

ABB PM Council

# Project Planning & Scheduling

# Course Objectives & Overview

- After this course, the participants know
  - how to schedule / plan project activities
  - how to efficiently use resources for project activities
  - how to track project activities and respond

Topics
Project Scope
Critical Path Method
Customer in the Critical Path
Schedule & Resources
Typical issues with Project Schedule
Project Planning & Scheduling

## Recommended Resources

Title	Author
Fast Forward MBA in Project Management	Eric Verzuh
Critical Chain	Eliyahu M Goldratt

# Project Planning & Scheduling

- People demonstrating this competency effectively plan, schedule, monitor and control activities necessary for predictable fulfillment of planned activities with efficient utilization of available resources.
- The output from project planning is captured as part of a project deliverable called as Project Execution Plan (PEP) or Project Management Plan or Project Plan.



## ABB Project Management Competencies

# Characteristics of the Project

- A project is a temporary endeavour undertaken to create a unique product, service, or result.
- Characteristics
  - Temporary
  - Unique
  - Progressively elaborated
- Triple Constraint



- Reference : PMBOK® Guide, Third Edition, Project Management Institute

# Project Planning

- Project Planning involves detailing the strategy for Customer.
- The Project Manager shall encourage the participation of whole project team while developing the Project Plan.
- Lot of iterations or progressive detailing of the execution strategy may be needed while developing this project deliverable as the project team understands the interdependencies and implications of different components of the Project Plan.

## Planning Overview

Determine the Project Scope

Build a Work Breakdown Structure (WBS) on a paper.

Identify the task relationships and build a high-level project schedule network diagram on a paper.

Estimate work packages

Calculate initial schedule

Assign and level resources

Create/refine the project schedule

# Project Plan

- A formal, approved document that defines how the project is executed, monitored, controlled and closed.
- The primary uses of the project plan are to document planning assumptions and decisions, to facilitate communication, among stakeholders, and to document approved scope, cost, and schedule baselines.
- It may be a summary or detailed, and may be composed of following subsidiary planning documents:
  - Project team and Roles & Responsibilities
  - Customers' obligation/deliverables for project, insurance, taxation and warranty requirements
  - Project Risk Management Plan
  - Project Communication Plan including meetings, reports, and who has authority to make or approve changes to contract
  - Procedure for changes/claims during the execution of the project
  - Project Documentation Plan
  - Project Quality Plan
  - Project Health, Safety & Environmental Plan
  - Project Procurements Plan including logistics
  - Project Schedule
  - Invoicing schedule
  - Customer acceptance criteria



## Objectives:

Determining the Project Scope

Work Breakdown Structure

# PROJECT SCOPE

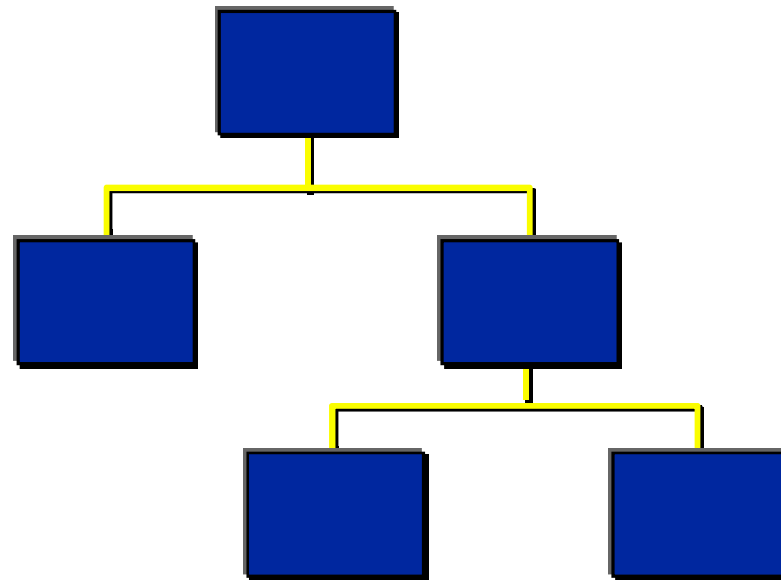
# Determining the Project Scope

- Project Deliverables
  - Any measurable, tangible, verifiable outcome, result or item that must be produced to complete a project or part of a project.
- Project Specific Deliverables
  - What the project requires.
  - Examples: GA Drawing, Wiring Diagram, Test Report , User Documentation etc.
- Organization Deliverables
  - What the organization requires
  - Examples : Internal Project Progress Report, Project Closure Report etc.



# Work Breakdown Structure (WBS)

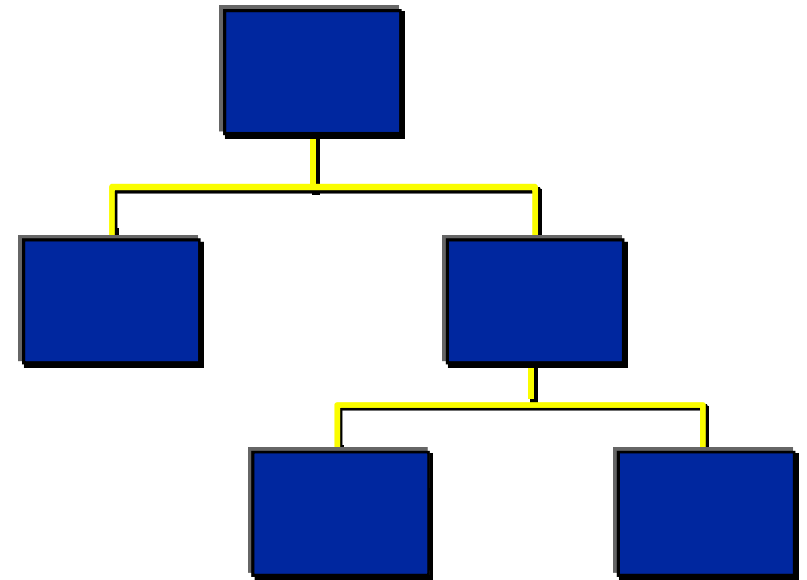
- A deliverable oriented grouping of project elements that organizes and defines the total workspace of the project.
- Each descending level represents an increasingly detailed definition of the project work.



- Reference : PMBOK® Guide, Third Edition, Project Management Institute

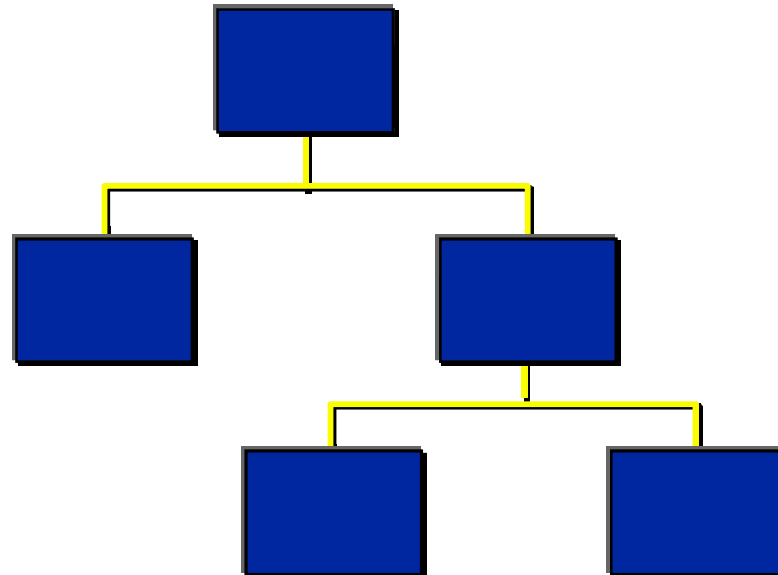
# Rules to create WBS

- Created with the help of project team.
- The first level is completed before breaking the project further. The entire project scope is included in this level.
- Each level of WBS is a segment which is smaller than above level and work towards the project deliverables.
- Work not included in WBS is not considered as part of the project.
- Breaking the WBS eventually will lead to Work Packages or activities that
  - Can be estimated realistically and confidently.
  - Cannot be logically subdivided further.
  - Can be completed quickly
  - Results in a meaningful deliverable.



# Benefits of WBS

- Helps the project team to understand the overall scope and how their work can impact the project as a whole
- Prevents work slipping through cracks
- Helps to identify **C**ost **O**pportunities by **P**erfecting **Q**uality (COPQ)
- Facilitates the communication among various stakeholders
- Excellent team building and reporting tool



# WBS Example

- BU Substations for example has issued an Instruction (3VAA 100115) for Work Breakdown Structure (WBS).
- WBS for Substations
  - 1 - Switchgear Main Components
  - 2 - Structural Elements & Connections
  - 3 - Control & Protection
  - 4 - Cables & Accessories
  - 5 - Auxiliary System
  - 6 - Special Systems
  - 7 - Civil Work
  - 8 - Erection & Commissioning
  - 9 - Project Management & Administration

- Link to inside.abb - Please type the below address in your web browser to access this instruction on WBS. The enclosure has full WBS as an excel file.

