

Project Time Management

**FSOFT PMP Exam Prep
v1.0**



Our roles...

- I am here as a facilitator
- You are the PMP® exam candidates!



- Time management process
 - Schedule baseline
 - Schedule compression
 - Crashing
 - Fast tracking
 - Network diagram
 - Precedence diagramming method (PDM)
 - Critical path
 - Float (Slack)
 - Three-point estimating
 - Monte Carlo analysis
 - Delphi technique
 - Bar charts
 - Milestone charts
 - Schedule model
 - Schedule management plan
 - Resource optimization
- Next slide

- Critical path method
- Leads and Lags
- Resource breakdown structure (RBS)
- Reserve analysis
- Padding
- Analogous estimating
- Parametric estimating
- Heuristics
- Critical chain method
- Activity resource requirements
- Activity attributes
- Re-estimating
- Rolling wave planning
- GERT

1. Project Time Management
2. Plan Schedule Management
3. Define activities
4. Sequence activities
5. Estimate activity resources
6. Estimate activity durations
7. Develop schedule
8. Control schedule

1. Project Time Management

> Overview

- Provide scheduling framework
- Develop a schedule
- Finalize deliverable delivery dates
- Prepare base for budgeting
- Control project schedule



6.1 Plan
Schedule
Management

6.2. Define
activities

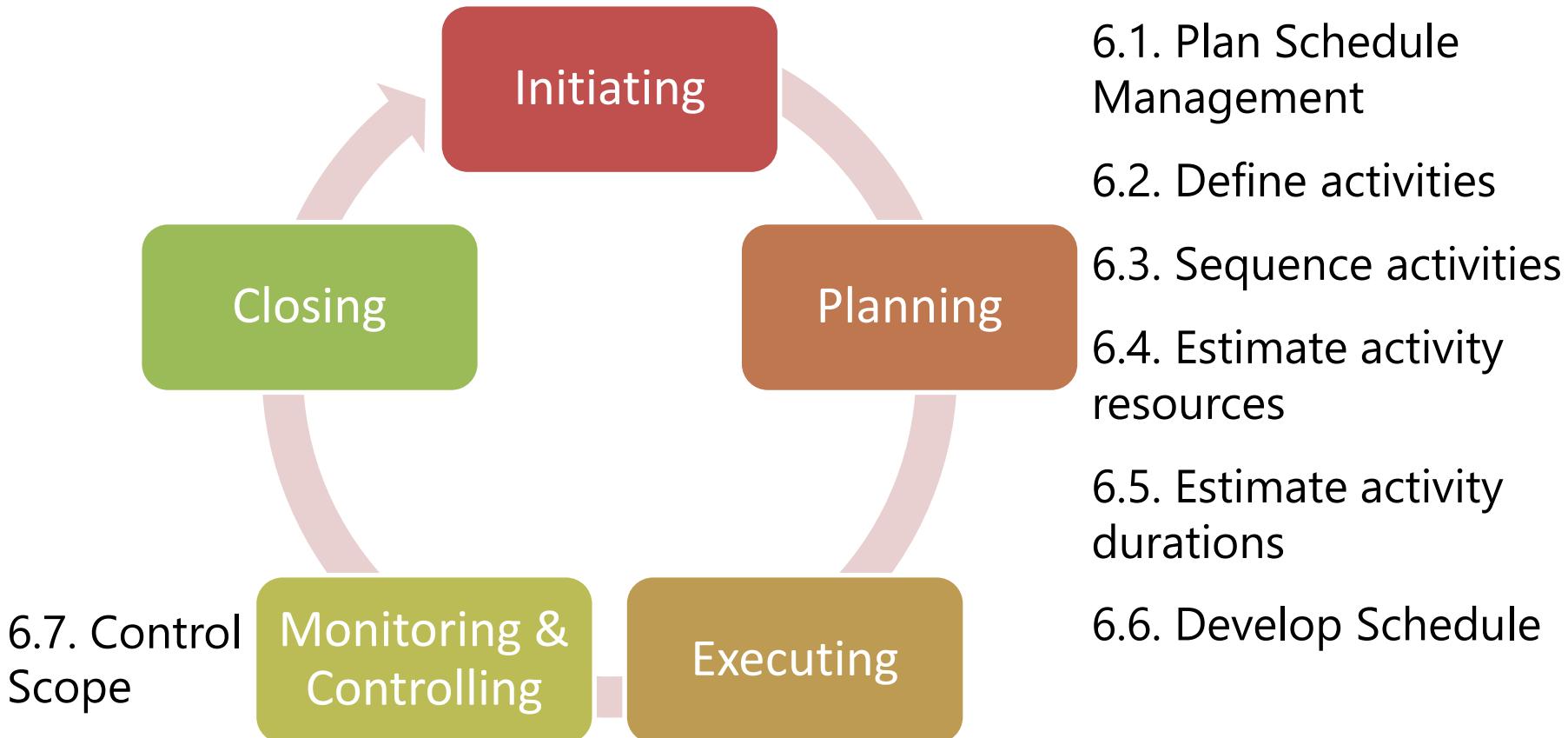
6.3. Sequence
activities

6.4. Estimate
activity
resources

6.5 Estimate
activity
durations

6.6 Develop
schedule

6.7 Control
schedule



2. Plan Schedule Management

- The process of establishing policies, procedures, & documentation for planning, developing, managing, executing, & controlling the project schedule



- Provide guidance & direction on how the project schedule will be managed

6.1. PLAN SCHEDULE MANAGEMENT



1. Project management plan
2. Project charter
2. Enterprise environmental factors
3. Organizational process assets

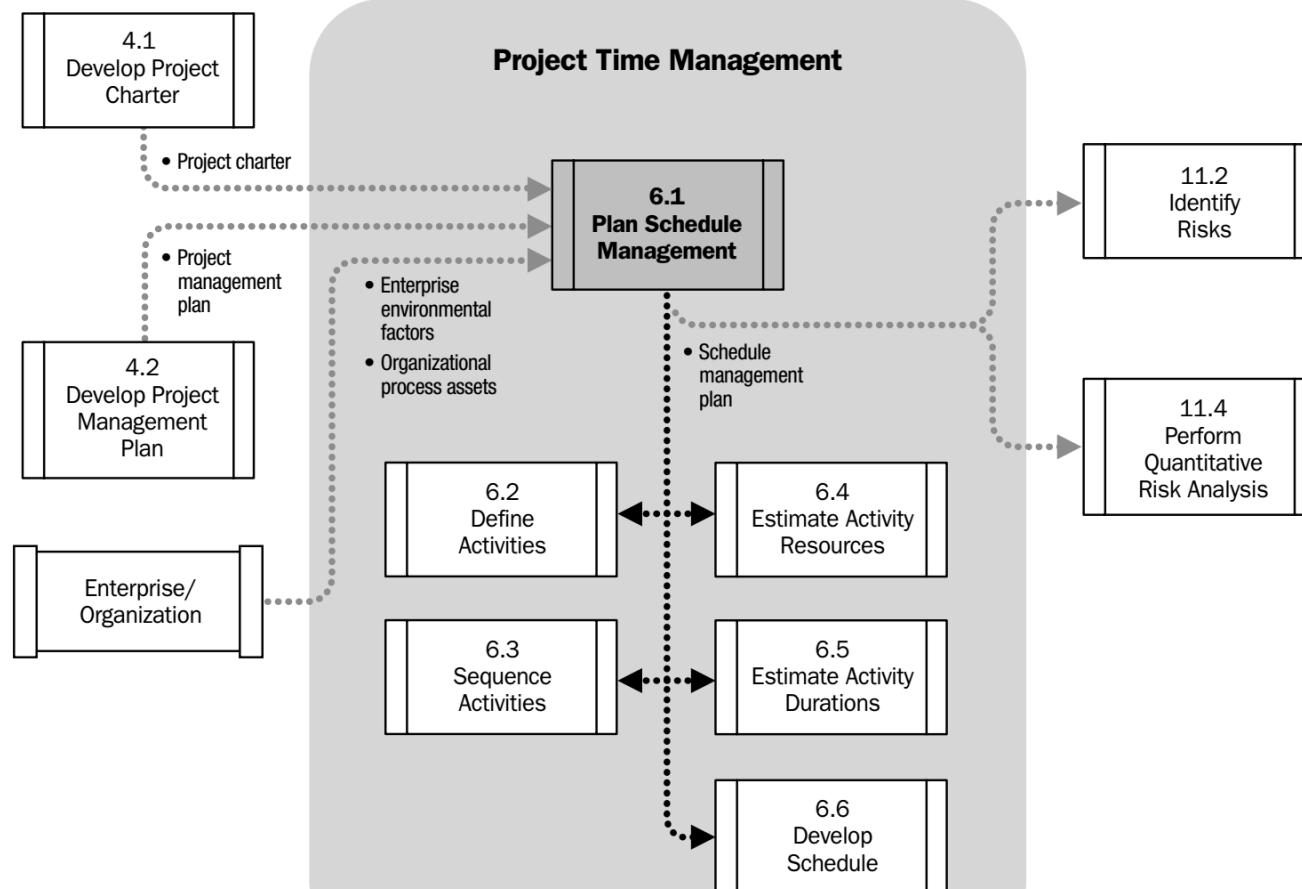


1. Expert judgment
2. Analytical techniques
3. Meetings



1. Schedule management plan

> Process Flow



> Input



1. Project management plan
2. Project charter
2. Enterprise environmental factors
3. Organizational process assets



1. Expert judgment
2. Analytical techniques
3. Meetings



1. Schedule management plan

1. Project management plan

- PMP contains the information about project execution and control.
- Other Subsidiary plans
- Scope baseline - Project scope statement, WBS, WBS dictionary
- Other information scheduling cost, risk & communication related decisions

