **Where** will it be performed?
 - This answer varies for each type of project. For example, if it's a construction project, the “where” will be the physical location of the building or road etc. If the project is a software development project, the answer could be the physical location of the project team or the final location of the project software.
- **Who** will perform the work?
 - This question is answered by determining if the work will be contracted or will use in-house resources. Then, the question will be examined in even more detail: if a contractor, what type of contractor, and if company resource, what department and who in each department?

Planning vs. Scheduling

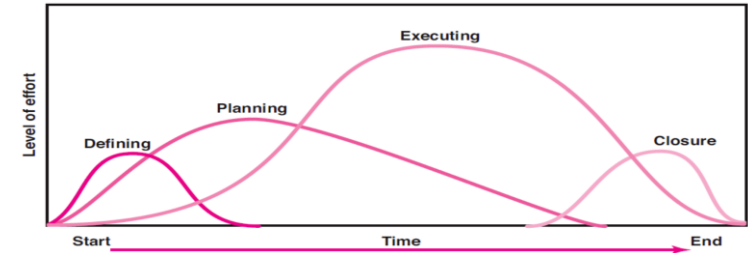
- With five main questions answered, only one last question remains: **when**.
- This question involves scheduling.
- Scheduling determines the timing of operations in the project. The schedule will determine the specific start and completion dates for the project and all project activities. In scheduling you answer the question:
- **When** will the work be performed? - This question involves determining
 - the order in which activities will be performed to complete the project (Sequence).
 - the project *start* and *completion* dates, project *deliverables* and *milestones dates*, and the *start* and *completion dates* for all activities

Project Scheduling

- The schedule must:
 - Include logical ties for all activities
 - Include all key milestones and deliverables
 - Reflect the agreed to project baseline
 - Integrate with the cost baseline

Project Scheduling

- Project planning is a *prerequisite* to Project Scheduling because there is no way to determine the sequence or start and finish dates of activities until they are identified.
- Terms of project planning and scheduling are often used synonymously because planning and scheduling are performed interactively.
- Planning is more difficult to accomplish than scheduling.
- The real test of the project planner/scheduler is his or her ability to identify all the work required to complete the project.



Some Benefits of Successful Scheduling

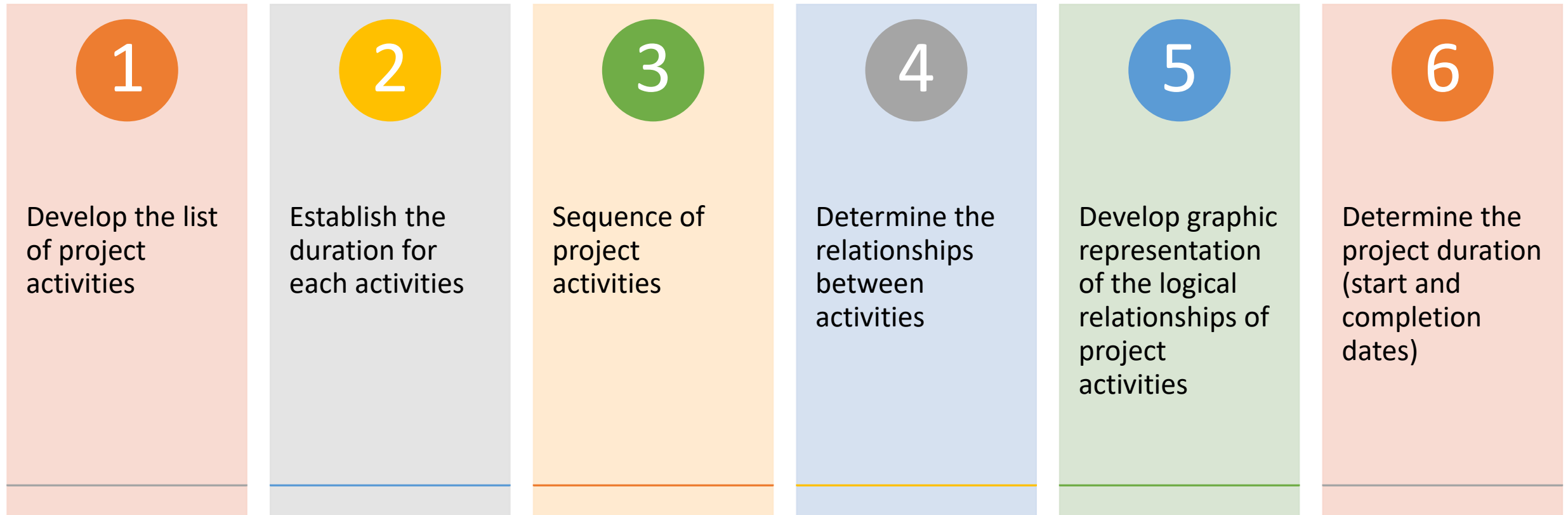
- Illustrates interdependence of all tasks
- Identifies times when resources must be available
- Facilitates communication throughout the project
- Determines critical activities/critical path
- Affects client expectations through establishment of activities, milestones, and completion dates

Project Scheduling Process



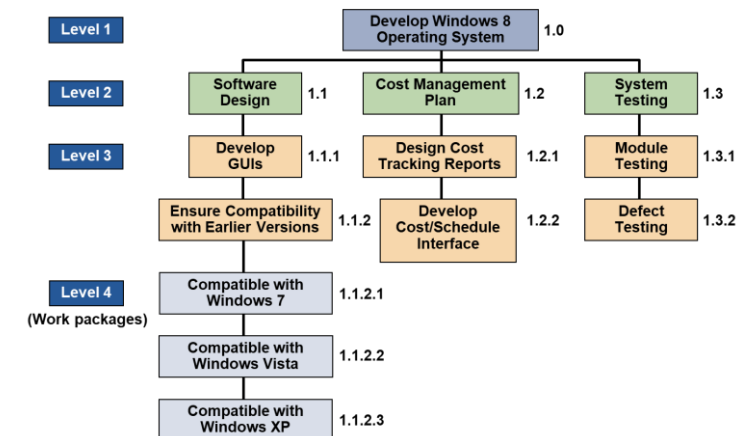
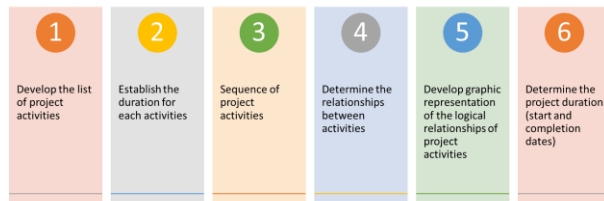
Project Scheduling Process

- Project scheduling involves a clear, 6 step process. This process aids managers in determining the project schedule and, eventually, the project schedule baseline. The process steps are:



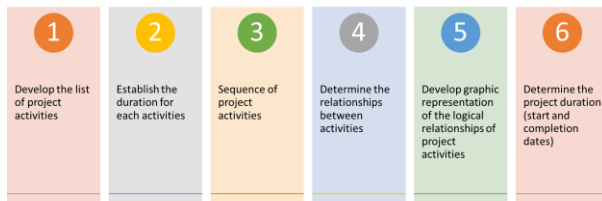
Scheduling – Step 1. Develop a List of Project Activities

- WBS is the best places to start from
- You need the help of the people or group of people familiar with the nature of the project.
- As you develop your list, you may see the need to update the WBS.
- Remember the WBS is a dynamic tool, revisions may be needed and should be expected as the scheduling of activities progresses.



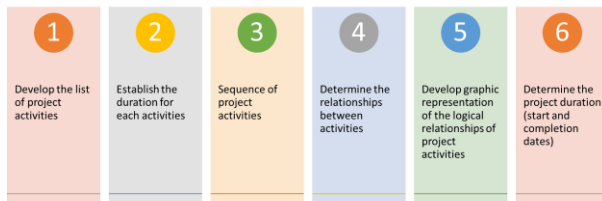
Project Scheduling - Step 2. Establish the Duration for Each Activity

- Now, it is time to determine the duration for each project activity.
- Establishing the duration of each project activity involves determining the work periods needed to complete each identified activity. Work periods can be
 - Hours, Days, Weeks, Months, etc..
- Remember, the period must be consistent for all activities in the schedule. The project manager and team member(s) must decide which work period is right for the project.



Scheduling – Step 3. Sequence of Project Activities

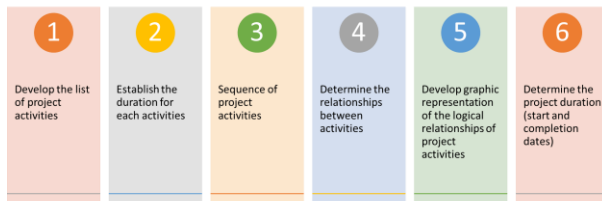
- With the activity list complete, we need to “sequence” or develop “logic” between activities. To complete this process, we need the WBS activities list and a pencil.
- A pencil? Why a pencil?
- This process requires the project manager, subject matter experts (SME), and other project team members who are familiar with the nature of the specific activities to meet, discuss and develop the sequencing of the project activities. This process is known as “a pencil to paper” process.