<http://inside.abb.com/cawp/gad00072/e615f38a68827337c125773000290e08.aspx>

1		2		3		4		5		6		7		8		9	
1. INFORMATION MAIN COMPONENTS		2. STRUCTURAL ELEMENTS & CONNECTIONS		3. CONTROL & PROTECTION		4. CABLES & ACCESSORIES		5. AUXILIARY SYSTEMS		6. SPECIAL SYSTEMS		7. CIVIL WORK		8. ERECTION & COMMISSIONING		9. PROJECT MANAGEMENT & ADMINISTRATION	
1.1 COMPLETE SWITCHGEAR	1.1.1	2.1.1	3.1.1	4.1.1	5.1.1	6.1.1	7.1.1	8.1.1	9.1.1	10.1.1	11.1.1	12.1.1	13.1.1	14.1.1	15.1.1	16.1.1	17.1.1
	1.1.2	2.1.2	3.1.2	4.1.2	5.1.2	6.1.2	7.1.2	8.1.2	9.1.2	10.1.2	11.1.2	12.1.2	13.1.2	14.1.2	15.1.2	16.1.2	17.1.2
	1.1.3	2.1.3	3.1.3	4.1.3	5.1.3	6.1.3	7.1.3	8.1.3	9.1.3	10.1.3	11.1.3	12.1.3	13.1.3	14.1.3	15.1.3	16.1.3	17.1.3
	1.1.4	2.1.4	3.1.4	4.1.4	5.1.4	6.1.4	7.1.4	8.1.4	9.1.4	10.1.4	11.1.4	12.1.4	13.1.4	14.1.4	15.1.4	16.1.4	17.1.4
	1.1.5	2.1.5	3.1.5	4.1.5	5.1.5	6.1.5	7.1.5	8.1.5	9.1.5	10.1.5	11.1.5	12.1.5	13.1.5	14.1.5	15.1.5	16.1.5	17.1.5
1.2 ACCESSORIES	1.2.1	2.2.1	3.2.1	4.2.1	5.2.1	6.2.1	7.2.1	8.2.1	9.2.1	10.2.1	11.2.1	12.2.1	13.2.1	14.2.1	15.2.1	16.2.1	17.2.1
	1.2.2	2.2.2	3.2.2	4.2.2	5.2.2	6.2.2	7.2.2	8.2.2	9.2.2	10.2.2	11.2.2	12.2.2	13.2.2	14.2.2	15.2.2	16.2.2	17.2.2
	1.2.3	2.2.3	3.2.3	4.2.3	5.2.3	6.2.3	7.2.3	8.2.3	9.2.3	10.2.3	11.2.3	12.2.3	13.2.3	14.2.3	15.2.3	16.2.3	17.2.3
	1.2.4	2.2.4	3.2.4	4.2.4	5.2.4	6.2.4	7.2.4	8.2.4	9.2.4	10.2.4	11.2.4	12.2.4	13.2.4	14.2.4	15.2.4	16.2.4	17.2.4
	1.2.5	2.2.5	3.2.5	4.2.5	5.2.5	6.2.5	7.2.5	8.2.5	9.2.5	10.2.5	11.2.5	12.2.5	13.2.5	14.2.5	15.2.5	16.2.5	17.2.5
1.3 SPECIAL SYSTEMS	1.3.1	2.3.1	3.3.1	4.3.1	5.3.1	6.3.1	7.3.1	8.3.1	9.3.1	10.3.1	11.3.1	12.3.1	13.3.1	14.3.1	15.3.1	16.3.1	17.3.1
	1.3.2	2.3.2	3.3.2	4.3.2	5.3.2	6.3.2	7.3.2	8.3.2	9.3.2	10.3.2	11.3.2	12.3.2	13.3.2	14.3.2	15.3.2	16.3.2	17.3.2
	1.3.3	2.3.3	3.3.3	4.3.3	5.3.3	6.3.3	7.3.3	8.3.3	9.3.3	10.3.3	11.3.3	12.3.3	13.3.3	14.3.3	15.3.3	16.3.3	17.3.3
	1.3.4	2.3.4	3.3.4	4.3.4	5.3.4	6.3.4	7.3.4	8.3.4	9.3.4	10.3.4	11.3.4	12.3.4	13.3.4	14.3.4	15.3.4	16.3.4	17.3.4
	1.3.5	2.3.5	3.3.5	4.3.5	5.3.5	6.3.5	7.3.5	8.3.5	9.3.5	10.3.5	11.3.5	12.3.5	13.3.5	14.3.5	15.3.5	16.3.5	17.3.5
1.4 TRANSFORMERS & REACTORS	1.4.1	2.4.1	3.4.1	4.4.1	5.4.1	6.4.1	7.4.1	8.4.1	9.4.1	10.4.1	11.4.1	12.4.1	13.4.1	14.4.1	15.4.1	16.4.1	17.4.1
	1.4.2	2.4.2	3.4.2	4.4.2	5.4.2	6.4.2	7.4.2	8.4.2	9.4.2	10.4.2	11.4.2	12.4.2	13.4.2	14.4.2	15.4.2	16.4.2	17.4.2
	1.4.3	2.4.3	3.4.3	4.4.3	5.4.3	6.4.3	7.4.3	8.4.3	9.4.3	10.4.3	11.4.3	12.4.3	13.4.3	14.4.3	15.4.3	16.4.3	17.4.3
	1.4.4	2.4.4	3.4.4	4.4.4	5.4.4	6.4.4	7.4.4	8.4.4	9.4.4	10.4.4	11.4.4	12.4.4	13.4.4	14.4.4	15.4.4	16.4.4	17.4.4
	1.4.5	2.4.5	3.4.5	4.4.5	5.4.5	6.4.5	7.4.5	8.4.5	9.4.5	10.4.5	11.4.5	12.4.5	13.4.5	14.4.5	15.4.5	16.4.5	17.4.5
1.5 TRANSMISSION & DISTRIBUTION	1.5.1	2.5.1	3.5.1	4.5.1	5.5.1	6.5.1	7.5.1	8.5.1	9.5.1	10.5.1	11.5.1	12.5.1	13.5.1	14.5.1	15.5.1	16.5.1	17.5.1
	1.5.2	2.5.2	3.5.2	4.5.2	5.5.2	6.5.2	7.5.2	8.5.2	9.5.2	10.5.2	11.5.2	12.5.2	13.5.2	14.5.2	15.5.2	16.5.2	17.5.2
	1.5.3	2.5.3	3.5.3	4.5.3	5.5.3	6.5.3	7.5.3	8.5.3	9.5.3	10.5.3	11.5.3	12.5.3	13.5.3	14.5.3	15.5.3	16.5.3	17.5.3
	1.5.4	2.5.4	3.5.4	4.5.4	5.5.4	6.5.4	7.5.4	8.5.4	9.5.4	10.5.4	11.5.4	12.5.4	13.5.4	14.5.4	15.5.4	16.5.4	17.5.4
	1.5.5	2.5.5	3.5.5	4.5.5	5.5.5	6.5.5	7.5.5	8.5.5	9.5.5	10.5.5	11.5.5	12.5.5	13.5.5	14.5.5	15.5.5	16.5.5	17.5.5
1.6 SPECIAL TOOLS & EQUIPMENT	1.6.1	2.6.1	3.6.1	4.6.1	5.6.1	6.6.1	7.6.1	8.6.1	9.6.1	10.6.1	11.6.1	12.6.1	13.6.1	14.6.1	15.6.1	16.6.1	17.6.1
	1.6.2	2.6.2	3.6.2	4.6.2	5.6.2	6.6.2	7.6.2	8.6.2	9.6.2	10.6.2	11.6.2	12.6.2	13.6.2	14.6.2	15.6.2	16.6.2	17.6.2
	1.6.3	2.6.3	3.6.3	4.6.3	5.6.3	6.6.3	7.6.3	8.6.3	9.6.3	10.6.3	11.6.3	12.6.3	13.6.3	14.6.3	15.6.3	16.6.3	17.6.3
	1.6.4	2.6.4	3.6.4	4.6.4	5.6.4	6.6.4	7.6.4	8.6.4	9.6.4	10.6.4	11.6.4	12.6.4	13.6.4	14.6.4	15.6.4	16.6.4	17.6.4
	1.6.5	2.6.5	3.6.5	4.6.5	5.6.5	6.6.5	7.6.5	8.6.5	9.6.5	10.6.5	11.6.5	12.6.5	13.6.5	14.6.5	15.6.5	16.6.5	17.6.5
1.7 PROJECT MANAGEMENT & ADMINISTRATION	1.7.1	2.7.1	3.7.1	4.7.1	5.7.1	6.7.1	7.7.1	8.7.1	9.7.1	10.7.1	11.7.1	12.7.1	13.7.1	14.7.1	15.7.1	16.7.1	17.7.1
	1.7.2	2.7.2	3.7.2	4.7.2	5.7.2	6.7.2	7.7.2	8.7.2	9.7.2	10.7.2	11.7.2	12.7.2	13.7.2	14.7.2	15.7.2	16.7.2	17.7.2
	1.7.3	2.7.3	3.7.3	4.7.3	5.7.3	6.7.3	7.7.3	8.7.3	9.7.3	10.7.3	11.7.3	12.7.3	13.7.3	14.7.3	15.7.3	16.7.3	17.7.3
	1.7.4	2.7.4	3.7.4	4.7.4	5.7.4	6.7.4	7.7.4	8.7.4	9.7.4	10.7.4	11.7.4	12.7.4	13.7.4	14.7.4	15.7.4	16.7.4	17.7.4
	1.7.5	2.7.5	3.7.5	4.7.5	5.7.5	6.7.5	7.7.5	8.7.5	9.7.5	10.7.5	11.7.5	12.7.5	13.7.5	14.7.5	15.7.5	16.7.5	17.7.5



# Objectives:

Project Schedule Network Diagram

Critical Path

Critical Path Method

Impact of Customer Obligations on Project Schedule

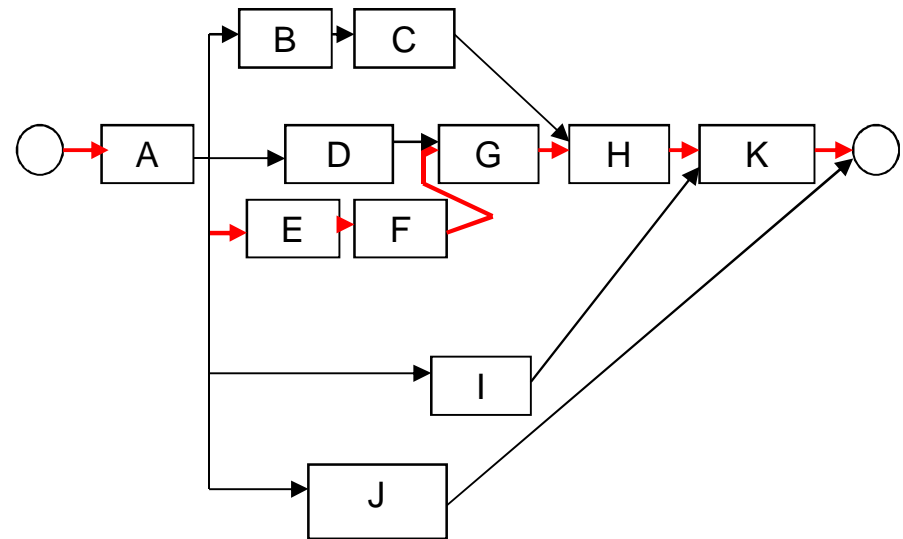
# CRITICAL PATH METHOD

# Project Schedule Network Diagrams

- Any schematic display of logical relationships of project activities. Always draws from left to right to reflect project chronology.