2. Project charter

- Summary Milestone Schedule
- Project approval requirements

3. Enterprise Environmental Factors

- Org. culture & structure can all influence schedule
- Resource availability & skills
- Scheduling tool
- Published commercial information – resource productivity
- Organizational work authorization systems

4. Organizational Process Assets

- Schedule Template
- Historical information - Scheduling related lessons learned
- Monitoring and reporting tools
- Schedule control tools & related policies, procedures, guidelines

> Tool & Technique



1. Project management plan
2. Project charter
2. Enterprise environmental factors
3. Organizational process assets



1. Expert judgment
2. Analytical techniques
3. Meetings



1. Schedule management plan

1. Expert Judgment

2. Analytical techniques

- Choosing option for estimate, optimizing & controlling schedule
- Scheduling Methodology
- Scheduling techniques
 - Fast Tracking or Crashing + Lead & Lags
 - Rolling wave planning
- Resource optimizing techniques
 - Resource Levelling + Resource Smoothing
- Schedule performance review techniques
 - Earn Value Management

3. Meetings

- Project team may attend meetings
 - Project manager
 - Sponsor
 - Selected team members
 - Selected stakeholders
- Any one with scope related responsibilities should attend meetings



> Output



1. Project management plan
2. Project charter
2. Enterprise environmental factors
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1. Expert judgment
2. Analytical techniques
3. Meetings



1. Schedule management plan

1. Schedule management plan

- It establishes criteria & activities for developing, monitoring and controlling the project schedule.
 - Project Schedule Model Development & maintenance
 - Scheduling techniques
 - Resource optimizing techniques
 - Schedule Control thresholds
 - Rules of Performance measurement
 - Reporting formats

1. Schedule management plan
 - Rules of performance measurement
 - Earned value management (EVM) rules
 - Physical measurement rules
 - Ex: Schedule management plan may specify
 - Rules for establishing percentage complete
 - Rules for Control accounts
 - Earned value measurement techniques (Baselines, fixed-formula, % complete, etc.)

The only way
to do great
work
is to love what
you do.

- Steve Jobs

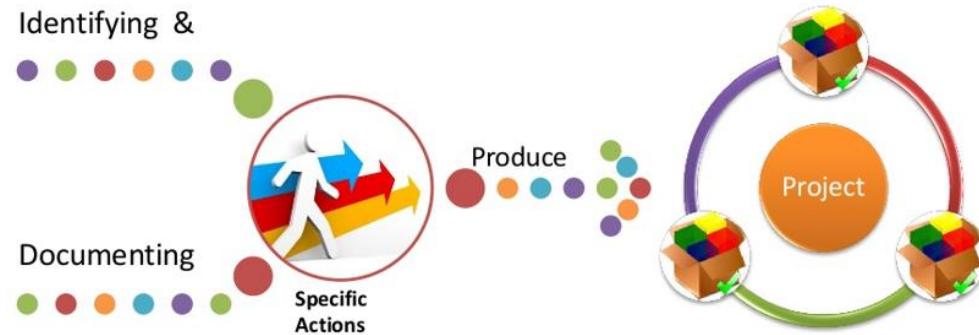


3. Define activities

- Consider Project to laydown 50 KM water Pipeline in difficult terrain
- It is huge task & will involve lot of planning & coordination
- **How do we execute this ?**
 - ➔ Start identifying all activities of each work package in WBS
 - ➔ Also, think about the key milestones.

> Overview

- Identifying & documenting specific actions to be performed to produce project deliverables



- It break down work packages into activities that provide a basis for estimating, scheduling, executing, monitoring & controlling project work



6.2. DEFINE ACTIVITIES



1. Schedule management plan
2. Scope baseline
3. Enterprise environmental factors
4. Organizational process assets

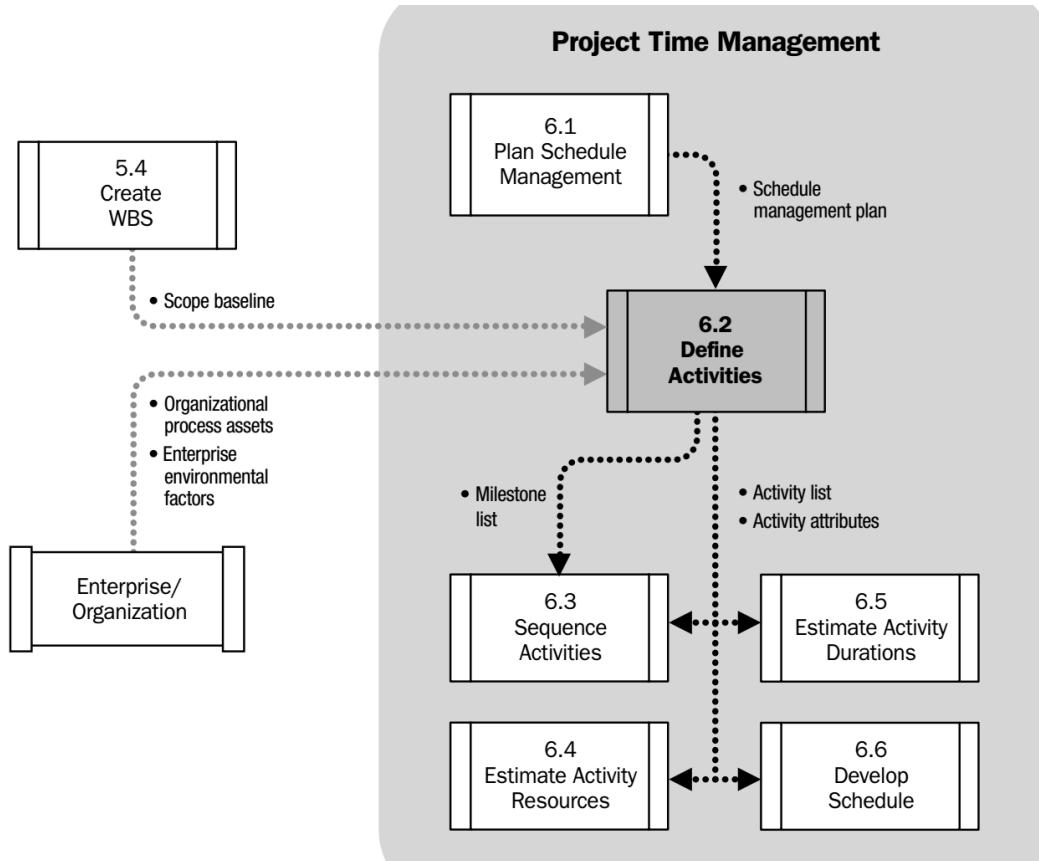


1. Decomposition
2. Rolling wave planning
3. Expert judgment



1. Activity list
2. Activity attributes
3. Milestone list

> Process Flow



> Input



1. Schedule management plan
2. Scope baseline
3. Enterprise environmental factors
4. Organizational process assets



1. Decomposition
2. Rolling wave planning
3. Expert judgment



1. Activity list
2. Activity attributes
3. Milestone list

1. Schedule management plan

- The key input from SMP is the prescribed level of details necessary to manage the work.
- Guideline to define activities (e.g. max duration)
- Organizational policies & procedure

2. Scope baseline

- Project scope statement
- WBS
- WBS dictionary

3. Enterprise Environmental factors

- Organizational culture & structure
- published Commercial information
- Project Management Information System (PMIS)