Scheduling – Step 4. Determine the relationships between activities

- How does sequencing differ from identifying the relationships of tasks and activities?
- Sequencing is the order of how things will happen. First, second, third, etc. . .
- Identifying direct relationships provides greater understanding to the project tasks and schedule.
- By identifying the relationships between activities in scheduling, you identify the sequence plus dependencies of tasks.
- There are 4 types of scheduling dependencies:

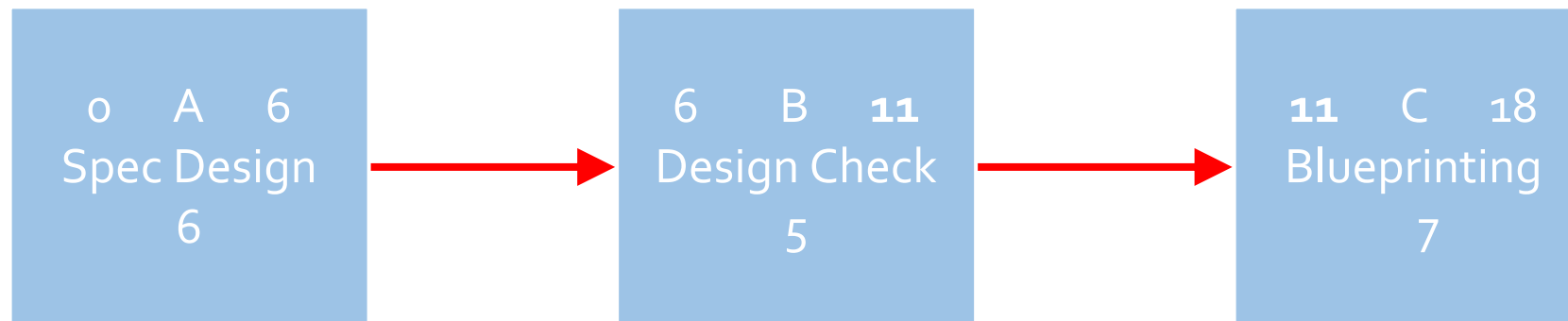
- FS – Finish to Start
- SS – Start to Start
- FF – Finish to Finish
- SF – Start to Finish



Scheduling – Step 4. Determine the relationships between activities

Finish-To-Start

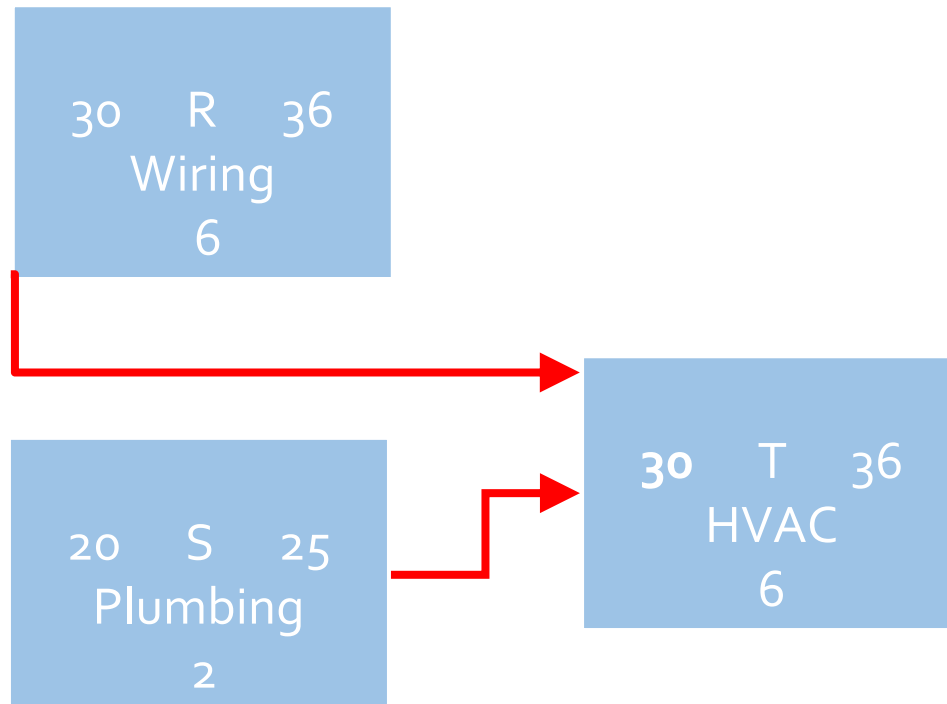
- This means that activity “A” must finish before activity “B” can start.
- Most common type of sequencing



Scheduling – Step 4. Determine the relationships between activities

Start-to-Start

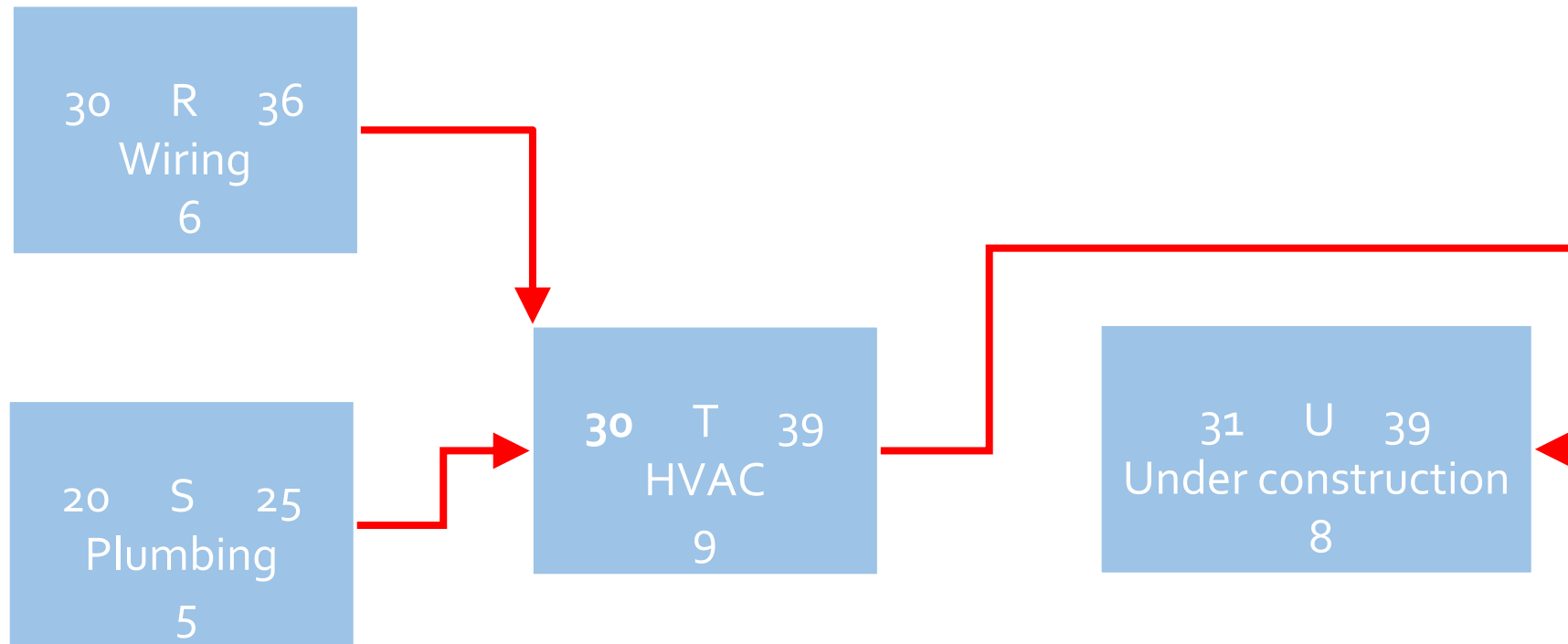
- This means that activity “B” can only begin once activity “A” has started.
- Both activities must start at the same time.
- Common within projects which require their tasks to run parallel to one another.



Scheduling – Step 4. Determine the relationships between activities

Finish-To-Finish

- This means that activity “B” cannot finish until activity “A” finishes



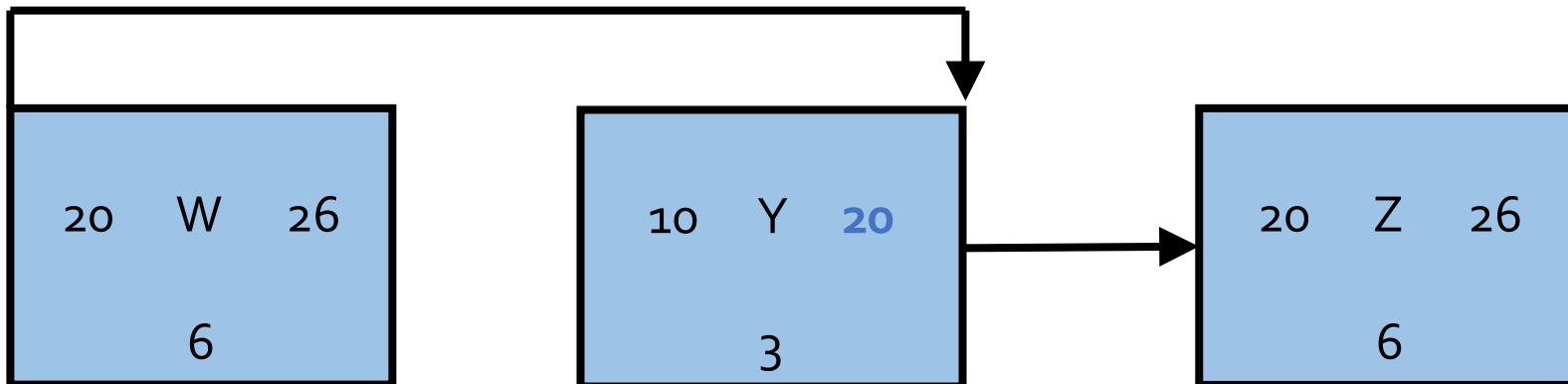
Scheduling – Step 4. Determine the relationships between activities