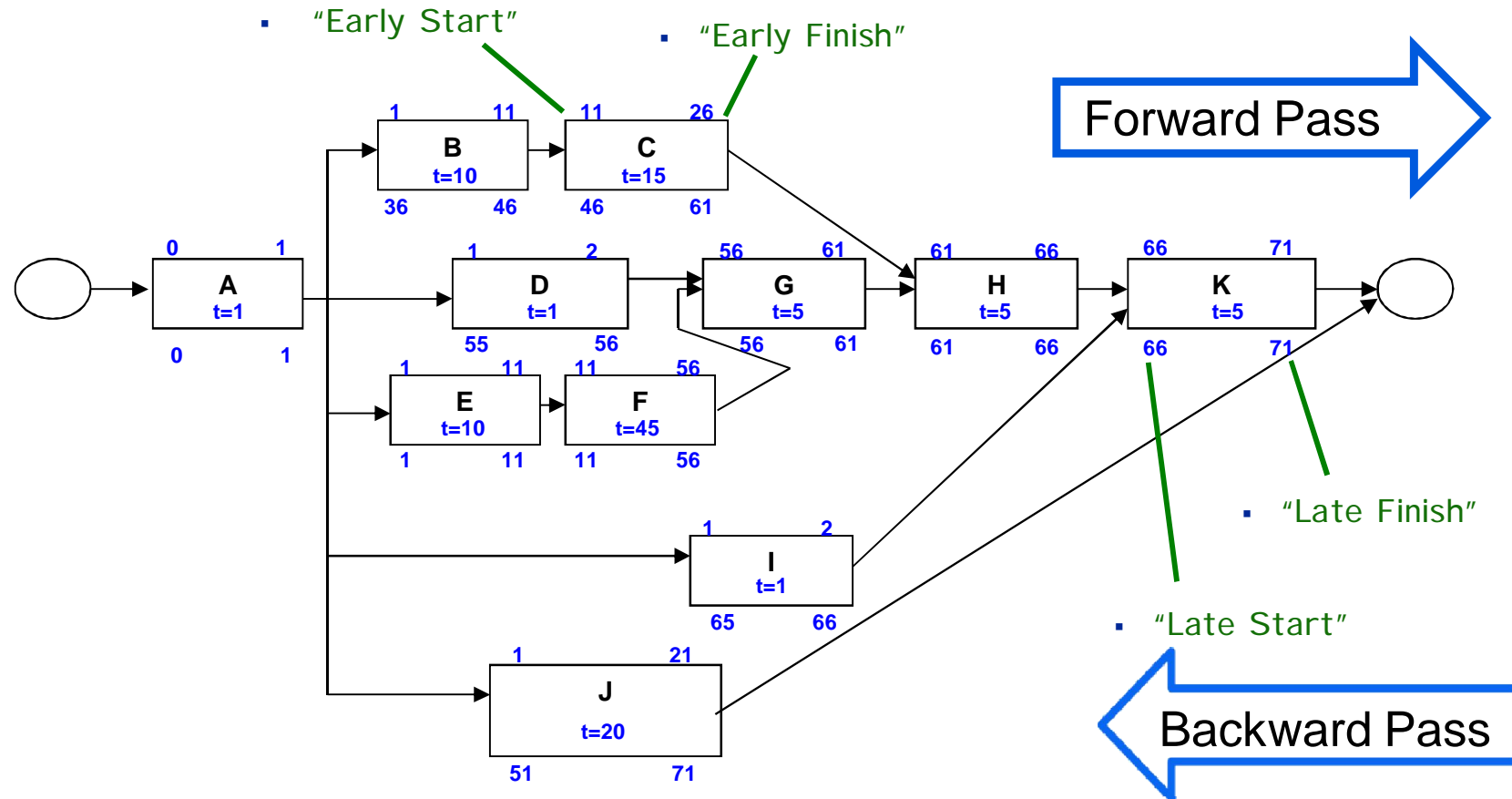
## Inputs to create network diagrams

- WBS
- Activity list
- Mandatory dependencies
- Discretionary dependencies
- External dependencies
- Milestones



- Reference : PMBOK® Guide, Third Edition, Project Management Institute

# Forward Pass & Backward Pass



- Two passes are made on the network diagram to find the total duration and critical path
  - Forward pass to find Early Start and Early Finish
    - Early Finish (EF) = Early Start (ES) + Task Duration (t)
  - Backward pass to find Late Start and Late Finish
    - Late Start (LS) = Late Finish (LF) – Task Duration (t)

# Float & Critical Path

## Float / Slack

- The amount of time a task can be delayed without delaying the project.

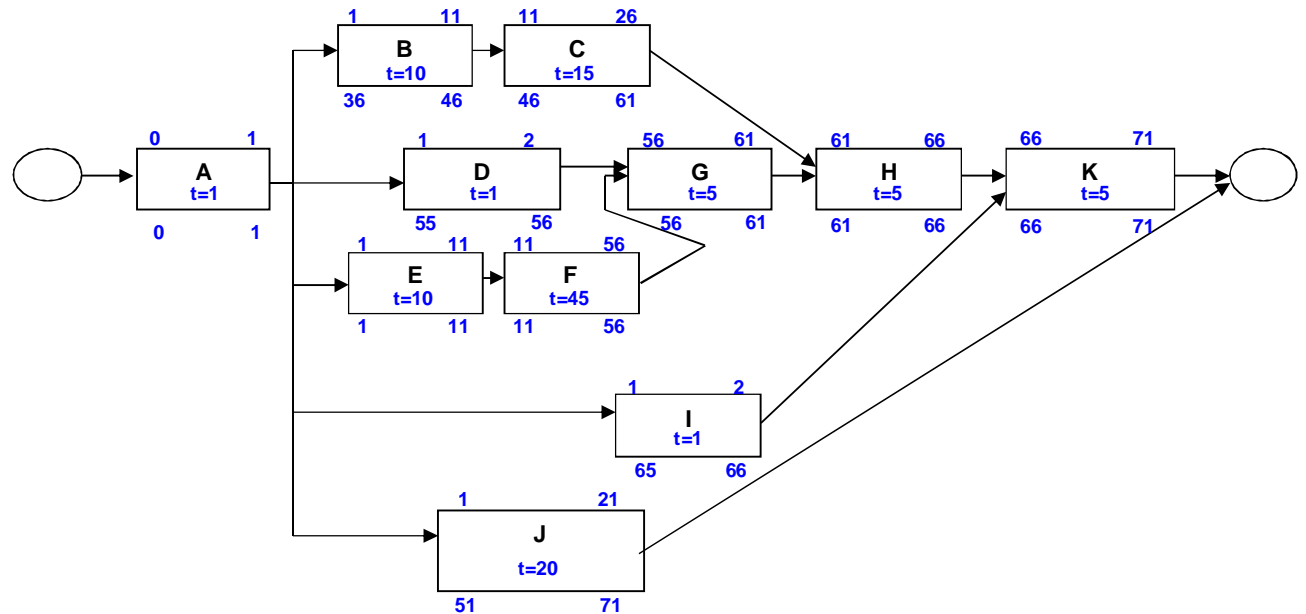
Float =

Late Start (LS) - Early Start (ES)

or

Late Finish (LF) - Early Finish (EF)

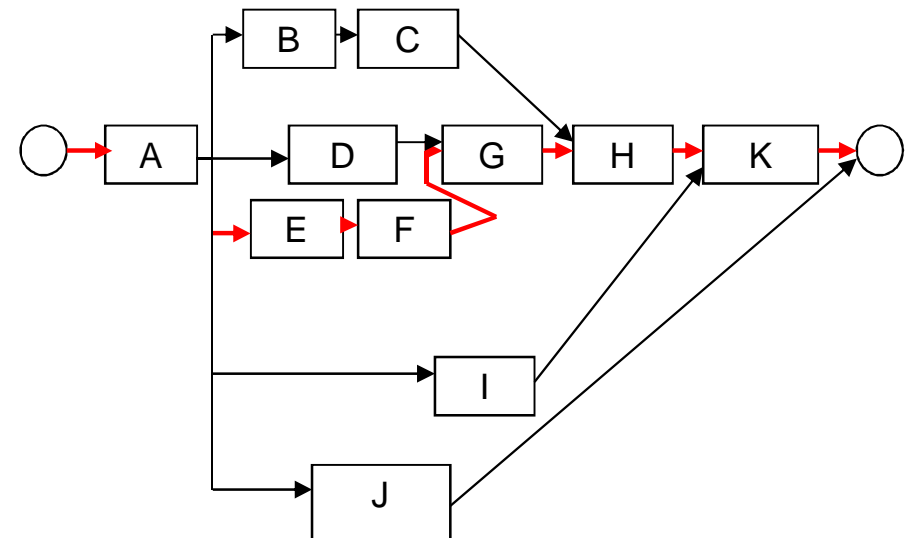
- Float on critical path = 0 (zero) or negative.**
- Total Float =  $LF - ES$
- Free Float = Total Float – Task Duration





# Critical Path

- Critical Path has all of the tasks with zero or negative float.
- Critical Path is the longest duration path through a network diagram.
- It determines shortest time to complete the project.
- Critical path may change over time.
- There can be more than one critical path. This situation may lead to increase in project risk.
- A project may have negative float. If such situation arises we may need to crash or fast-track a project.