4. Organizational process assets

- Lessons learned about activity list
- Standardized processes
- Templates with standard activity list
- Activity planning & definition related policies, procedures & guidelines

> Tool & Technique



1. Schedule management plan
2. Scope baseline
3. Enterprise environmental factors
4. Organizational process assets



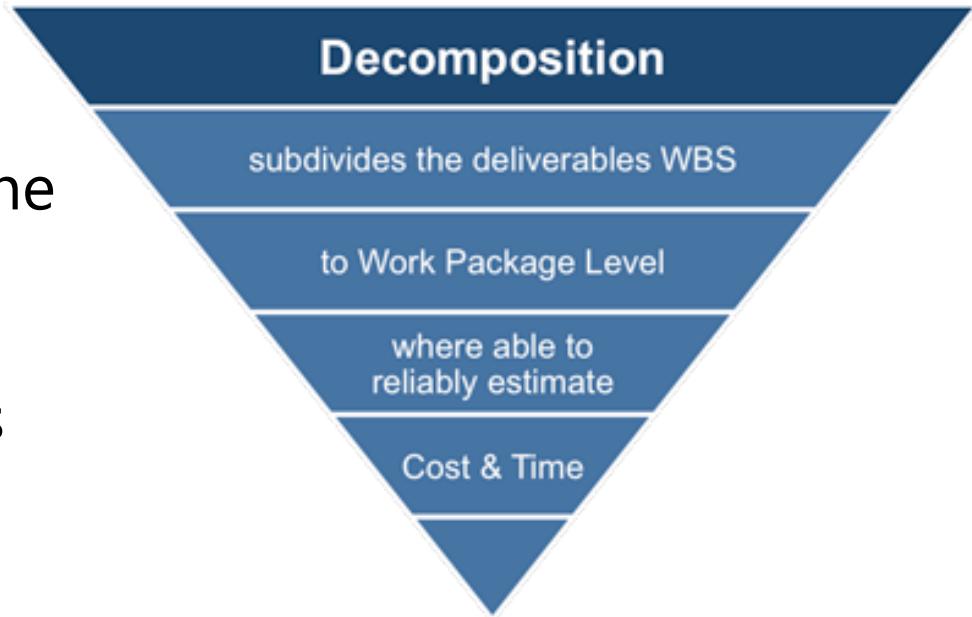
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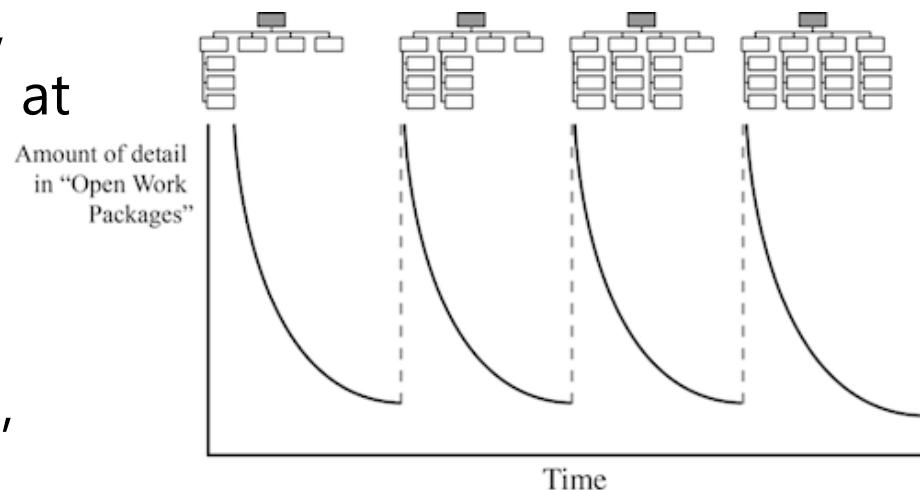
1. Decomposition

- A technique used for dividing & sub-diving the project scope & deliverables in smaller, more manageable parts



2. Rolling wave planning

- An iterative planning technique in which work to be accomplished in near term is planned in details, while work in future is planned at a higher level.
- It is a form of progressive elaboration.
- As more is known in near term, work packages can be decomposed further



3. Expert judgment

- Person experienced & skilled in developing detailed
 - Project scope statement
 - WBS
- Who's should define activities
 - Person responsible to execute them

> Output



1. Schedule management plan
2. Scope baseline
3. Enterprise environmental factors
4. Organizational process assets



1. Decomposition
2. Rolling wave planning
3. Expert judgment



1. Activity list
2. Activity attributes
3. Milestone list

1. Activity List

- A list of all activities that will be performed on project. Also, unique id & description for each activity

Activity ID	WBS Id	Name
501	W50	Compare Furniture brands
502	W50	Find showrooms
503	W50	Get Quotes
504	W50	Compare Quotes

- Complete activity list helps in accurate estimation & project schedule
- Refer to [Template\3.9_Activity List.doc](#)

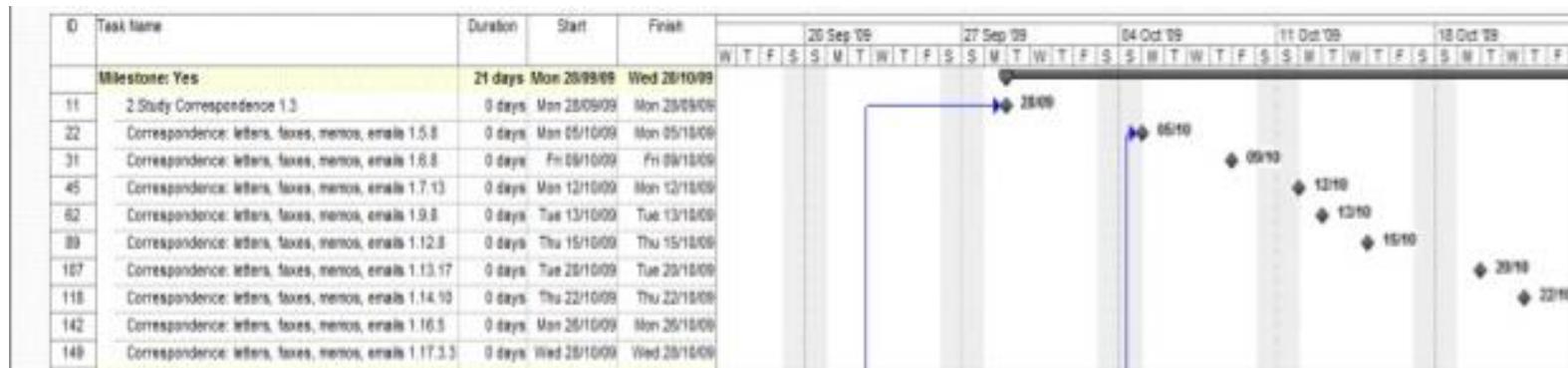
2. Activity attributes

- During the initial stages of the project, they include
 - Activity identifier (ID) + WBS ID
 - Activity label or name
 - When completed they may include
 - Refer to [Template\3.10 Activity Attributes.doc](#)



3. Milestone list

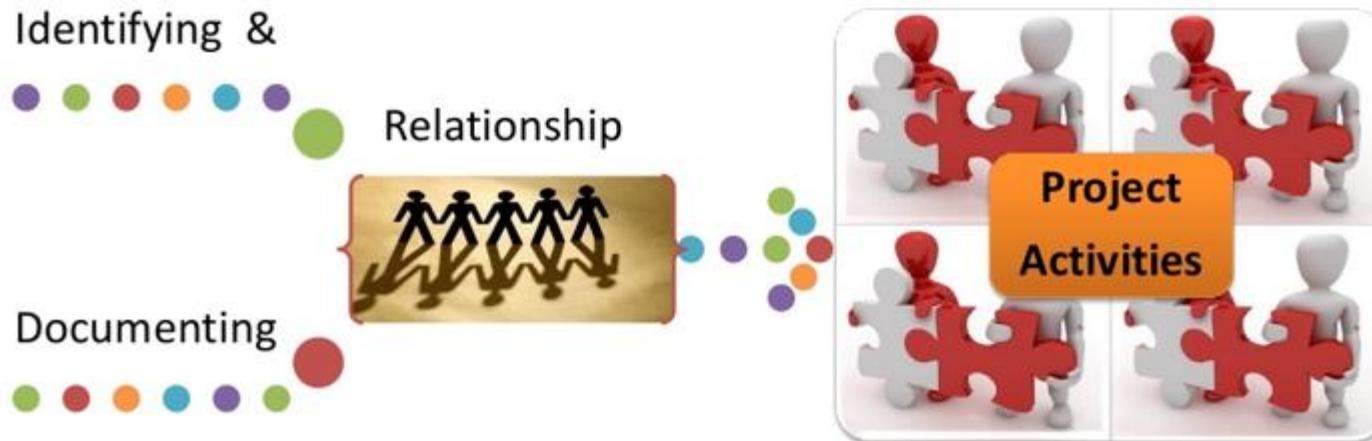
- A milestone is a significant point in project.
- Used for setting schedule goals & monitoring progress