Start-To-Finish

- This means that activity “B” must start so that activity “A” can finish
- Least common type of lag relationship

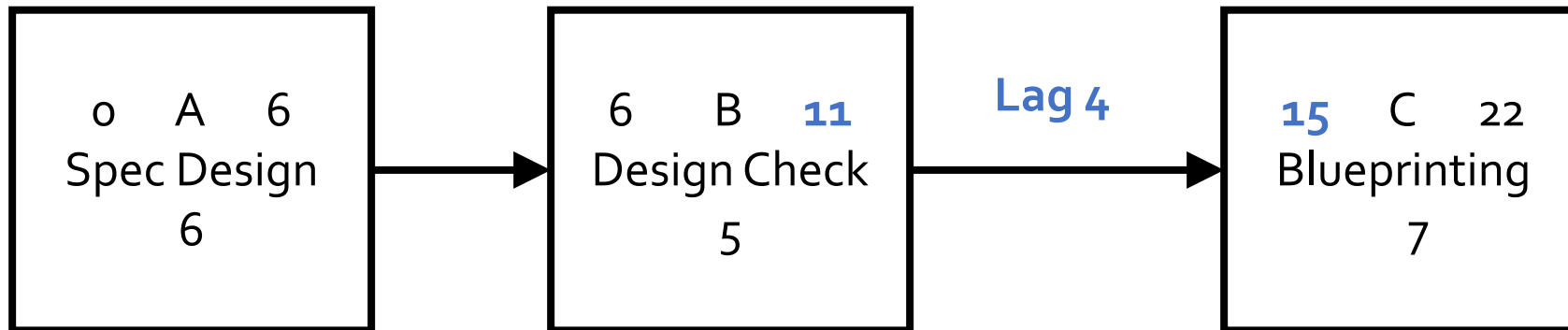
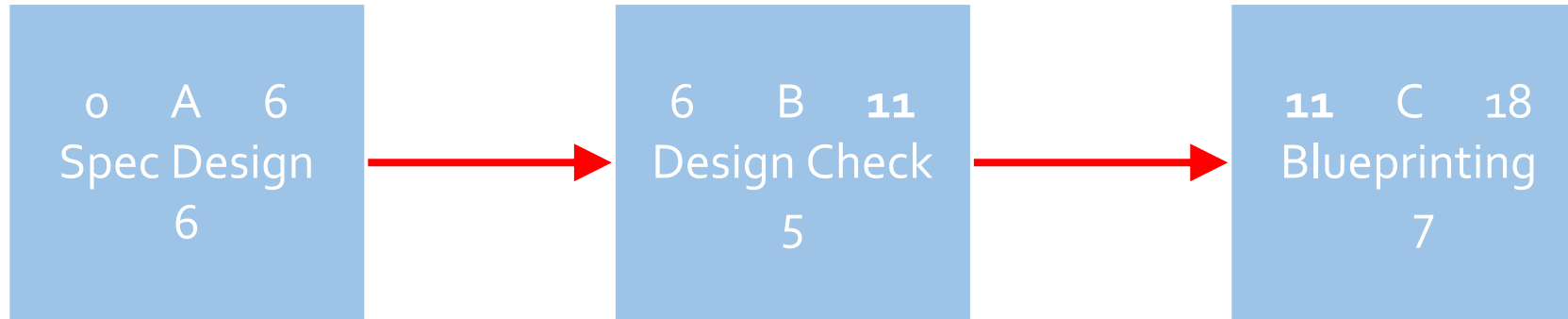
W: Get new system up and running

Y: Shut down old system

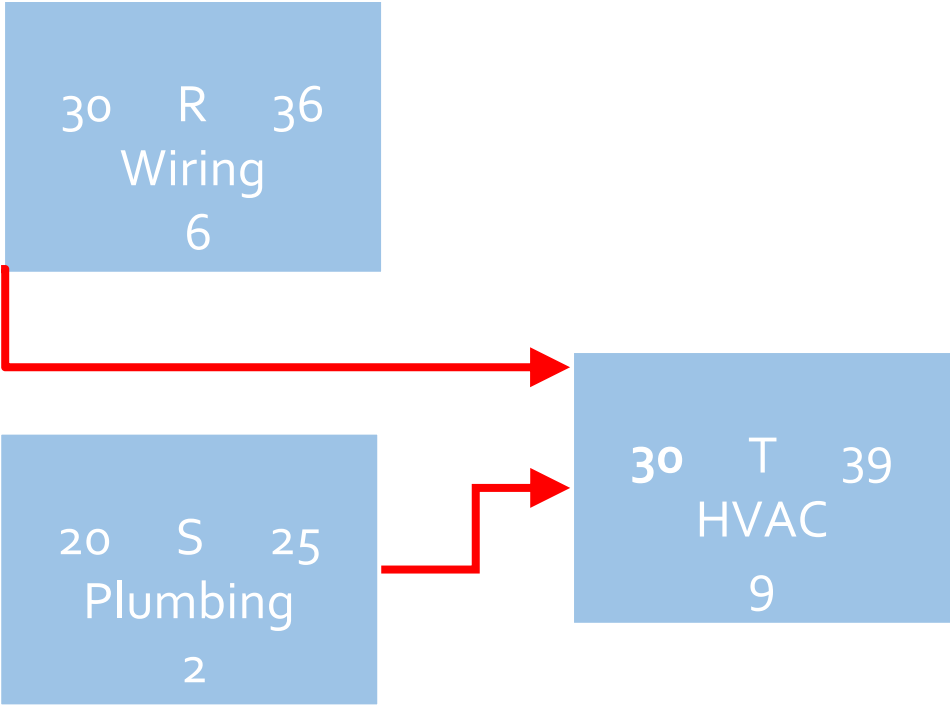
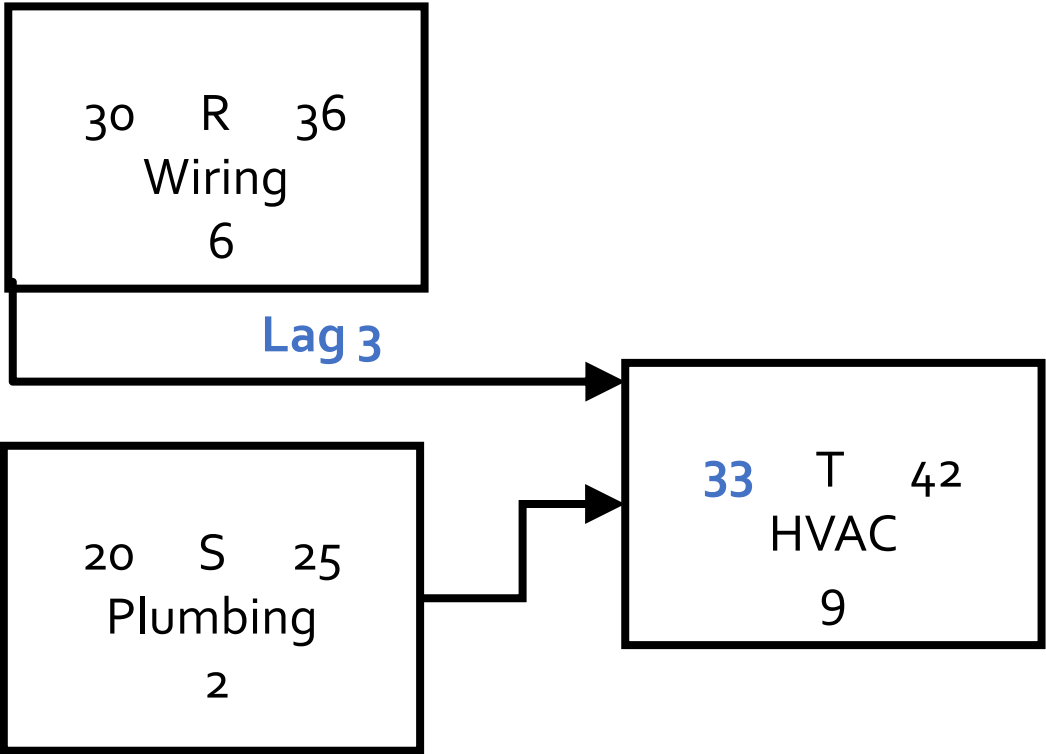


Lags

- **Lags:** The amount of time a dependent activity must be delayed to begin or end

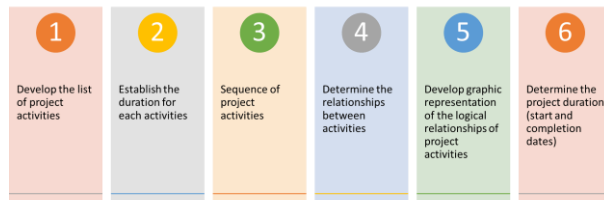


Lags



Scheduling – Step 5. Develop graphic representation of the logical relationships of project activities

- The Checklist
- The Linear Schedule
- Gant Chart
- The Logic Network or Network Diagram
 - A diagram showing the relationship, in a logical and time wise fashion, of the identified tasks or activities of the project.