- Reference : PMBOK® Guide, Third Edition, Project Management Institute

# Critical Path Method

- The Critical Path Method define a set of tasks linked to one or more tasks that have no float or negative float, the sequence of activities that must be completed on the dates scheduled for the project can be completed within the deadline.
- **Use the Critical Path Method to identify and manage critical tasks for the project**
- **Include the customer related activities in the Critical Path.**

# Objectives:

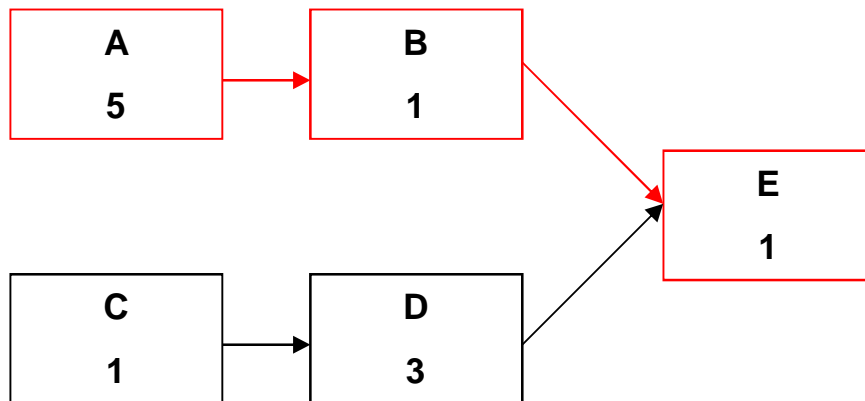
Understand the different scheduling situations based on resources



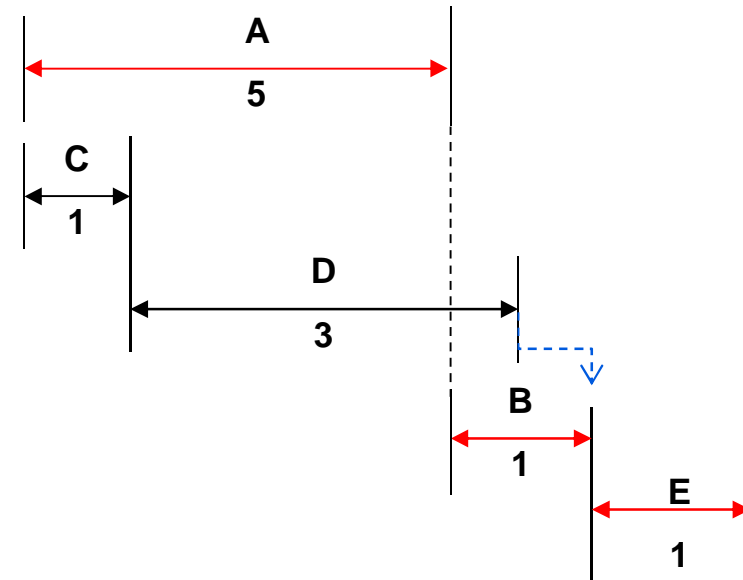
# SCHEDULE & RESOURCES

# PERT Chart and Gantt Chart

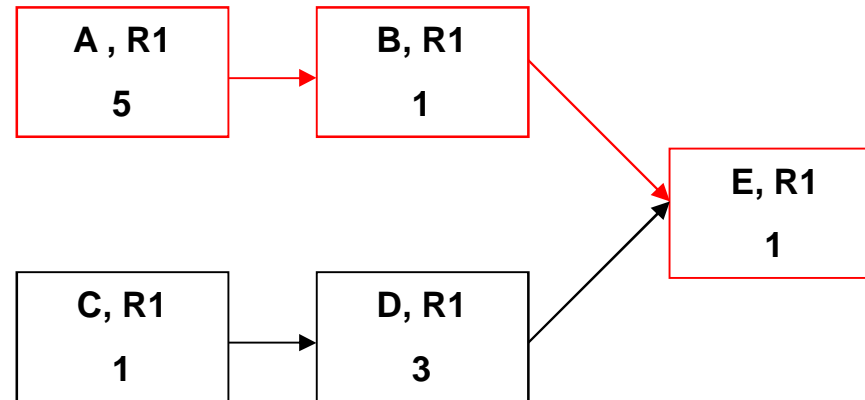
PERT Chart



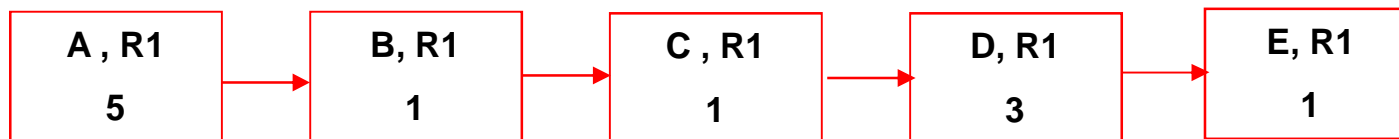
Gantt Chart



# Single person(R1) working on one project

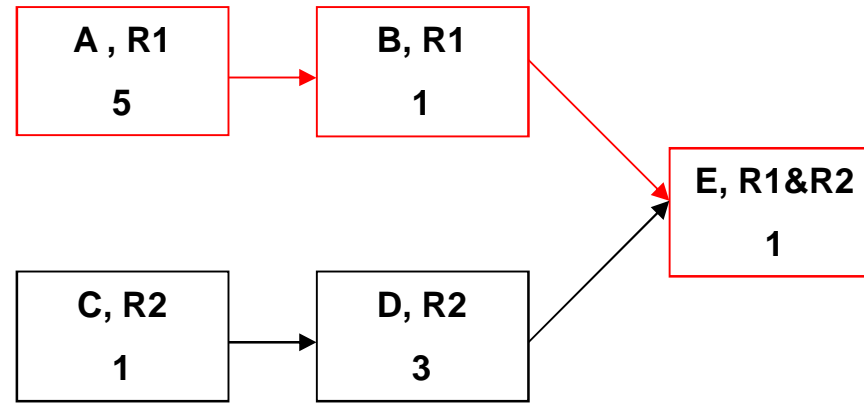


- We need to consider all the tasks as serial as the same resource (R1) is working on all the tasks. All the tasks are on critical path.

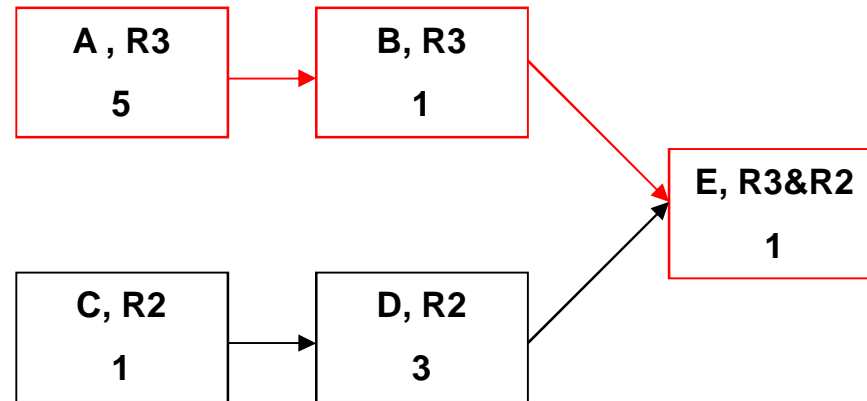


# One common resource (R2) for two projects

- Project 1



- Project 2



- Project 1 and 2 as a stand-alone project needs 7 days to complete each project.
- If R2 needs to work on both the projects at the same time, then either of the projects may get delayed by 4 days, The inclusion of R2 (a common resource) may impact critical paths of both the projects .

# Resources, Work and Duration

- Duration is the length of working time between start and finish of a project activity or task.
- Work is the amount of effort that project resource(s) needs to complete the project activity or task. The effort is measured in time units like weeks, hours and days.
- Resources are people, equipment or other services or material that are applied to completing a project activity or task.
- Resource Units indicate how much of the resources available time is being used to work on a particular project activity or task.

## Scheduling formula

$$\text{Duration} = \frac{\text{Work}}{\text{Resource Units}}$$

- Reference : Microsoft Corporation, Project 2003 Training

# Resource Levelling

- The project team adjusts the initial project schedule to account for resource constraints. Project activities and tasks are rescheduled in order to optimize the resource utilization on the project.
- Assign and level resources:
  - Estimate the resource requirements throughout the project for the initial project schedule
  - Identify the resource peaks.
  - At each project activity or task, delay the non-critical tasks within their float.
  - Reevaluate the work package estimates to eliminate the remaining peaks.

## Planning Overview

Determine the Project Scope

Build a Work Breakdown Structure (WBS) on a paper.

Identify the task relationships and build a high-level project schedule network diagram on a paper.

Estimate work packages

Calculate initial schedule

Assign and level resources

Create/refine the project schedule

- Reference : Fast Forward MBA in Project Management, Eric Verzuh



# Project Cash-flow

- Cash comes out of our Business Processes.
- Schedule should define key milestones to which payments are tied to ensure positive cash flow throughout the execution phase.

## Contract conditions:

Project time: 18 m

Payment conditions:

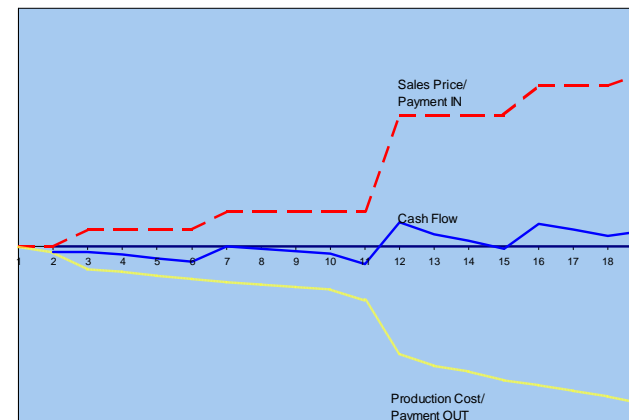
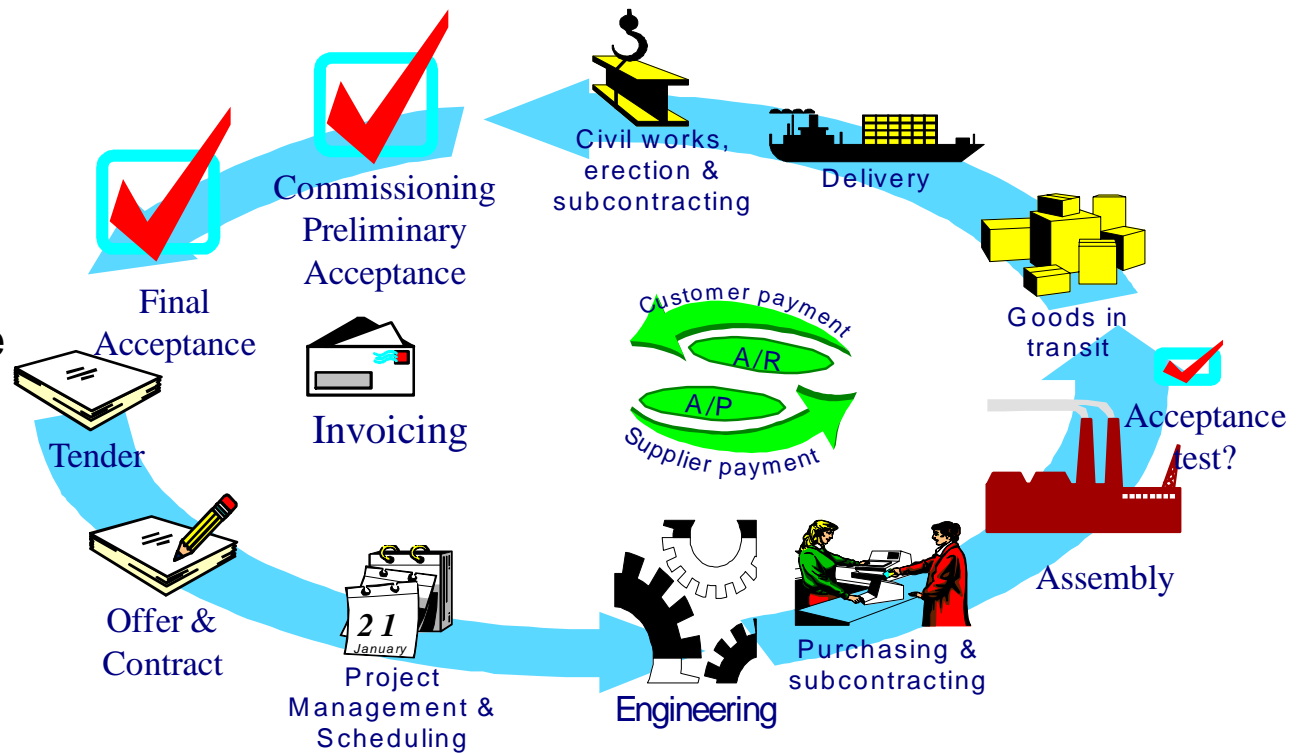
10% advance