- Maybe mandatory (contractual), or just guidance.
- Zero duration & no resources

4. Sequence Activities

- The process of identifying and documenting relationships among the project activities



- It defines the logical sequence of work to obtain the greatest efficiency, given all project constraints

6.3. SEQUENCE ACTIVITIES



1. Schedule management plan
2. Activity list
3. Activity attributes
4. Milestone list
5. Project scope statement
6. Enterprise environmental factors
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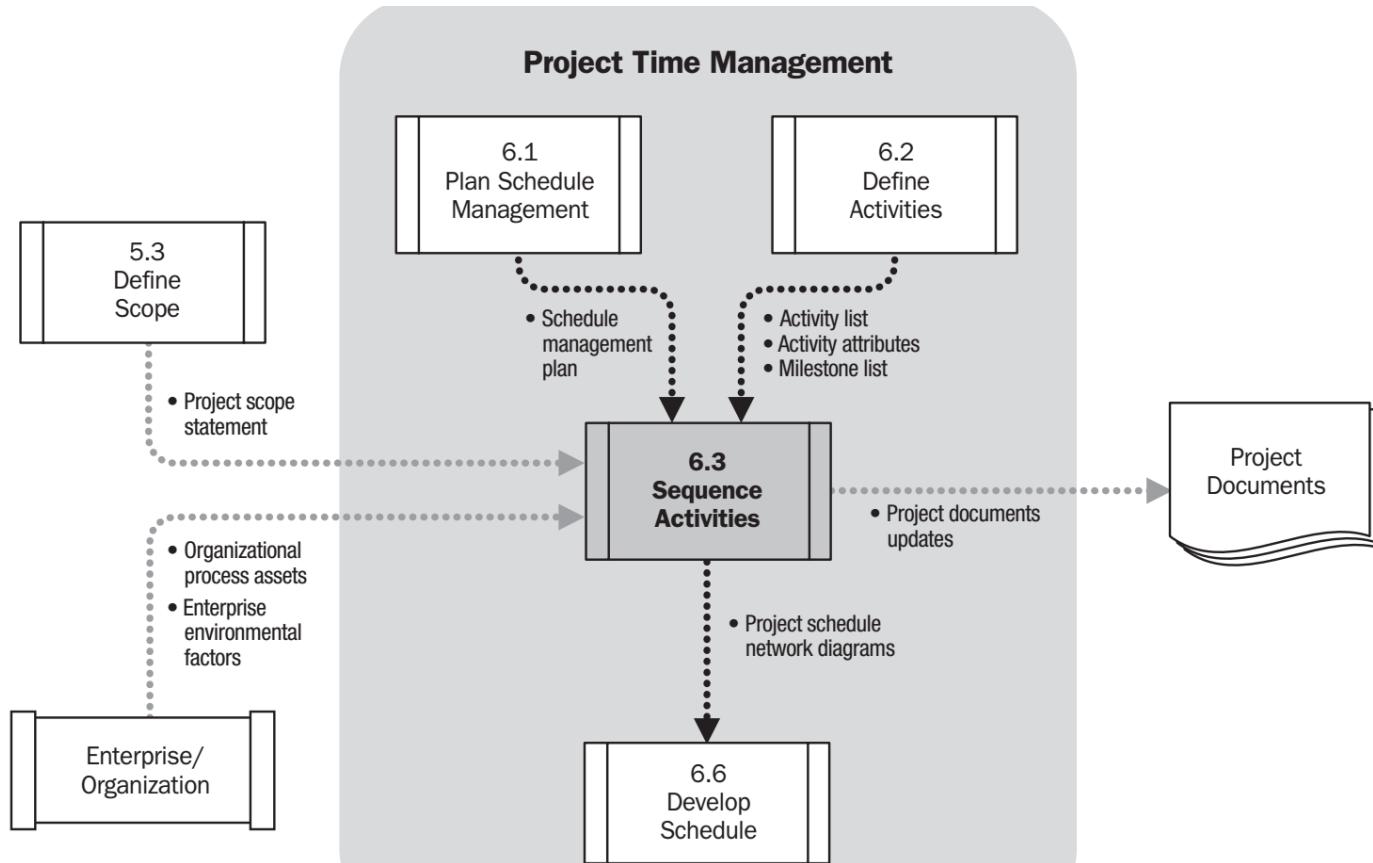


1. Precedence diagramming method (PDM)
2. Dependency determination
3. Leads and lags



1. Project schedule network diagrams
2. Project document updates

> Process Flow



> Input



1. Schedule management plan
2. Activity list
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1. Precedence diagramming method (PDM)
2. Dependency determination
3. Leads and lags



1. Project schedule network diagrams
2. Project document updates

1. Schedule management plan
 - It identifies scheduling method & tools to be used for the project, which will guide how the activities may be sequenced.
2. Activity list
 - All schedule activities required which are to be sequenced
 - Dependencies & constraints can influence sequencing

3. Activity attributes

- It describes necessary sequence of events or defined predecessor & successor activities

4. Milestone list

- It will have schedule date for specific milestone, which may influence the way activities are sequenced.

5. Project scope statement

- Scope statement contains product scope description that may effect activity sequencing. Deliverables, constraints, assumption also may effect sequencing

6. Enterprise environment factors

- Govt. or Industry standards, PIMS, scheduling tool, Work authorization system

7. Organizational process assets

- Scheduling methodology, activity planning related policies, procedures guidelines.

> Tool & Technique



1. Schedule management plan
2. Activity list
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1. Precedence diagramming method (PDM)

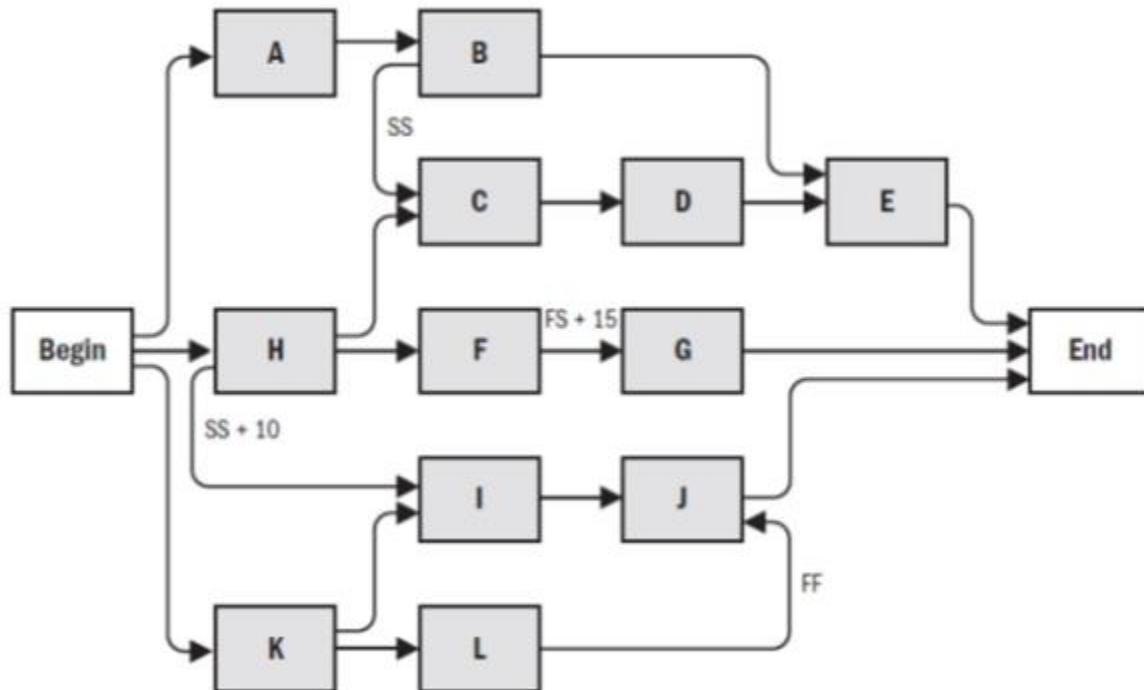
- It is a method of constructing a project schedule network diagram that uses boxes(nodes), to represent activities & connects them with arrows that show dependencies
 - Activities are represented by boxes.
 - Arrows show relationships between activities
 - More popular than ADM method & used by PM software
 - Better at showing different types of dependencies