The Checklist

- Not considered a formal type of scheduling
- Sometimes called a “to do list,”
- used for very short-term planning, rarely more than a few days.
- Its main purpose is to ensure that nothing is omitted.
- Advantages
 - Do not require special skills, equipment, or training to use.
 - Easy to maintain
- Disadvantages
 - There is no way to show the interdependence of activities.
 - If one task is delayed, what is its effect on the remaining tasks in the schedule?

The Checklist

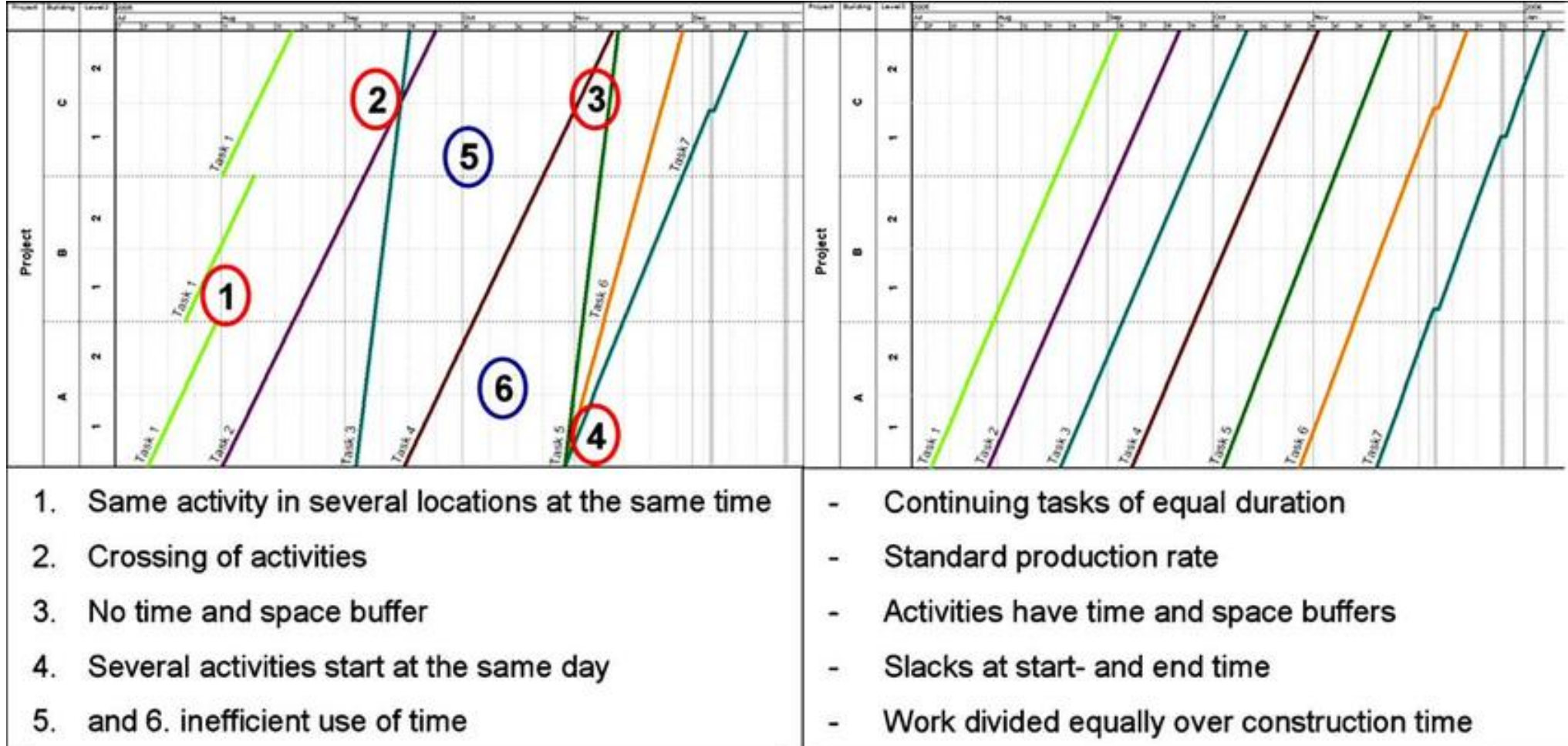
Table 4.1 Checklist Using Microsoft Excel™

Ref. No.	Task	Duration	Due Date	Resource Responsible	Milestone
1	Grade and compact trench bottom	2 days	7/5/2012	Site Contractor	No
2	Inspect bottom of footing	1 day	7/6/2012	Building Inspector	Yes
3	Verify footing locations and pin corners	1 day	7/7/2012	Civil Engineer	No
4	Deliver rebar	1 day	7/7/2012	Rebar Supplier	No
5	Form footings	5 days	7/12/2012	Formwork Contractor	No
6	Set rebar at footings	3 days	7/13/2012	Formwork Contractor	No
7	Cast concrete in footings	1 day	7/14/2012	Formwork Contractor	No
8	Strip footings	1 day	7/17/2012	Formwork Contractor	No
9	Erect one side of wall formwork	2 days	7/20/2012	Formwork Contractor	No
10	Set rebar in walls	2 days	7/21/2012	Formwork Contractor	No
11	Install sleeves in foundation wall	1 day	7/22/2012	Electrical Contractor	No
12	Double up panels and brace walls	3 days	7/25/2012	Formwork Contractor	No
13	Verify wall panel locations	1 day	7/26/2012	Civil Engineer	No
14	Cast concrete in wall forms	1 day	7/28/2012	Formwork Contractor	No
15	Strip wall forms	2 days	7/31/2012	Formwork Contractor	Yes
16	Break ties and patch holes	2 days	8/3/2012	Formwork Contractor	No

The Linear Schedule

- Line of balance (LOB) is a management control process used in construction where the project contains blocks of repetitive work activities, such as roads, pipelines, tunnels, railways and high-rise buildings.
- LOB collects, measures and presents information relating to time, cost and completion, and presents it against a specific plan.
- Advantages
 - Allowing a clearer understanding of the amount of work taking place at a certain time
 - Relatively, It is easy to modify, update and change the schedule.
- Disadvantages
 - Does not shows critical activities.