85% at delivery

5% retention

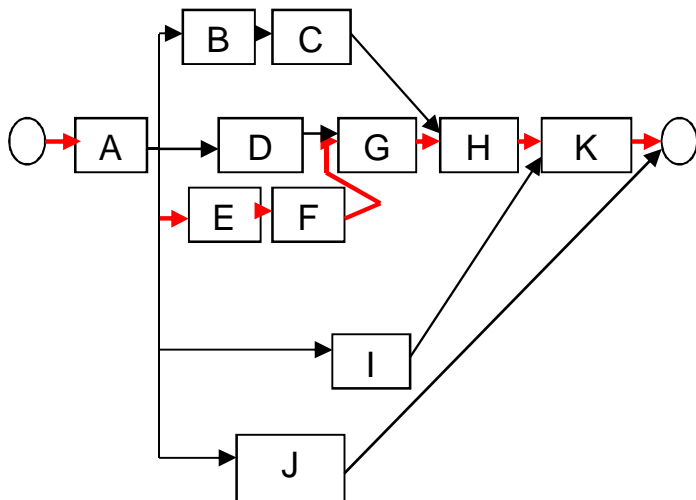
3 deliveries:

month 5, month 10, month 14



# Project Schedule

Task Description	Days	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
Kick-off Meeting with Customer	1																	
Basic Design (E)	10																	
Procurement, Manufacturing, Shipment and Receipt of Material (F)	45																	
Software Design (B)	10																	
Software Development (C)	15																	
Site Start-up (D)	1																	
Inspection of Material at Site (I)	2																	
Installation (G)	5																	
Commissioning (H)	5																	
Final Documentation (J)	20																	
Preliminary Acceptance/PAC (I)	5																	



- Project schedule includes the planned dates for starting and completing project activities and milestones.
- Assure a minimum but sufficient project float for tasks on non- critical path
- Actively strive to optimize overall resource planning and utilization

# Project Baseline

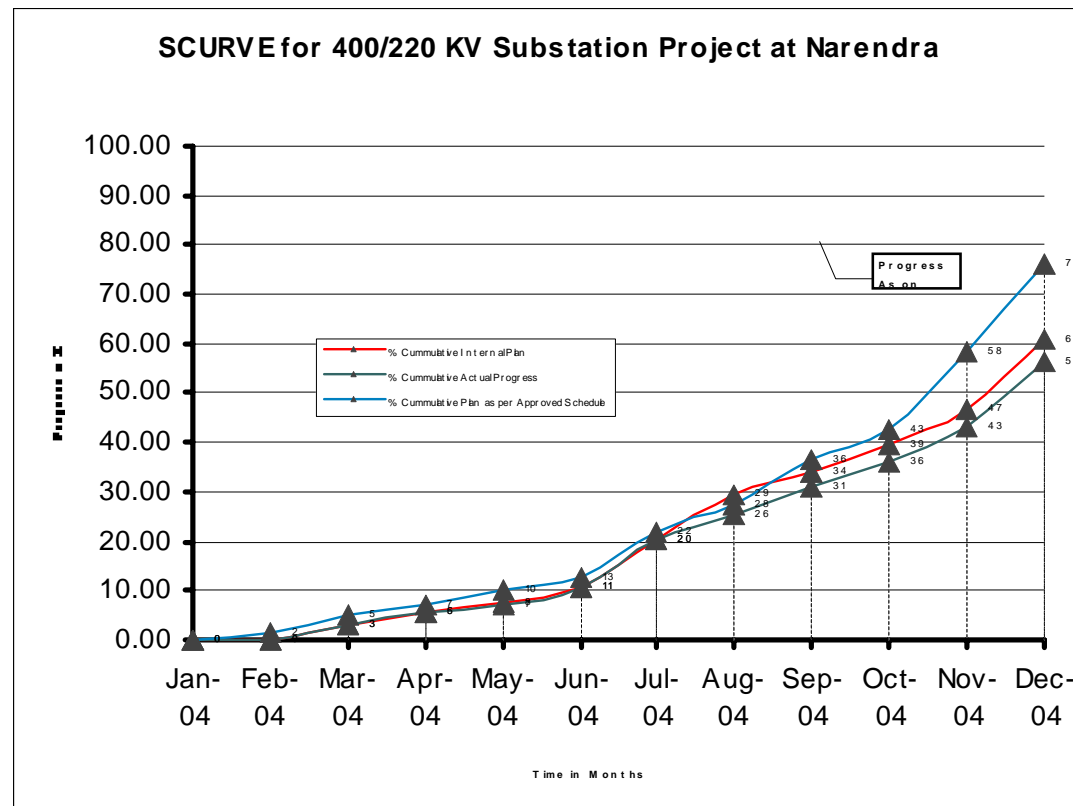
- Project Baseline is the original project plan as approved by the stakeholders. It is changed only in response to an approved scope of work or deliverable change.
- The project baseline also represents the accepted “Triple Constraint” for the project.
- A baseline is a comparison point. Ideally a project should never vary from its original plan. So a comparison between actual performance and the baseline show no variance.
- One of the ways of holding the focus on project objectives is by keeping the baseline schedule and cost goals visible.
  - WBS facilitates the communication among various stakeholders related to scope.
  - S-Curve and Gantt chart are examples for tracking the schedule goals.
  - Earned value reporting is an example for tracking the schedule and cost variances.



- Reference : Fast Forward MBA in Project Management, Eric Verzuh

# S-Curve

- S-Curve is a method for measuring progress in a graphical way utilizing the cumulative data for plan vs. actual.
- The analysis can predict whether the project is progressing as per plan or not.



# Earned Value Management (EVM)

1/2

- EVM is a method for integrating scope, schedule and resources and for measuring project performance.
- Earned value analysis can predict:
  - whether the project is on-time & on-cost and
  - what is estimate at completion of the project.

Term	Formula	Interpretation
Schedule Variance (SV)	▪ $SV = EV - PV$	<ul style="list-style-type: none"><li>▪ Positive means ahead of schedule</li><li>▪ Negative means behind schedule.</li></ul>
Cost Variance (CV)	▪ $CV = EV - AC$	<ul style="list-style-type: none"><li>▪ Positive means under the budget.</li><li>▪ Negative means there is a cost overrun.</li></ul>
Schedule Performance Index (SPI)	▪ $SPI = EV / PV$	<ul style="list-style-type: none"><li>▪ <math>&gt; 1</math> means ahead of schedule</li><li>▪ <math>&lt; 1</math> means behind schedule</li></ul>
Cost Performance Index (CPI)	▪ $CPI = EV / AC$	<ul style="list-style-type: none"><li>▪ <math>&gt; 1</math> means under the budget</li><li>▪ <math>&lt; 1</math> means there is a cost overrun.</li></ul>

## EVM Terminology

### Planned Value (PV)

Estimated value of the work planned.

### Earned Value (EV)

Estimated value of the work actually accomplished or performed.

### Actual Cost (AC)

Actual cost incurred.

### Budgeted at Completion (BAC)

Budgeted value for the work.

- Reference : PMBOK® Guide, Third Edition, Project Management Institute

# Earned Value Management (EVM)

2/2

Term	Formula	Notes
Estimate at Completion (EAC)	<ul style="list-style-type: none"><li>▪ <math>EAC = BAC/CPI</math></li></ul>	<ul style="list-style-type: none"><li>▪ Used when no variances from BAC have occurred or we continue at the same rate of spending.</li></ul>
Estimate at Completion (EAC)	<ul style="list-style-type: none"><li>▪ <math>EAC = AC + ETC</math></li></ul>	<ul style="list-style-type: none"><li>▪ Used when original estimate is fundamentally flawed.</li></ul>
Estimate at Completion (EAC)	<ul style="list-style-type: none"><li>▪ <math>EAC = AC + (BAC - EV)</math></li></ul>	<ul style="list-style-type: none"><li>▪ Used when current variances are thought to be atypical of future</li></ul>
Estimate at Completion (EAC)	<ul style="list-style-type: none"><li>▪ <math>EAC = AC + (BAC - EV)/CPI</math></li></ul>	<ul style="list-style-type: none"><li>▪ Used when current variances are thought to be typical of future</li></ul>
Estimate to Complete (ETC)	<ul style="list-style-type: none"><li>▪ <math>ETC = EAC - AC</math></li></ul>	<ul style="list-style-type: none"><li>▪ How much do we need to spend for completing the remaining work?</li></ul>
Variance at Completion (VAC)	<ul style="list-style-type: none"><li>▪ <math>VAC = BAC - EAC</math></li></ul>	



## Objectives:

Early Start vs. Late Start

How to shorten the Project Duration?

Revenue Plan driven schedule crashing

# TYPICAL ISSUES WITH PROJECT SCHEDULE

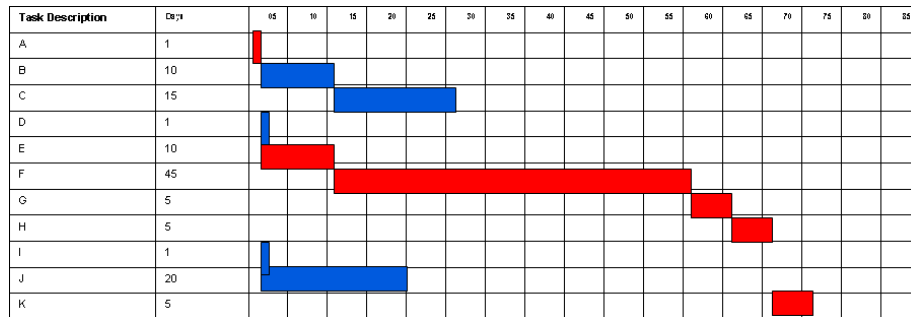
# Project Schedule based on Early Start & Late Start

- Most project scheduling tools have an option to define the project based on Project Start Date or Project End (or Finish) Date. The scheduling with
  - Project Start Date utilize the Early Start(ES) Dates for schedule computation based on Forward Pass technique.
  - Project End Date utilize the Late Finish(LF) Dates for schedule computation based on Backward Pass technique.
- Project Manager(PM) needs to manually do Resource leveling and balancing the schedule by moving the non-critical tasks within their float.
  - Tasks with external dependencies shall start on Early Start(ES) considering there may be delays in finishing these activities.
  - Discretionary dependency tasks may start on Late Start(LS) Date.