1. Precedence diagramming method (PDM)

- It is a method of constructing a project schedule network diagram that uses boxes(nodes), to represent activities & connects them with arrows that show dependencies
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1. Precedence diagramming method (PDM)

Early Start	Duration	Early Finish
Task name		
Late Start	Slack	Late Finish



1. Precedence diagramming method (PDM)
 - Logical relationships
 - **Finish to Start (A-FS->B)**: Task B can not start until Task A finishes
 - **Start to Start (A –SS->B)**: Task B can not start until Task A starts
 - **Finish to Finish (A-FF->B)**: Task B can not finish until Task A finishes
 - **Start to Finish (A-SF->B)**: Task B can not finish until Task A starts

2. Dependency determination

– Internal dependency

- Precedency relationship defined between two project activities
- Done by internal team member. Inside project team control

– External dependency

- Relationships between project and non-project activities
- Activities are done by external people
- Outside project control

2. Dependency determination

– Mandatory dependency

- Also known as Hard logic
- Legally or contractually required
- Inherent in the nature of work

– Discretionary dependency

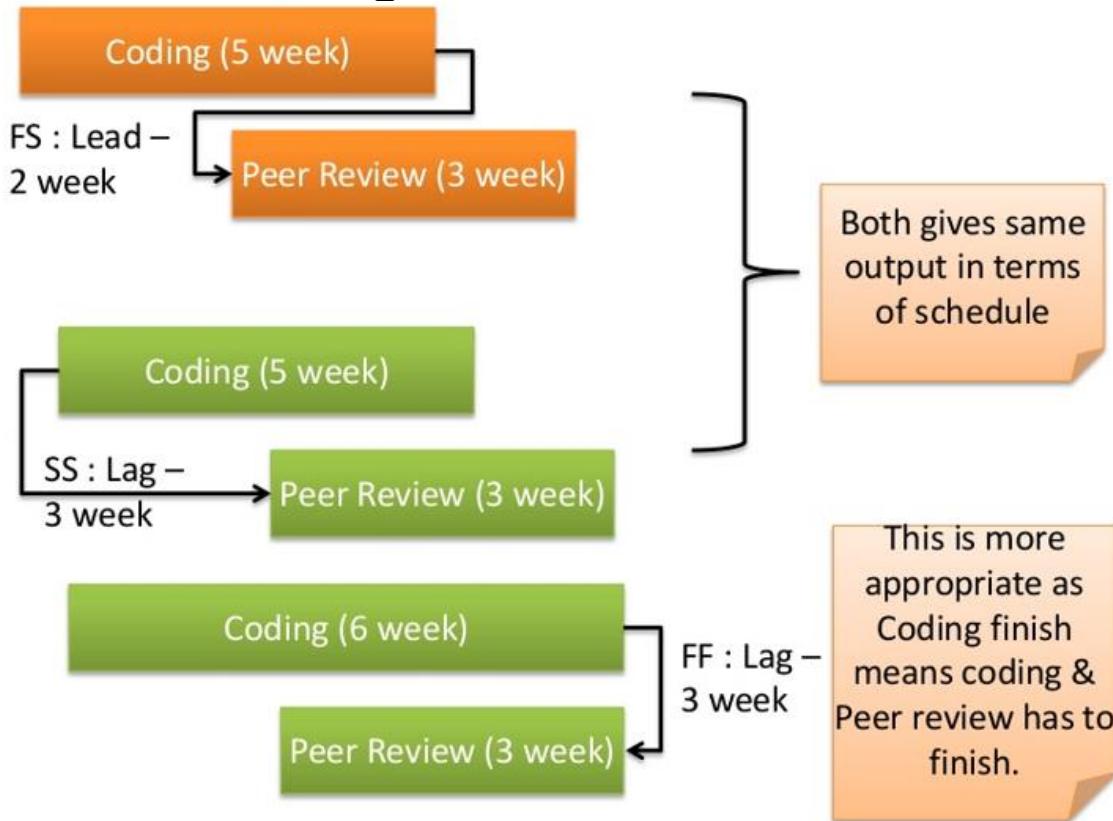
- Could be more one way to define the sequence between 2 activities
- Based on best practices
- Defined by project team

3. Leads and lags

- Lead: It is amount of time where successor activity can be advanced with regard to predecessor activity.
- Lag: It is amount of time whereby a successor activity will be delayed with regard to a predecessor activity.



3. Leads and lags



> Output



1. Schedule management plan
2. Activity list
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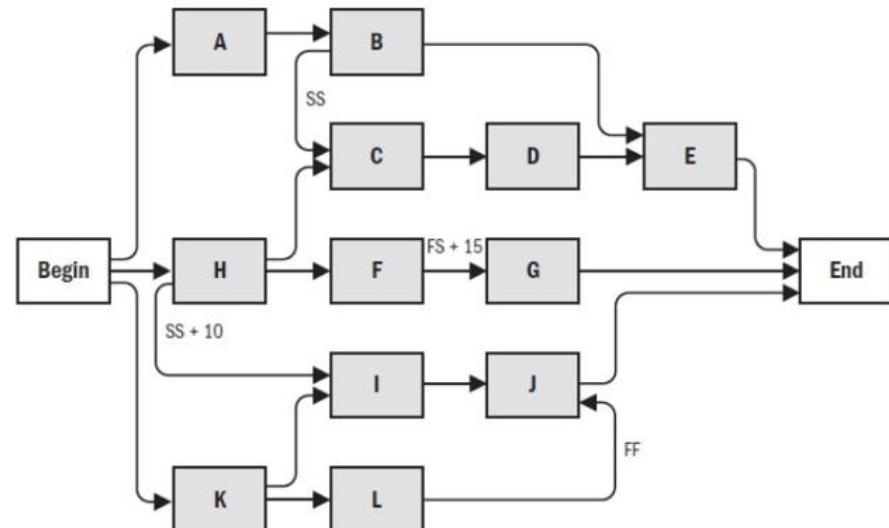
1. Precedence diagramming method (PDM)
2. Dependency determination
3. Leads and lags



1. Project schedule network diagrams
2. Project document updates

1. Project schedule network diagrams

- It is a graphical representation of logical relationship between activities
- Shows dependencies among schedule activities



1. Project schedule network diagrams
 - Schedule network template
 - Will be generated once all activities are sequenced & relationship/dependencies are set
 - Templates can be used from similar projects
 - Developed by accumulating lesson learned
 - Used for entire project or portion of a project

2. Project document updates

- Activity lists
 - New activities identified during sequencing
- Activity attributes
 - New attribute identified
 - Change in attributes of older activities
- Risk register
 - Risk identify due to dependencies
- Schedule management plan
 - Any change in scheduling process

5. Estimate activity resources

- Estimating type & quantities of material, human resources, equipment, or supplies required to perform each activity
- Estimating
 - Type & Quantities
 - Material + Human resources
 - Equipment + Suppliers
 - Perform
 - Project Activities
- It helps more accurate cost and duration estimates.