The Linear Schedule



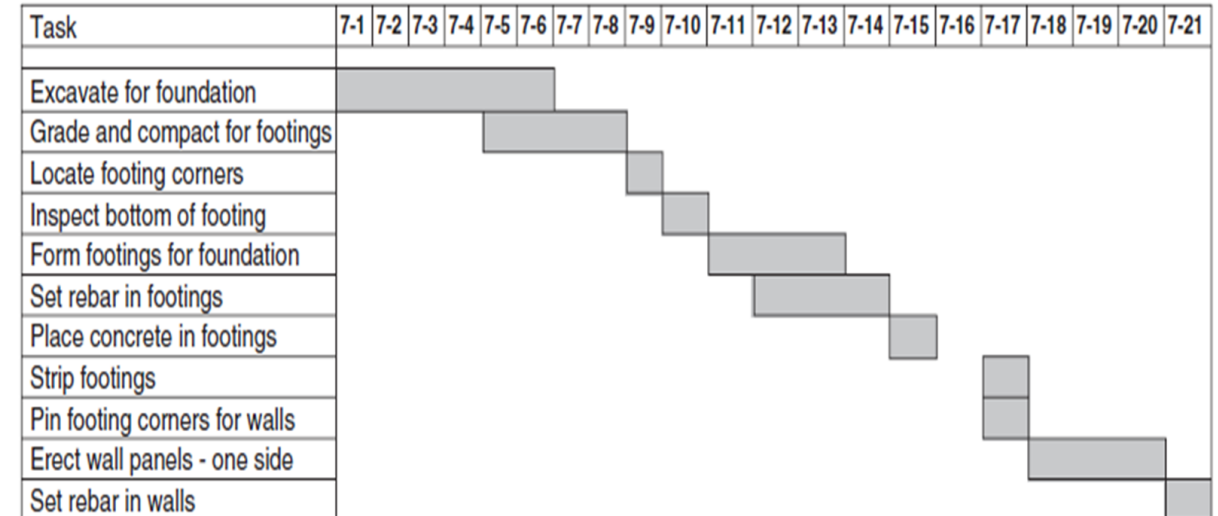
Gantt Charts

- Advantages

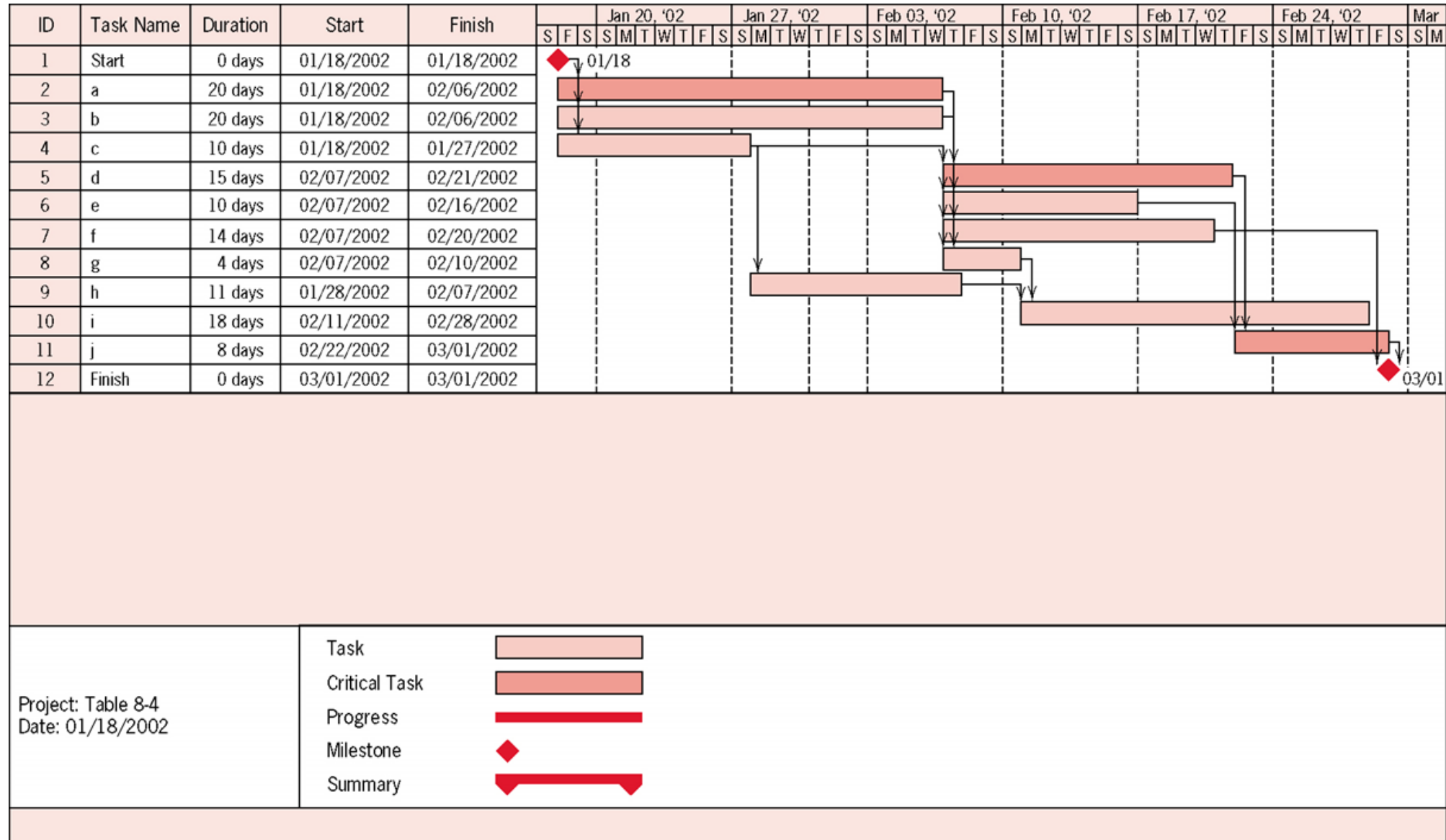
- Easy to understand
- Easy to show progress and status
- Easy to maintain
- Most popular view to communicate project status to client and/or senior management