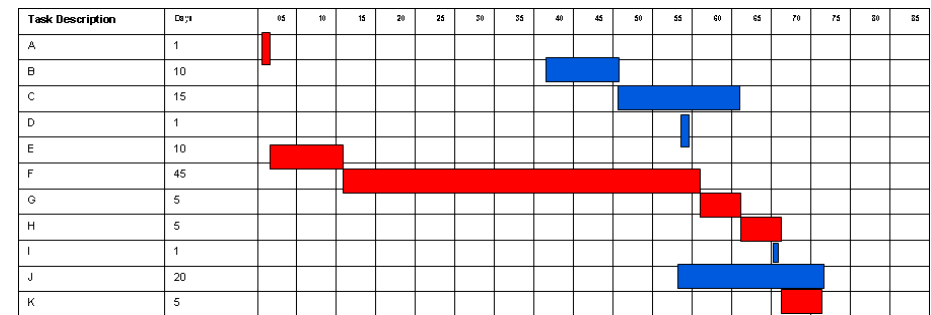
# Project Schedule based on Early Start & Late Start

## Project Schedule based on Early Start



- What do we observe if we start all the tasks on Early Start
  - PM needs to concentrate on Red colored tasks as they are on Critical Path. Any delay on critical path will delay the project.
  - The project team may not have been fully on-boarded as they may have been busy on existing projects.
  - PM may lose focus by starting tasks that are on non-critical path.
  - PM needs to consider the impact of multitasking if the same resource is working on two or more tasks.

## Project Schedule based on Late Start



- What do we observe if we start all the tasks on Late Start
  - PM needs to consider the availability of resources on non-critical path tasks that are starting on Late Start.
  - Any delay in non-critical path tasks may delay the project. In such case, the non-critical path tasks also become critical path tasks. There can be more than one critical path now. This situation may lead to increase in project risk.

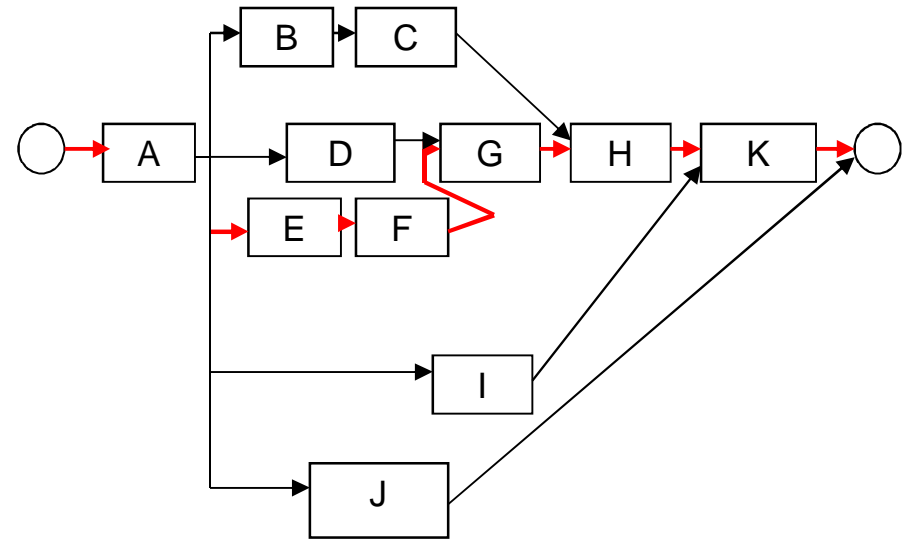
# How to shorten the project duration - Crashing & Fast Tracking

## Crashing

- Adding more resources to the activities on the critical path.
- Moving resources from non-critical activities.
- Adding more resources to the project.

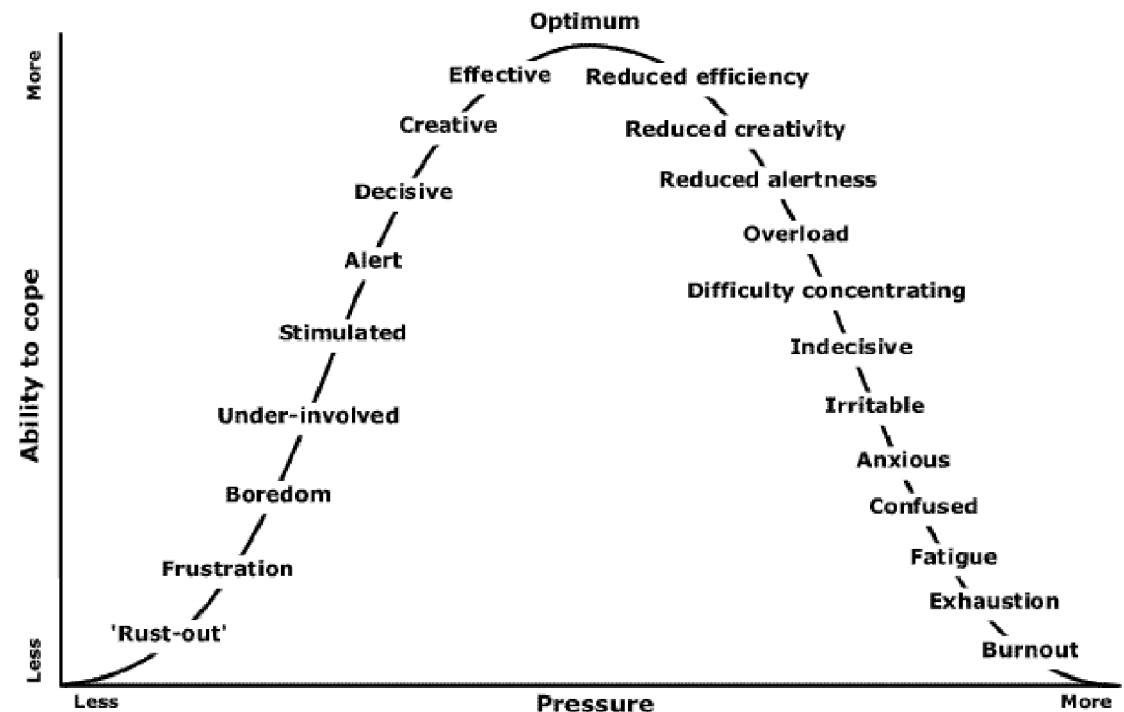
## Fast Tracking

- Performing the activities on the critical path in parallel instead of sequentially.
- Fast tracking often results in rework, increases risk and requires more attention to communication among project team.



# Issues with crashing

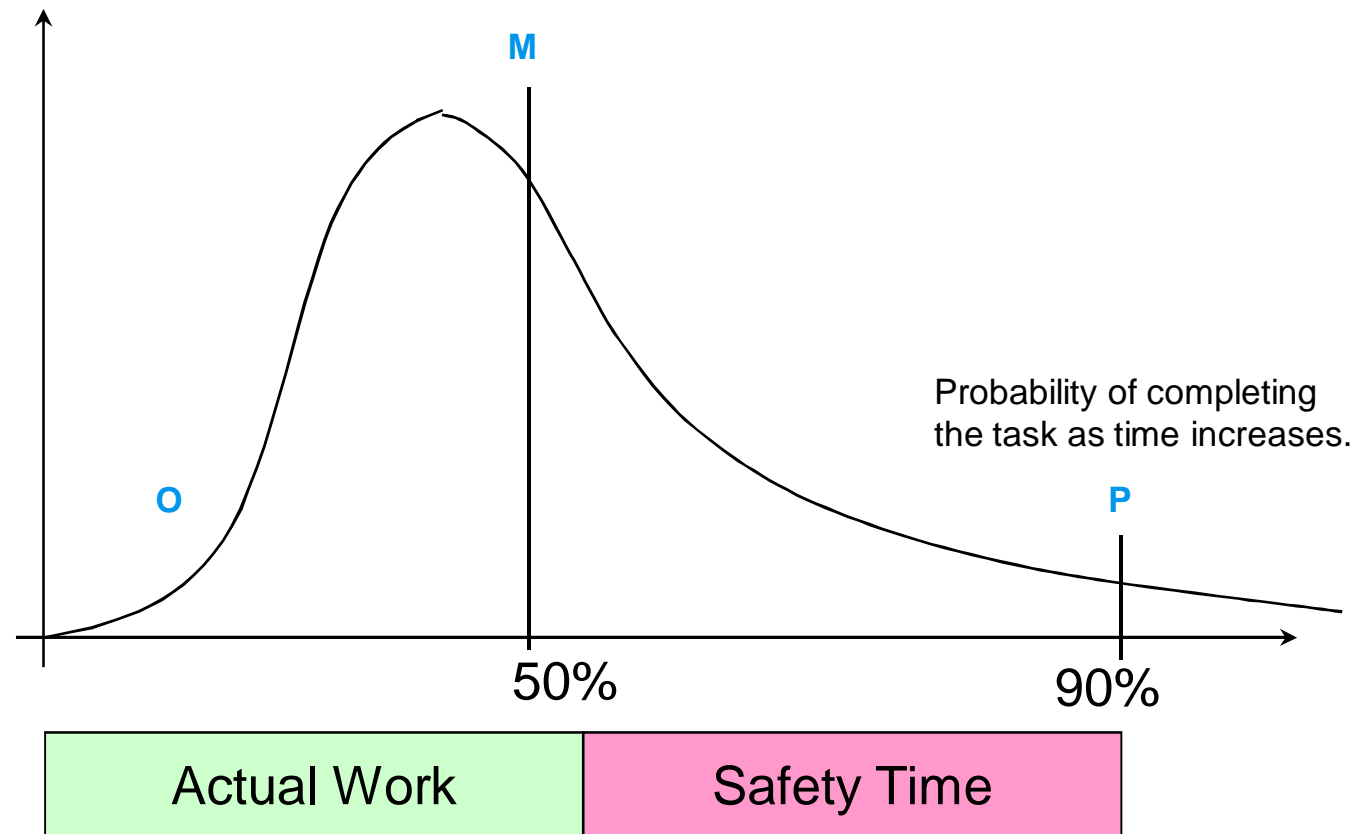
- A project needs to have optimum team size.
- The communication load of the total team increases as the project size increases exponentially.
- If we need to increase the team size, then consider
  - the communication load of the existing team members
  - the issues of team dynamics. The team already under pressure may be demoralized due to the inclusion of new team member
  - the overall project cost.