> Overview

- Key Factors
 - Complexity
 - Resource skills
 - Resource availability
 - History of performing similar task





6.4. ESTIMATE ACTIVITY RESOURCES



1. Schedule management plan
2. Activity list
3. Activity attributes
4. Resource calendars
5. Risk register
6. Activity cost estimates
7. Enterprise environmental factors
8. Organizational process assets

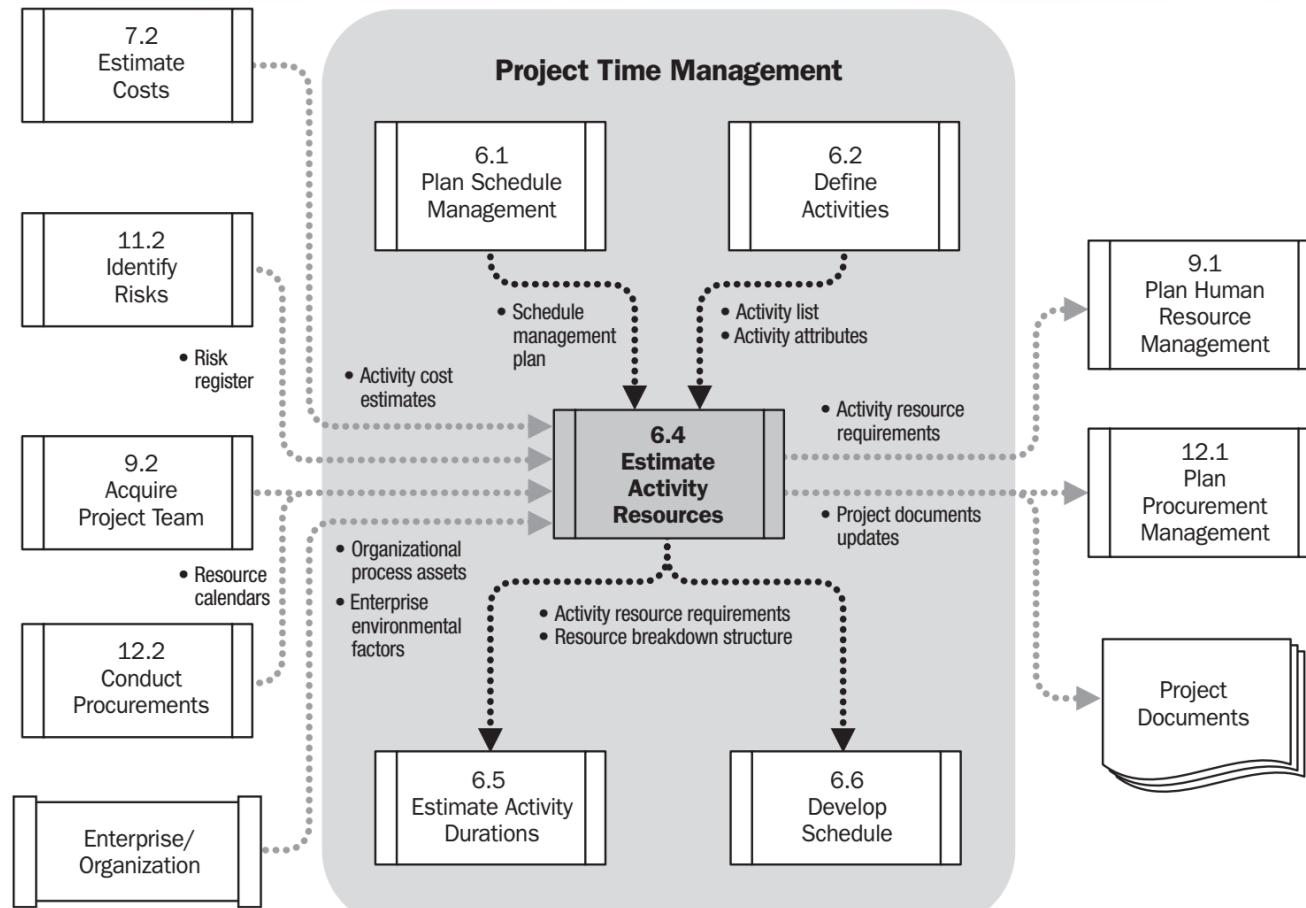


1. Expert judgment
2. Alternatives analysis
3. Published estimating data
4. Bottom-up estimating
5. Project management software



1. Activity resource requirements
2. Resource breakdown structure
3. Project document updates

> Process Flow



> Input



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1. Expert judgment
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1. Activity resource requirements
2. Resource breakdown structure
3. Project document updates

1. Schedule management plan

- It establishes criteria & activities for developing, monitoring and controlling the project schedule.
- Project Schedule Model Development
- Level of accuracy
- Unit of measure (Hour, Day etc.)
- Control thresholds

2. Activity list

- A list of all activities that will be performed on project & a description of each activity

3. Activity attributes

- Refer to [Template\3.10 Activity Attributes.doc](#)

4. Resource calendars

- Identifies working days & shifts on which each specific resource is available.
- Details about when & how long identified project resource will be available
- **Remember:** Resource may be material, human resources, equipment etc.

5. Risk register

- Risk events may impact resource selection and availability.
- Risks related to activity sequencing, dependencies
- Refer to [Template\3.29 Risk Register.doc](#)

6. Activity cost estimates

- Provides probable costs required to complete activities / project work. (summary or detail)
- It's output of estimate cost process of Project Cost Management
- Estimate cost uses Scope baselines & Project schedule as input
- Analogues, parametric or three point estimation are used
- Refer to [Template\3.19 Cost Estimating Worksheet.xls](#)

7. Enterprise environmental factors

- Resource
 - Location
 - Availability and skills

8. Organizational process assets

- Policies, procedures regarding staffing
- Policies, procedures relating to rental and purchase
- Historical information – type of resources used for similar work on previous projects

> Tool & Technique



1. Schedule management plan
2. Activity list
3. Activity attributes
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1. Activity resource requirements
2. Resource breakdown structure
3. Project document updates

1. Expert judgment

- Specialized knowledge in resource planning & estimating can provide such expertise
- Can help in choosing right resource
- Identify activity resource requirement
- Can perform or contribute in estimating & alternative analysis

2. Alternatives analysis

- Many schedule activities have alternative methods of accomplishment
- Analyze focus on:
 - Various level of resource capability or skills
 - Different size or type of machines
 - Different tools (hand versus automated)
 - Make – rent – or buy decisions regarding the resource

3. Published estimating data

- Production rates & unit costs of resources, material, and equipment.
- Data from different countries and geographical locations
 - Unit cost + Material + Labor trade
 - Rates + Equipment

4. Bottom-up estimating

- Estimating resources or cost by aggregating estimates of lower-level components of WBS
- Activities are broken into smaller activities which can be estimated
- The resource needs are estimated
- Resources are assigned to each activity
- These estimates are aggregated into a total quantity of resources or cost

5. Project management software

- Project Management Software has capability to:
 - Plan, organize & manage the resource pools
 - Develop resource estimates
- Optimizing Resource utilization
 - Resource breakdown structure - Resource availability
 - Resource rate - Resource calendar
- Management software
 - Can automatically resolve scheduling conflict, can compare Schedule baselines, can highlight delayed tasks; can help perform workload analysis; can help optimize resource utilization

> Output



1. Schedule management plan
2. Activity list
3. Activity attributes
4. Resource calendars
5. Risk register
6. Activity cost estimates
7. Enterprise environmental factors
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1. Expert judgment
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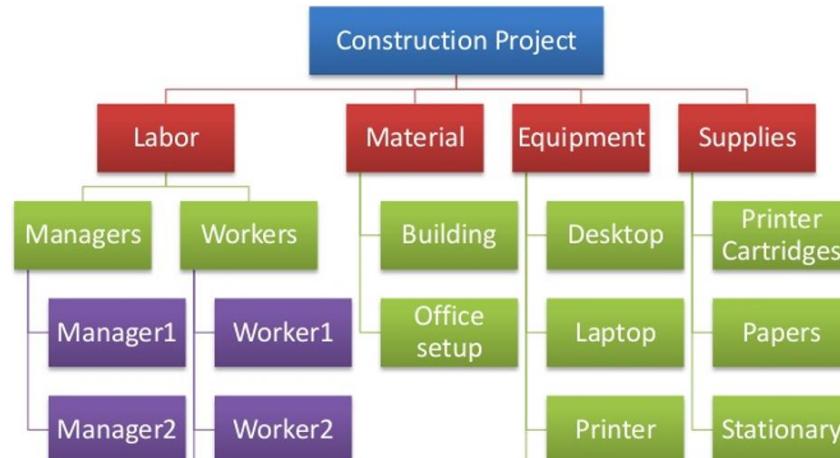
1. Activity resource requirements
2. Resource breakdown structure
3. Project document updates

1. Activities resource requirements

- The types and quantities of resources required for each activity in a work package.
- Aggregated to determine the estimated resources for each work package and each work period.
- **Resource Type/ Activity + Resource Quantity/ Activity = Resource for Work Package**
- Basis for resource identification & allocation
- Estimation Assumption

2. Resource breakdown structure

- Hierarchical representation of resources by category and type
- RBS is useful for organizing & reporting project schedule data with resource utilization information



3. Project document updates

- Activity lists
 - Activities identified during process
- Activity attributes
 - Attribute for new activities
 - Change in attributes of older activities
- Risk register
 - Resource related risk
- Resource calendars
 - Update project & resource calendar

6. Estimate activity durations

- Estimating number of work periods needed to complete each activity with estimated resources
 - Estimating
 - Work periods per activity
 - With estimated resources
- It is a major input to Develop Schedule process