- Disadvantages

- Can be superficial
- Not always easy to see precedence, relationships

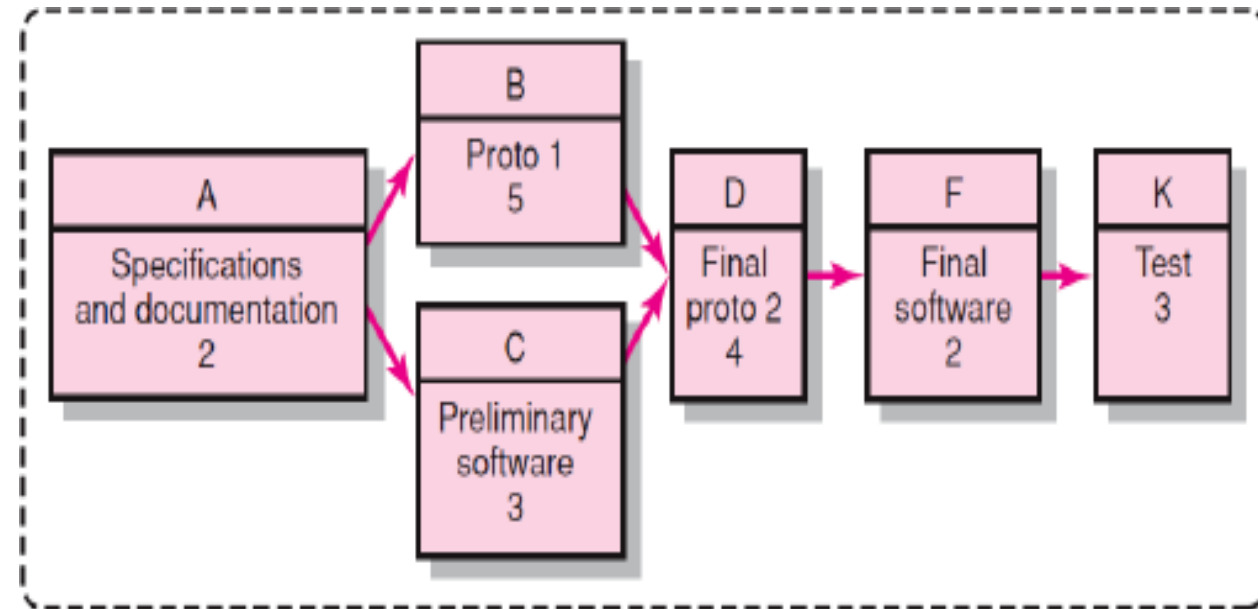


Gantt Chart Example

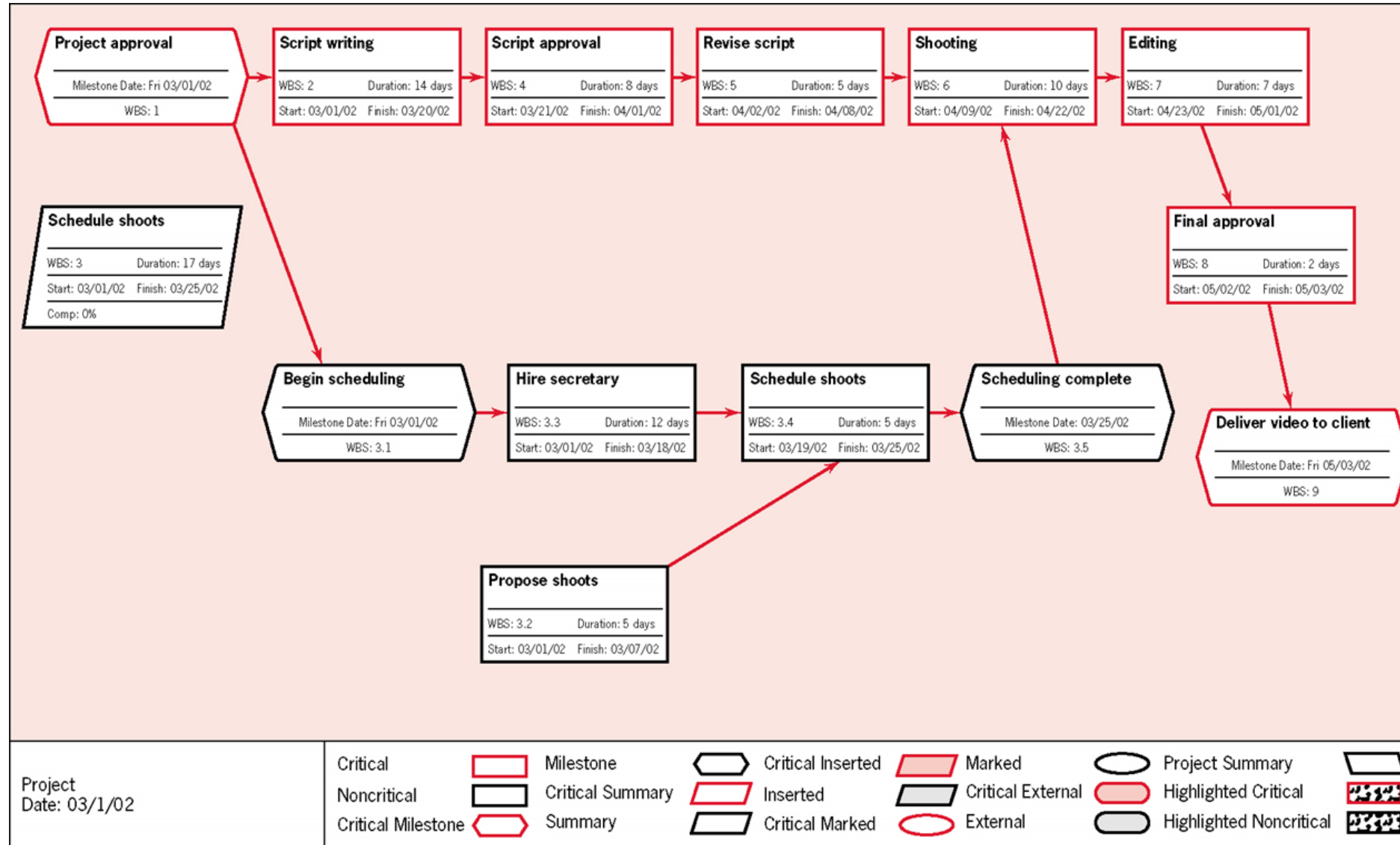


PERT/CPM Network Charts

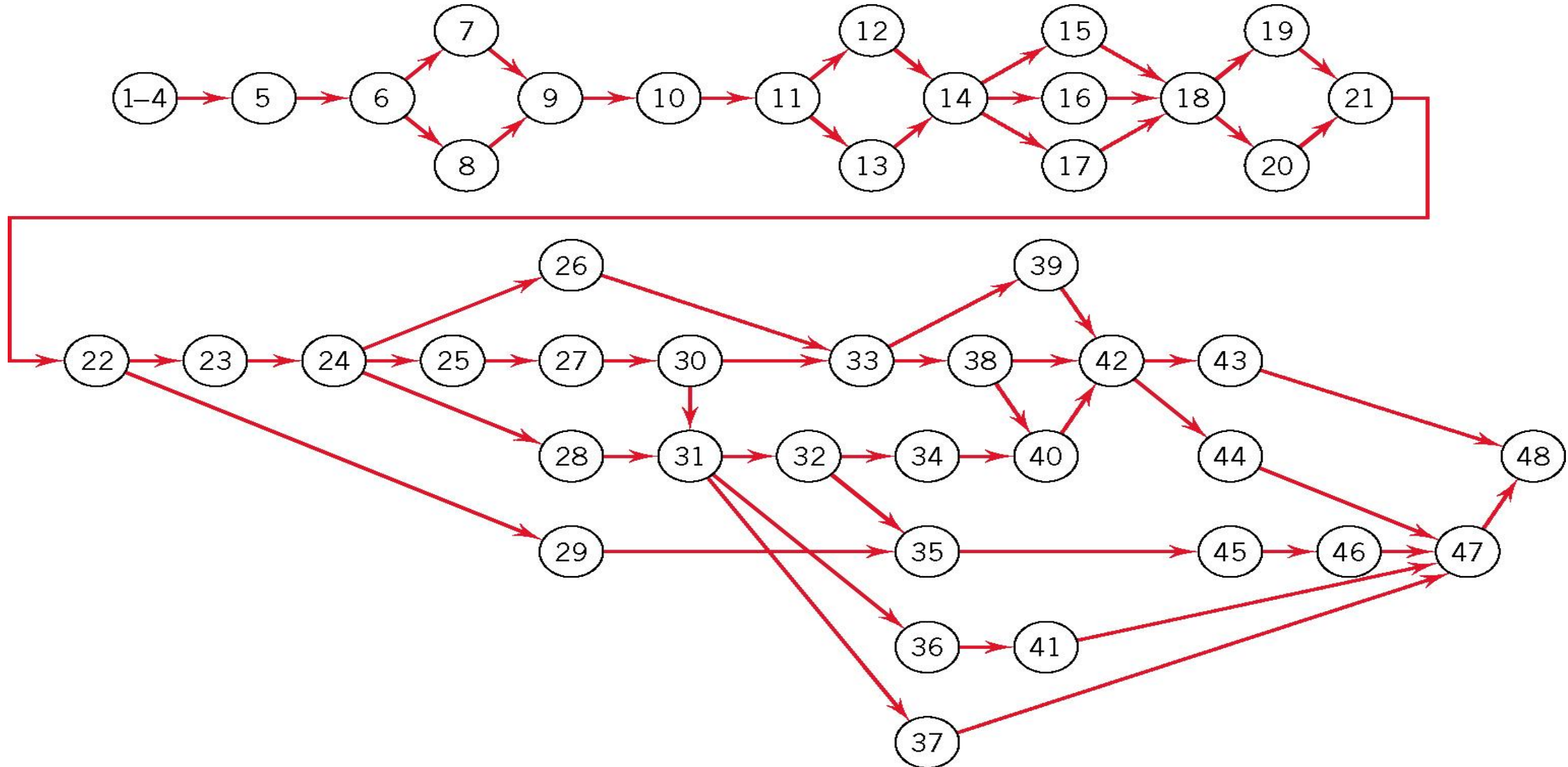
- Advantages
 - Allows visualization of task relationships
 - Facilitates calculation of critical path
 - Clarifies impact of decisions on downstream activities
- Disadvantages
 - Complex, not easy to comprehend at a glance
 - Charts don't readily show durations, dates, progress



PERT/CPM Network Charts

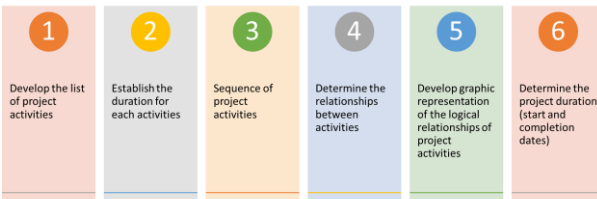


Apartment Complex Network



Scheduling – Step 6. Determine the project duration (start and completion dates)

- Usually the project duration and activity start and completion dates are mapped in a typical scheduling software application. The activities are placed in the software tool, and the relationships are identified. The software calculates the dates.
- To better understand how the software calculates the dates, we will take a look at the process known as Forward and Backward Pass.



Scheduling – Step 6. Determine the project duration (start and completion dates)

The **Forward Pass** determines the early start (ES) and the early finish (EF) of each activity.

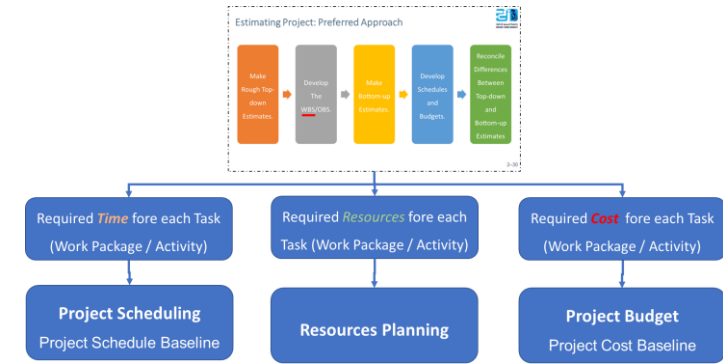
The **Backward Pass** determines the late start (LS) and late finish (LF) of each activity.

- Together, these processes give
 - The total project duration, including the start and finish dates for each activity.
 - Critical path, which tells you the activities that cannot slip without increasing the total duration of the project or moving the project completion date, and
 - Float, which tells you how much certain activities can slip without impacting the total project duration.

Baseline

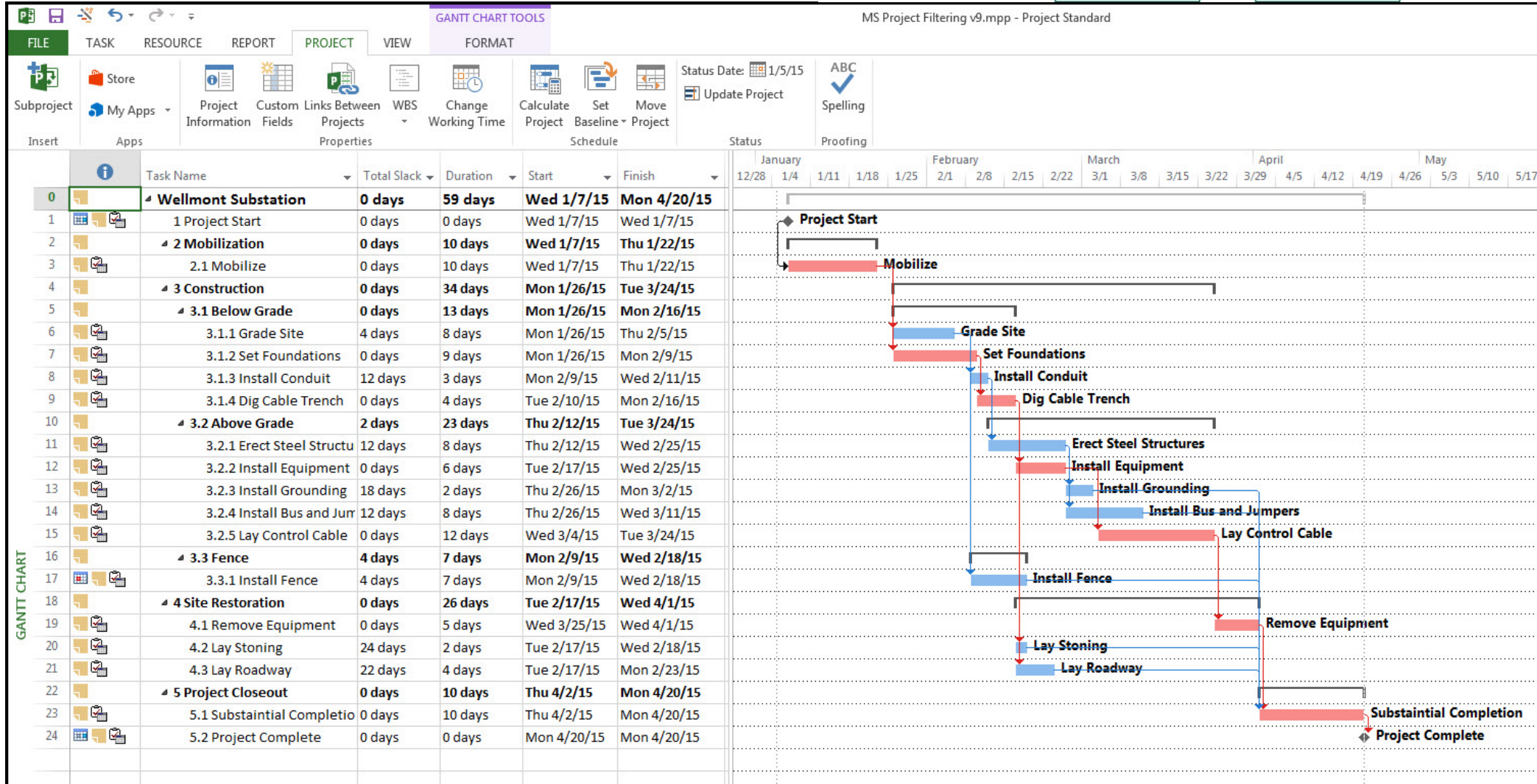
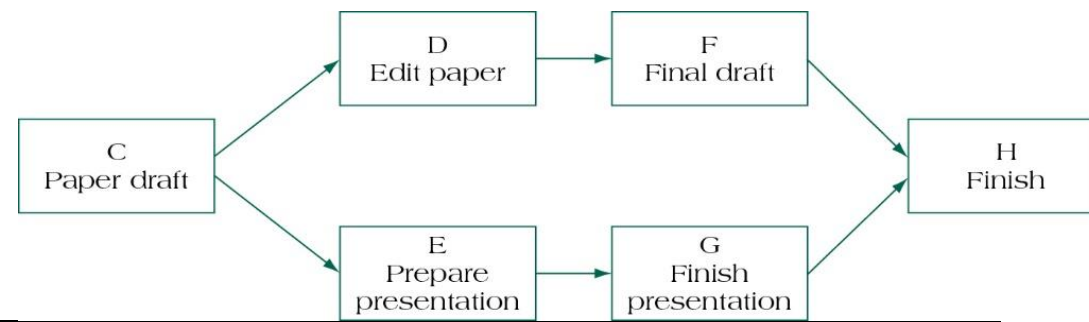