# What is a Realistic Time Estimate?

## PERT Heuristic

- Duration can be estimated by various ways
- CPM (Critical Path Method) – One estimate
- PERT - Three Estimates
  - $(P + 4M + O)/6$
  - P = Pessimistic
  - O = Optimistic
  - M = Most Likely



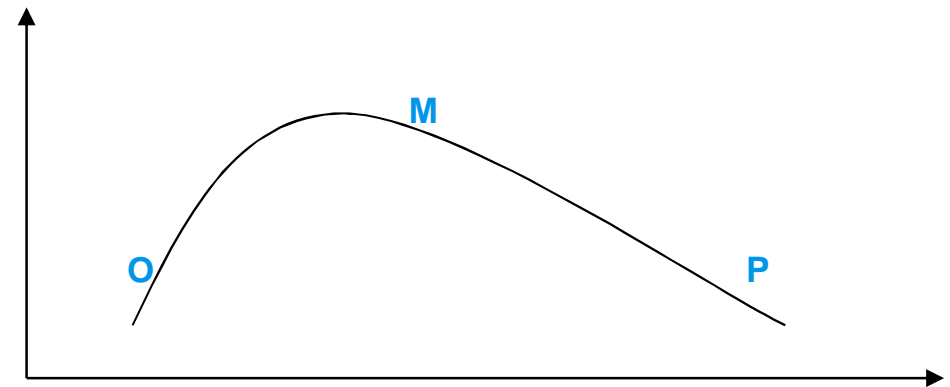
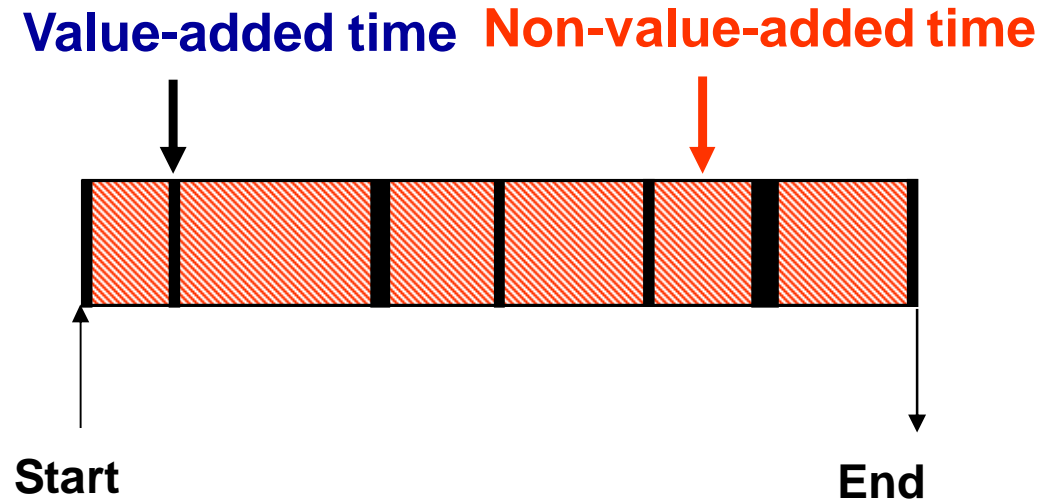
- The more uncertainty → the more skewed shape of the curve → we get estimates that are further away from the median (Most Likely)....

# How to shorten the project duration?

- Today's reality in most projects:
  - Value-added time in project management is usually 10 % or less
  - Queuing, following-up and waiting comprise rest of the time

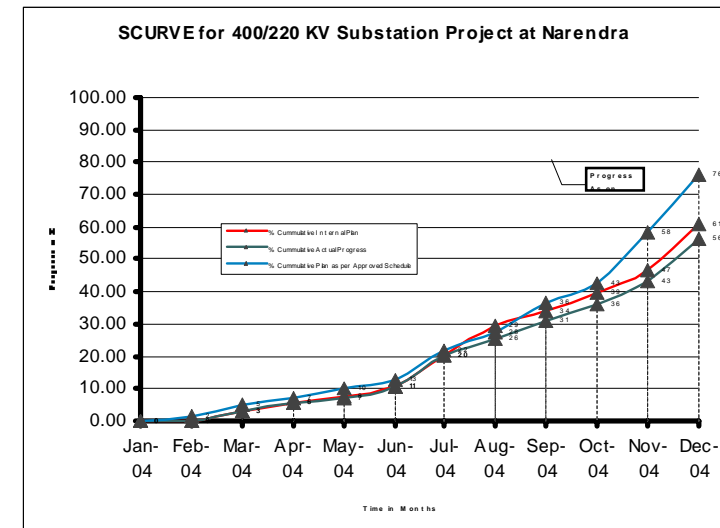
## How to shorten the project duration?

- Revisit the estimates once more.
- Consider moving the estimates to “Optimistic” or “Most Likely”, instead of “Pessimistic”.
- Review the waiting period between different tasks.
- Reward the project team if they can meet the “On Time Delivery” by reducing the estimate



# Delay analysis and corrective action

- Following are the steps for keeping the project on track, and these steps need to be repeated throughout the project:
  - Monitor the project scope utilizing the project contract and its subsequent amendments for any scope changes and the WBS.
  - Monitor the project cost with Full Cost Calculation/FCM and/or Business System.
  - Monitor the project schedule and cost performance utilizing the project Gantt chart, S-curve and/or Earned value reporting.
  - Identify the sources for the problems causing the schedule and/or cost variances.
  - Develop a solution.
  - Communicate the impacts of the problem and the solution to all affected stakeholders.
  - Update the project plan and implement it.



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# PROJECT PLANNING & SCHEDULING TOOLS

# Project Planning & Scheduling Tools

- Project Planning & scheduling tools provides schedule component names, definitions, structural relationships, and formats that support the application of the scheduling method.
- Variety of software applications are available in the market to prepare a project schedule. e.g. Microsoft Project, Primavera
- Usually there is a great temptation to start creating project schedule by entering data into templates provided by the software. There is a major flaw in this approach -
  - Only a part of the project activities can be seen on the computer screen
  - The dependencies for different project activities or tasks may not be visible or overlooked.
  - Most project scheduling tools have an option to define the project based on Project Start Date or Project End (or Finish) Date. Project Manager(PM) needs to manually do Resource leveling and balancing the schedule by moving the non-critical tasks within their float.

Before start creating project schedule software application:

Build a Work Breakdown Structure (WBS) on a paper.

Identify the task relationships, and build a high-level project schedule network diagram on a paper.



# Microsoft Project

- Microsoft Project is a popular application for project scheduling and execution tracking.
- Microsoft provides lot of free eLearning modules. Please visit:  
<http://office.microsoft.com>
- ABB US has developed an extensive guide to utilize this application. Please visit:  
<http://inside.abb.com/cawp/gad00636/2241c4d4b2976bcec1257818004e70a4.aspx>
- Advantages:
  - Easy to use application
  - Most customers prefer project schedule using this application

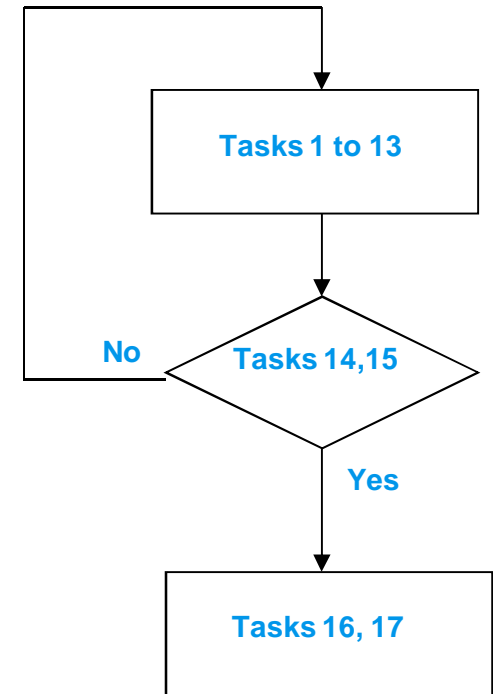
# Primavera

- Primavera is an application for project scheduling and execution tracking.
- ABB UK has developed an extensive guide to utilize this application. Please visit:  
<http://inside.abb.com/cawp/gad00636/2241c4d4b2976bcec1257818004e70a4.aspx>
- Advantages:
  - Very popular in EPC companies, and in projects where the number of project activities or tasks are very large.