- Efforts
 - Labor units required to complete activity; Expressed in Hours, Days or Weeks
- Duration (Work days or work weeks)
 - Total time (work periods) to complete the activities based on the resources availability; Does not include holidays & waiting periods
- Elapsed time
 - Calendar time required to complete activities based on resource availability & including holidays
- Example: Painting a house
 - Effort: 20 days; Duration: 10 days with 2 resources; Elapsed time: 15 days (includes 2 weekends & 1 day holiday by resources)



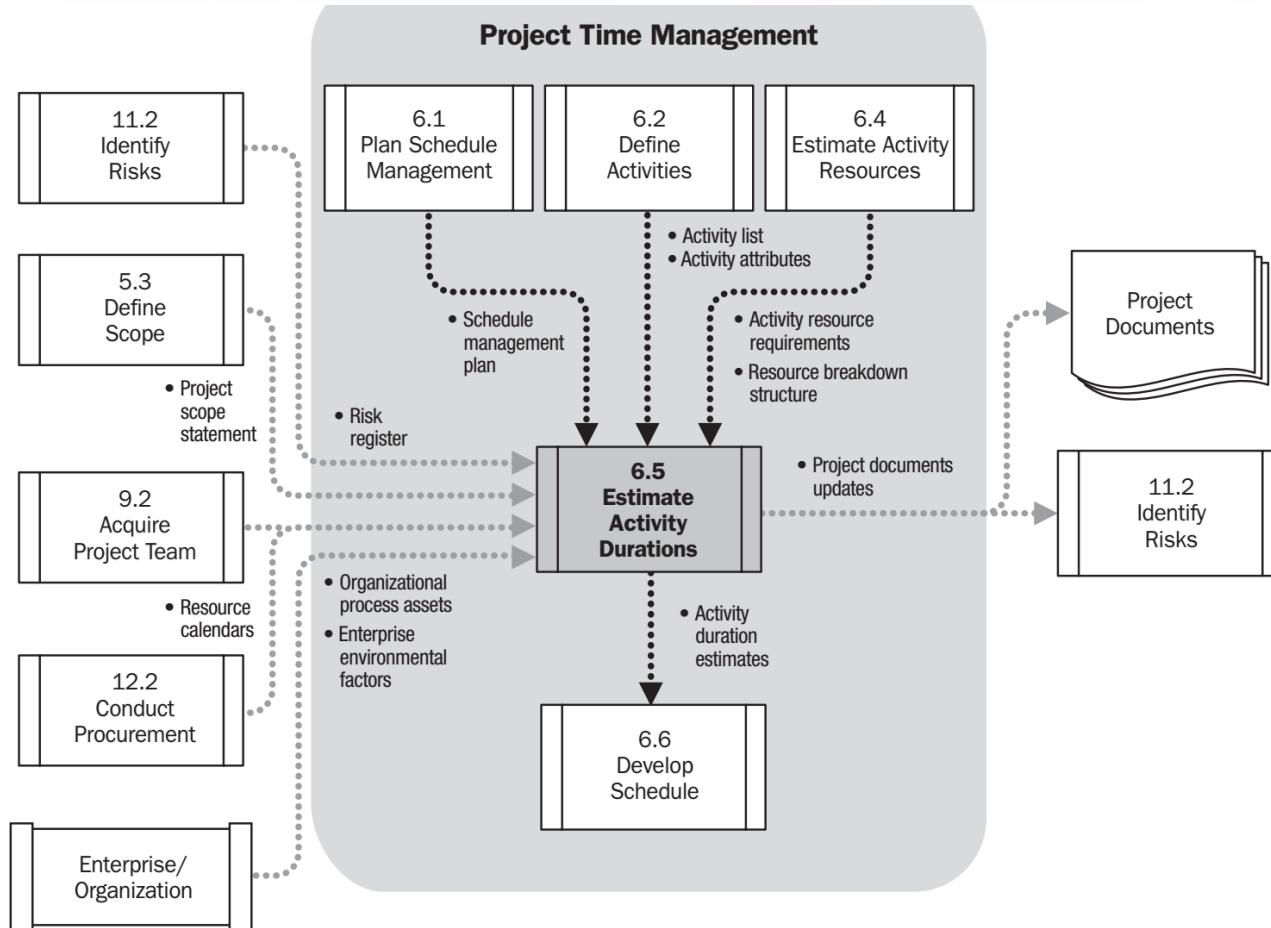
6.5. ESTIMATE ACTIVITY DURATIONS

- 
1. Schedule management plan
 2. Activity list
 3. Activity attributes
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 6. Project scope statement
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 9. Enterprise environmental factors
 10. Organizational process assets

- 
1. Expert judgment
 2. Analogous estimating
 3. Parametric estimating
 4. Three-point estimates
 5. Group decision-making techniques
 6. Reserve analysis

- 
1. Activity duration estimates
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> Process Flow



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1. Activity duration estimates
2. Project document updates

1. Schedule management plan
2. Activity list
 - List of all activities under each work package
3. Activity attributes
 - Additional details of activities, which are useful for estimation
4. Activity resource requirements
 - The types and quantities of resources required for each activity in a work package; Aggregated to determine resource estimation for each work package
5. Resource calendars

6. Project scope statement

- It provides description of the project scope, major deliverables and assumptions & constraints

7. Risk register

- Concerns with results or Risk analysis & response planning
- Refer to [Template\3.29 Risk Register.doc](#)

8. Resource breakdown structure

- Hierarchical representation of resources by category or type
- Used for searching resources

6. EEF

- Duration estimating databases & other reference data
- Productivity metrics
- Published commercial information
- Location of team members

7. OPA

- Historical duration information
- Project calendars
- Scheduling methodology
- Lessons learned

> Tool & Technique



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1. Expert judgment
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1. Activity duration estimates
2. Project document updates

1. Expert judgment

- All estimations should be done by Experts.
- Expert can be internal or external.
- Complex project need many experts.
- Uses experience of similar projects or instinct.
- Experts are
 - SME
 - Technical Lead
 - Solution Architect
 - Quality expert

2. Analogous estimating

- Estimate duration of activity using historical data from a similar activity or a project
- Uses historical information, expert judgment
- Think “analogy” – something similar
- Relatively quick and low cost
- It is gross value estimation approach
- Parameters used:
 - Duration; Budget; Size; Weight; Complexity

2. Analogous estimating (cont.)

- Used when:
 - Limited information is available
 - Similar project information available
 - Experienced estimator



Computer Lab in School A



Computer Lab in School B

Similar

3. Parametric estimating

- Algorithm is used to calculate duration based on Historical data & project parameters
- Uses statistical relationship between historical data & other variables
- Can be highly accurate based on:
 - Accurate historical data.
 - Sophistication & scalability of model.
 - Quantifiable parameters

4. Three point estimates

- Estimate duration by applying an average of optimistic, pessimistic & most likely estimates when there is uncertainty in estimates
- This is also called as PERT techniques (Program Evaluation and Review Technique). PERT formulas are as below
- Triangular Distribution = $(O + M + P) / 3$
- Beta Distribution (Weighted average) = $(O + 4M + P) / 6$

Estimation Discussion meeting



What's efforts required for activity1:
Optimistic = 10 hours (coding guru)
Most likely = 12 hours (Regular prog.)
Pessimistic = 16 hours (New prog.)

Triangular

- $= 10+12+16 / 3$
- $= 12.66 \text{ hours}$

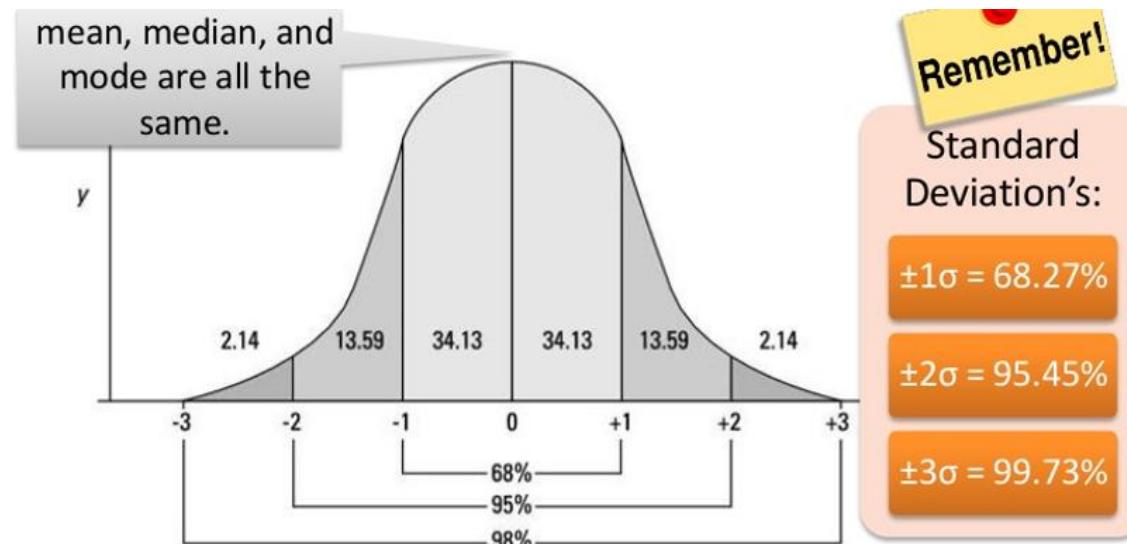
Beta

- $= [10 + (4 \times 12) + 16] / 6$
- $= 12.33 \text{ hours}$

4. Three point estimates (cont.)

- Standard deviation represents the distance a given point is from the mean. It is also called sigma, or s.
- $SD = (P - O)/6$
- This is really an approximation of standard deviation.