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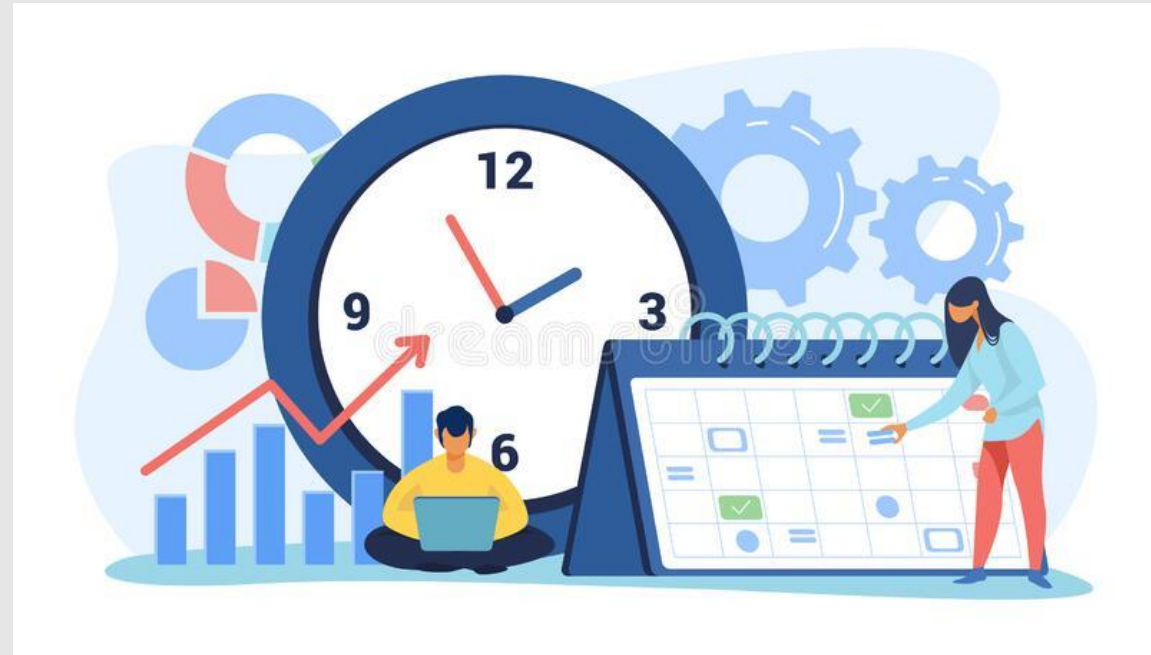


- Baseline is the original approved plan that consists of both schedule and cost
- The schedule and cost baseline are essential.
- The Schedule Baseline is the standard that all schedule performance will be measured against.
- It should be approved by the project manager and other appropriate individuals.
- Once the project manager approved the project start, logic, relationships and project duration, the schedule is then “baselined” to measure schedule performance.

Baseline



Project Scheduling Terms



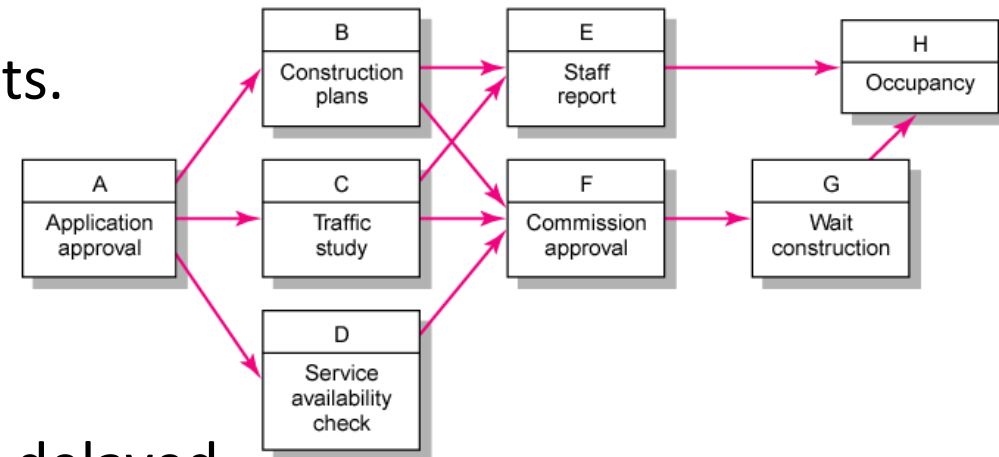
Project Scheduling Terms

- The Project Network
- Activity
- Predecessors
- Successors
- Merge Activity
- Burst activity
- Path
- Critical Path
- Duration (D)
- Early start (ES) date
- Early Finish (EF) date
- Late start (LS) date
- Late Finish (LF) date
- Total Float (TF)
- Free Float (FF)
- Lags

Project Scheduling Terms

- The Project Network

- Flow chart that graphically depicts the sequence, interdependencies, and start and finish times of the project job plan of activities that is the critical path through the network.
- Provides the basis for scheduling labor and equipment.
- Enhances communication among project participants.
- Provides an estimate of the project's duration.
- Provides a basis for budgeting cash flow.
- Highlight activities that are “critical” and can not be delayed.
- Help managers get and stay on plan.

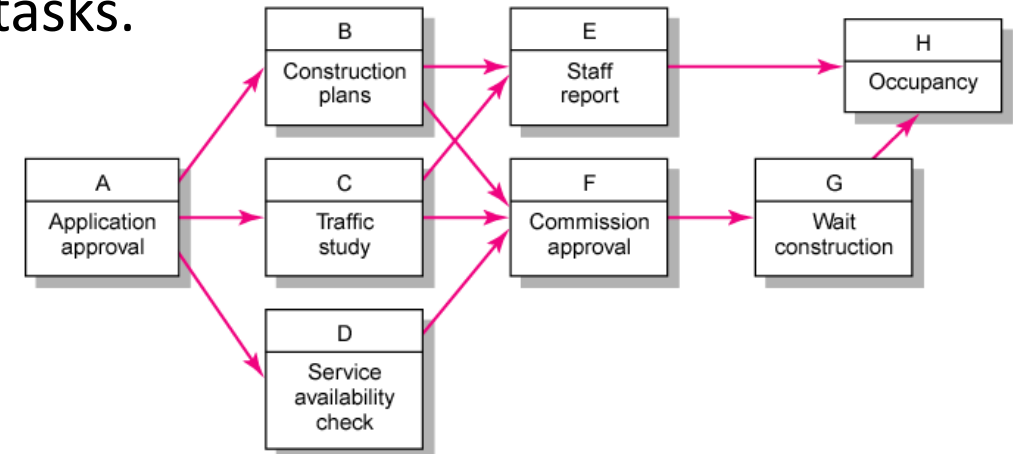


Project Scheduling Terms

- **Activity:** an element of the project that requires time.