# PROJECT PLANNING & SCHEDULING

# Typical tasks involved during Planning

1. Review the contract.
2. Define/organize the project team and Roles & Responsibilities
3. Analyze/review resource planning
4. Define/refine Work Breakdown Structure (WBS)
5. Review the costing of the project incl. insurance & taxation.
6. Create/refine Project Schedule Network Diagram
7. Create/refine Project Risk Management Plan
8. Create/refine Project Communication Plan
9. Create/refine Quality , Environment , Health & Safety Plan
10. Conduct risk analysis and open Risk Register.
11. Create/refine Project Procurements Plan
12. Create/refine Project Schedule
13. Create/refine time-phased cash-flow/budget
14. Compile the Project Management Plan and get team commitment
15. Get approval for the Project Management Plan
16. Conduct kick-off meetings with Internal project organization, Consortium (if applicable) and, Client
17. Review the Project Planning & Start-up

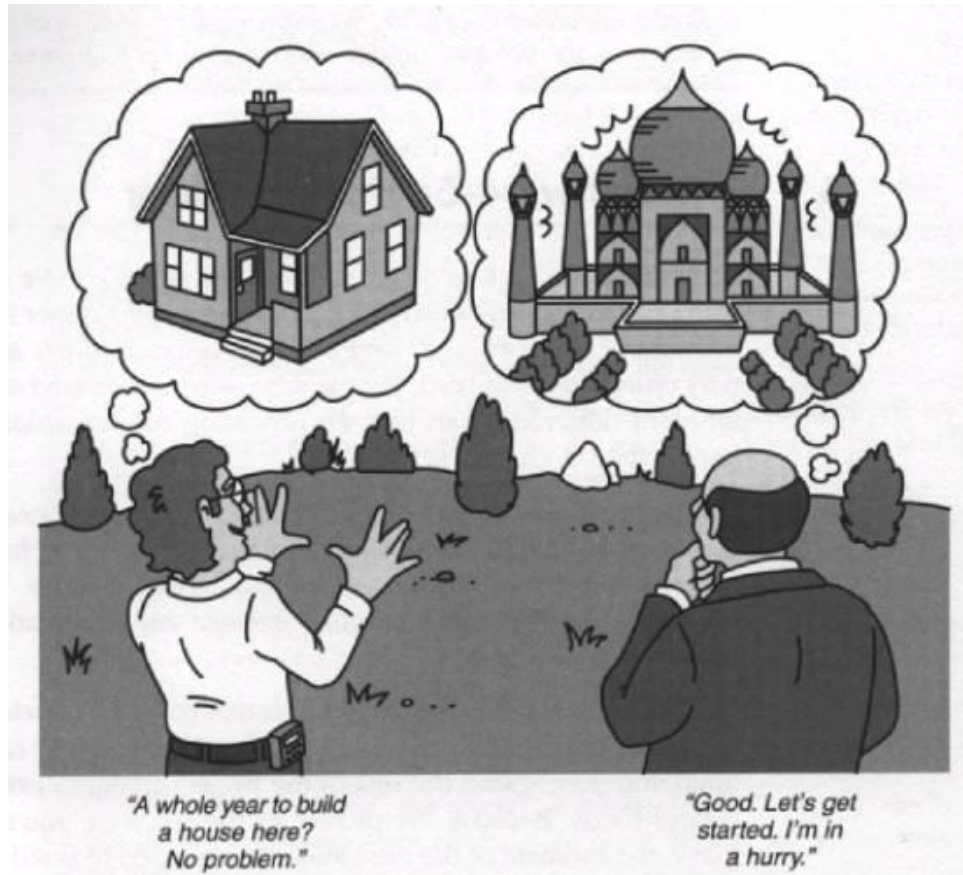


# What is a good schedule ?

- A Time table who does what and by when?
- A description of the progress of an order through the delivery process.
- A prediction of how much money we will make during the execution of the project.
- A tool for saying what we can do with the resources we have.
- A tool to tell us how many resources we need, when and where to achieve a certain set of orders.

Task Description	Days	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
Receipt Contract. (A)	1																	
Basic Design (E)	10																	
Procurement, Manufacturing, Shipment and Receipt of Material (F)	45																	
Software Design (B)	10																	
Software Development ©	15																	
Site Start-up (D)	1																	
Inspection of Material at Site (I)	1																	
Installation (G)	5																	
Commissioning (H)	5																	
Final Documentation (J)	20																	
Preliminary Acceptance/PAC (I)	5																	

# Begin with Project Closure in Mind



- It is difficult to know whether you can build the product that the customer wants in the desired time frame, until you have a detailed understanding of what the customer really wants.
- Acceptance criteria should be clearly defined, i.e.
  - The customer knows what we will deliver for the money
  - We know what we must deliver to satisfy the customer and receive contractual payment
  - Any open action item including agreed upon time for completion should be listed and acted upon.

# Planning & Schedule Management

- Planning is done to secure project deliverables with efficient utilization of resources
- The schedule meets what we have committed to customer.
- Customer obligations are identified
- Can contribute to margin improvement, if we focus on Critical Path.
- Should build in float to allow for unanticipated 'surprises'.
- Cash comes out of our Business Processes. Schedule should define key milestones to which payments are tied to ensure positive cash flow throughout the execution phase.



# GG/LC-050 Project planning, scheduling & resources

- Proper project planning & scheduling is essential for meeting Customer requirements & managing resources
- **Project Planning**
  - Use WBS packages with appropriate detail & milestones to ensure resource assignment
  - Establish documentation per Customer requirements
- **Project Schedule**
  - Prepare project schedule with main activities, procurement schedule, supplier schedule & contractual milestones prior to start of work – review regularly
  - Show Customer activities on the schedule – review critical path during execution
- **Project Resources**
  - During initial planning & scheduling phases, review list of required resources based on size & complexity of project
  - Define roles & responsibilities of project team & schedule regular feedback team meeting



# Project Planning & Scheduling

**People demonstrating this competency effectively plan, schedule, monitor and control activities necessary for predictable fulfillment of planned activities with efficient utilization of available resources.**

## ABB Project Manager

- Understands critical path scheduling and assures a minimum but sufficient project float.
- Actively strives to optimize overall resource planning and utilization considering resources within the local organization.
- Assures a valid Quality, Environment, Health and Safety plan in place
- Considers close out activities and influences for an early close out.
- Explains to project team about the benefits of the project as seen by the Customer
- Manages planned activities including schedule difficulties accordingly.
- Identifies and shares lessons learned.

Project Planning  
& Scheduling

Customer  
Satisfaction  
Management in  
Projects

Project Financial  
& Cost  
Management

Legal & Contract  
Management for  
Projects

Project Execution  
Tracking and  
Reporting

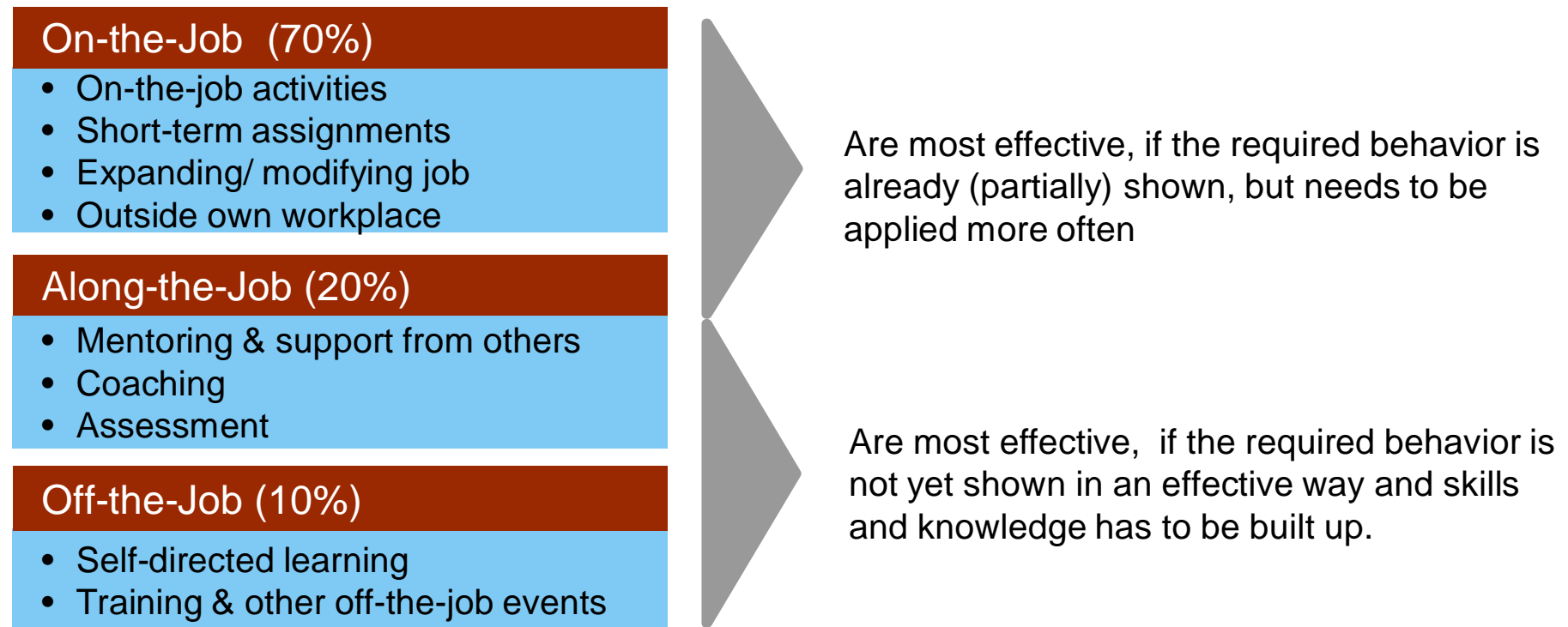
Scope & Change  
Management in  
Projects

Project Risk and  
Opportunity  
Management

Procurement  
Management for  
Projects

# Development Plan

- Research has demonstrated that most learning comes from work and life experiences. Consider the following model while developing your own Personal Leadership Development Plan to develop this competency.
- It is important to ensure that there is an appropriate balance of development actions in the development plan



# Developing Project Planning & Scheduling Competency

Type of Learning	Suggested Learning Activities
<p>On-the- Job (70%)</p> <ul style="list-style-type: none"> <li>• On-the-job activities</li> <li>• Short-term assignments</li> <li>• Expanding/ modifying job</li> <li>• Outside own workplace</li> </ul>	<ul style="list-style-type: none"> <li>• Develop &amp; deliver Lessons Learned for past 3 projects</li> <li>• Develop Work Breakdown Structure and Network Diagram for your project</li> <li>• Develop &amp; document “Traffic Signal” presentations to mark project progress &amp; explain to Project Team</li> <li>• Develop follow-up routines to update progress on activities in contract schedule.</li> </ul>
<p>Along- the- Job (20%)</p> <ul style="list-style-type: none"> <li>• Mentoring &amp; support from others</li> <li>• Coaching</li> <li>• Assessment</li> </ul>	<ul style="list-style-type: none"> <li>• Develop 3 actions for personal learning from archived lessons learned on past 3 projects</li> <li>• Identify the areas where you need coaching or mentoring.</li> </ul>
<p>Off-the-Job (10%)</p> <ul style="list-style-type: none"> <li>• Self-directed learning</li> <li>• Training &amp; other off-the-job events</li> </ul>	<ul style="list-style-type: none"> <li>• Study “Fast Forward MBA in Project Management” by Eric Verzuh</li> <li>• Study “Critical Chain” by Eliyahu Goldratt</li> <li>• ABB APM6: Project Management Video (TrainingPartner)</li> <li>• Microsoft Project or Primavera scheduling tool. Microsoft has lot of free eLearning courses in their web site.</li> <li>• ESI Project Planning Analysis &amp; Control (PPAC) or ESI Schedule &amp; Cost Control (SCC) or equivalent</li> <li>• ESI Project Management Applications (PMA)</li> </ul>

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