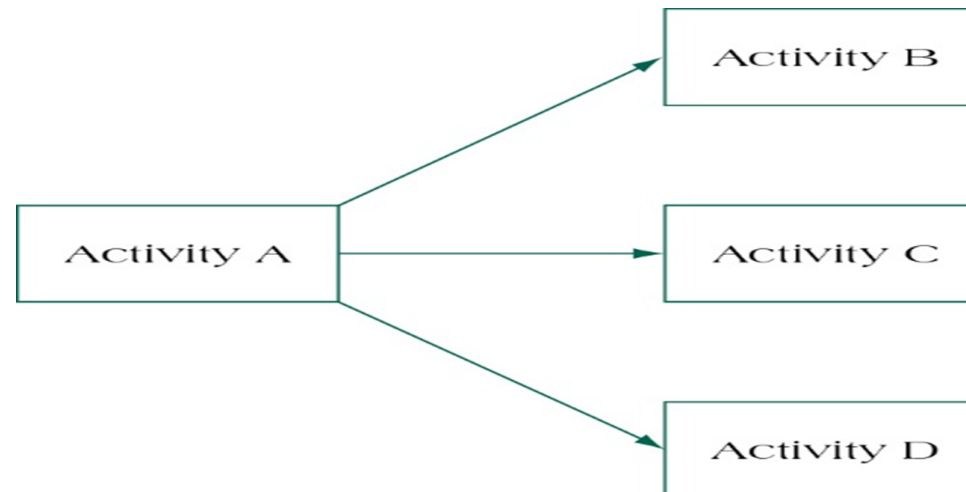
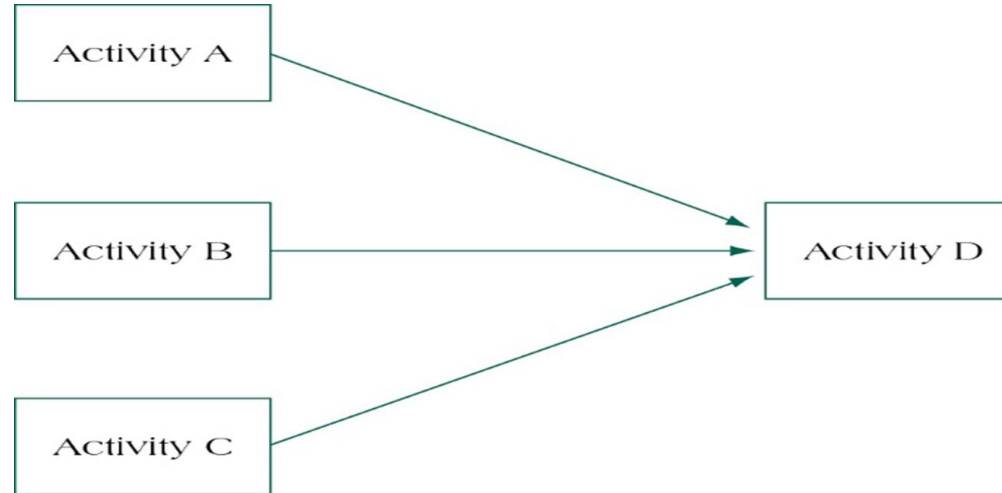
Early start	Identifier number	Early finish
Activity float	Activity descriptor	
Late start	Activity duration	Late finish

- **Predecessors:** Those activities that must be completed prior to initiation of a later activity in the network.
- **Successors:** Activities that cannot be started until previous activities have been completed. These activities follow predecessor tasks.



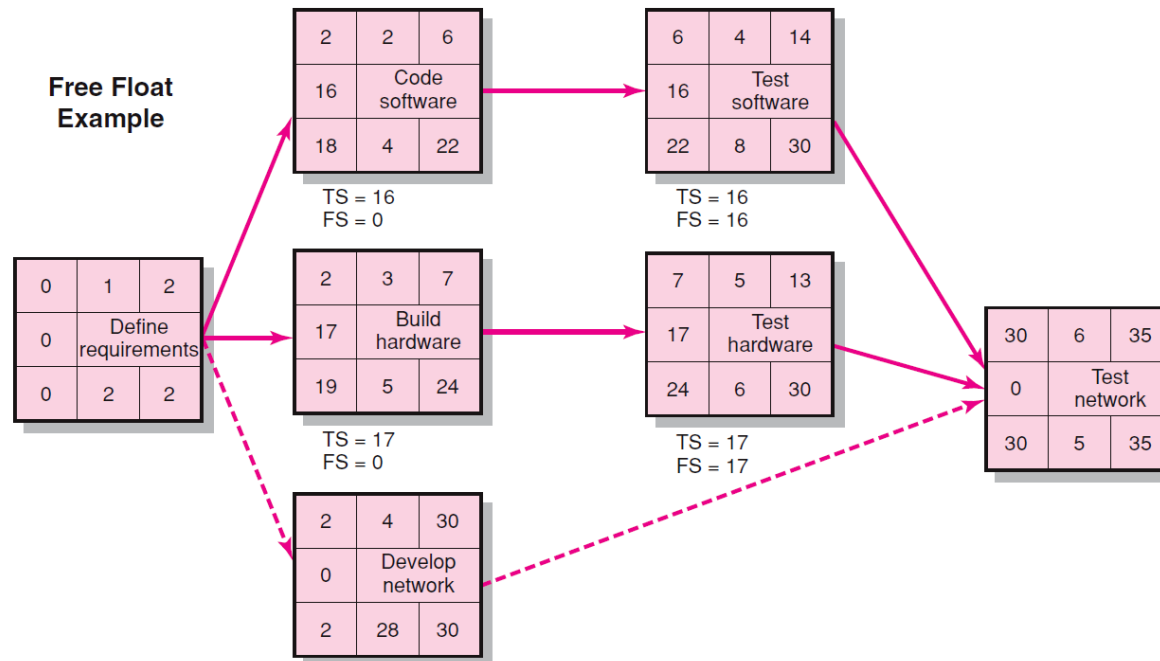
Project Scheduling Terms

- **Merge Activity:** An activity with two or more immediate predecessors.
- **Burst activity:** An activity with two or more immediate successors.



Project Scheduling Terms

- **Path:** a sequence of connected, dependent activities.
- **Critical Path:** the longest path through the activity network that allows for the completion of all project related activities; the shortest expected time in which the entire project can be completed. Delays on the critical path will delay completion of the entire project.



Project Scheduling Terms

- **Duration (D):** The estimated time required to perform an activity
- **Early start (ES) date:** The earliest time an activity can be started
- **Early Finish (EF) date:** The earliest time an activity can be finished and is equal to the early start plus the duration
- **Late start (LS) date:** The latest time an activity can be started without delaying the completion date of the project
- **Late Finish (LF) date:** -The latest time an activity can be finished.

Project Scheduling Terms

- **Total Float (TF):** The amount of time an activity may be delayed without delaying the completion date of the project
- **Free Float (FF):** The amount of time an activity may be delayed without delaying the early start time of the immediately following activity
- **Lags:** The amount of time a dependent activity must be delayed to begin or end



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Summary of Today Session

Project Scheduling

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The identification of the project objectives and the ordered activity necessary to complete the project including the identification of resource types and quantities required to carry out each activity or task.

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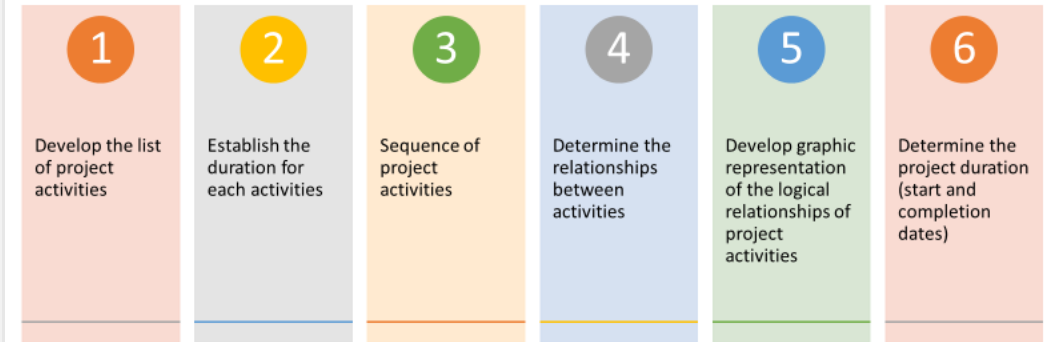
PMBoK states,

“an output of a schedule model that presents linked activities with planned dates, durations, milestones, and resources.”

3-9

Project Scheduling Process

- Project scheduling involves a clear, five step process. This process aids managers in determining the project schedule and, eventually, the project schedule baseline. The process steps are:



3-16

Project Scheduling Terms

- The Project Network
- Activity
- Predecessors
- Successors
- Merge Activity
- Burst activity
- Path
- Critical Path
- Duration (D)
- Early start (ES) date
- Early Finish (EF) date
- Late start (LS) date
- Late Finish (LF) date
- Total Float (TF)
- Free Float (FF)
- Lags

3-20

Baseline



- Baseline is the original approved plan that consists of both schedule and cost
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- The Schedule Baseline is the standard that all schedule performance will be measured against.
- It should be approved by the project manager and other appropriate individuals.
- Once the project manager approved the project start, logic, relationships and project duration, the schedule is then “baselined” to measure schedule performance.

3-46

Resources

Project Management

The Managerial Process

Fifth Edition

By: Erik W. Larson

Oregon State University

Clifford F. Gray

Oregon State University