SD calculation/formula in Quality theories like Six Sigma is different



4. Three point estimates (cont.)

- Variance Formula is used if you trying to get the estimate for the whole project
- Activity variance (AV) = SD * SD
- Steps
 - Get the total of the estimates for all activities along the critical path
 - Take the variance for each activity
 - Sum them up across the whole project
 - Take the square root
- AV is square root of sum of total activity variance
- SD for project as a whole is sum of all AV's

5. Group decision-making techniques

- Assessment process with multiple alternatives with an expected outcome in the form of future actions
- Brainstorming: To generate and collect Multiple ideas related to estimation
- Delphi Techniques: Structured communication technique developed as systematic, interactive forecasting method which relies on a panel of experts
- Nominal group techniques: Enhances brainstorming with a VOTING process used to rank the most useful ideas for further brainstorming or for prioritization

6. Reserve analysis

- Contingency reserves (time reserves or buffers) are used in schedule to account schedule uncertainty
- PM has to use reserve to protect baseline & constantly reduce or eliminate it
- Quantitative analysis like Monte Carlo can be used to identify reserves
- Reserve can be @
 - Activity Level Work package level
 - Can be fixed amount Can be % of the estimates

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3. Parametric estimating
4. Three-point estimates
5. Group decision-making techniques
6. Reserve analysis



1. Activity duration estimates
2. Project document updates

1. Activity duration estimates

- It is important to properly communicate estimates
- Estimates should be given in range
- State the confidence level
- Refer to [Template\3.15 Activity Duration Estimates.xls](#)

2. Project document updates

- Activity attributes
 - Duration estimates + Basis of estimates
- Risk register
 - Assumptions + Contingencies

**“In order to succeed,
your desire for success
should be greater than
your fear of failure”**

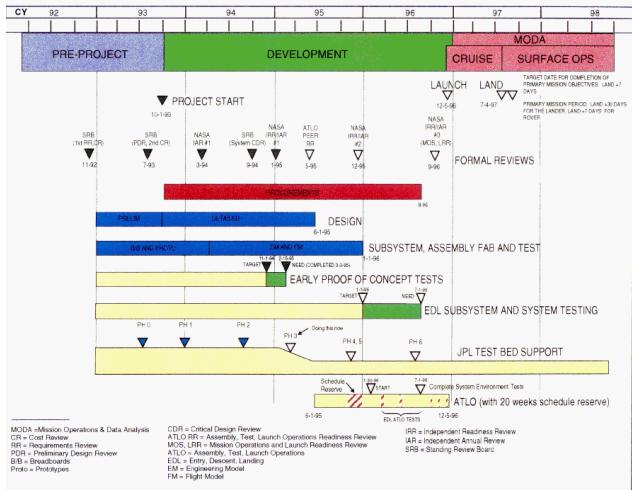


www.thequotes.in

7. Develop Schedule

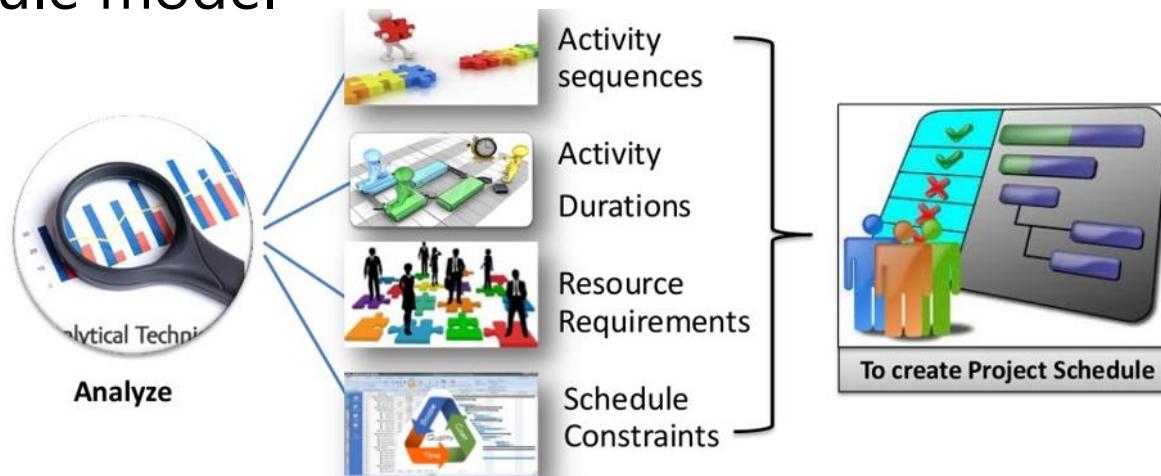
> Overview

- Enter
 - Use existing Schedule model(template)
 - Update with information from previous processes (Activity, sequencing, resources, Duration etc.)
- Optimize
 - Developed Project schedule model
 - Optimize schedule by Resource leveling/smoothing, resource crashing/Fast tracking etc.



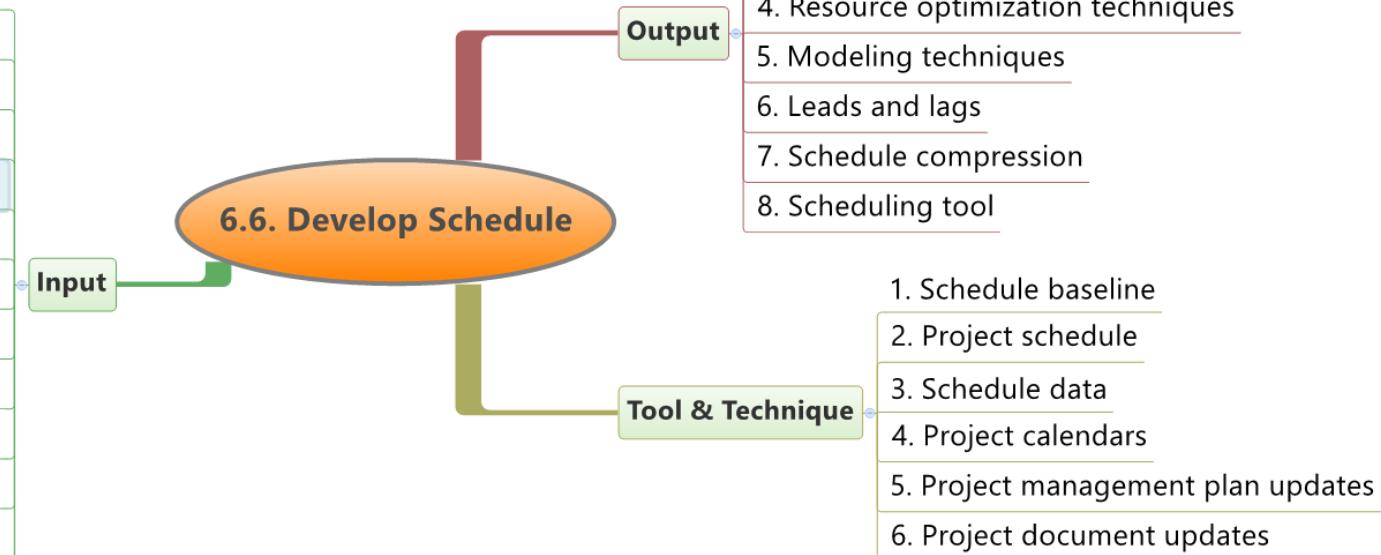
> Overview

- Analyzing activity sequences, durations, resource requirements & schedule constraints to create project schedule model

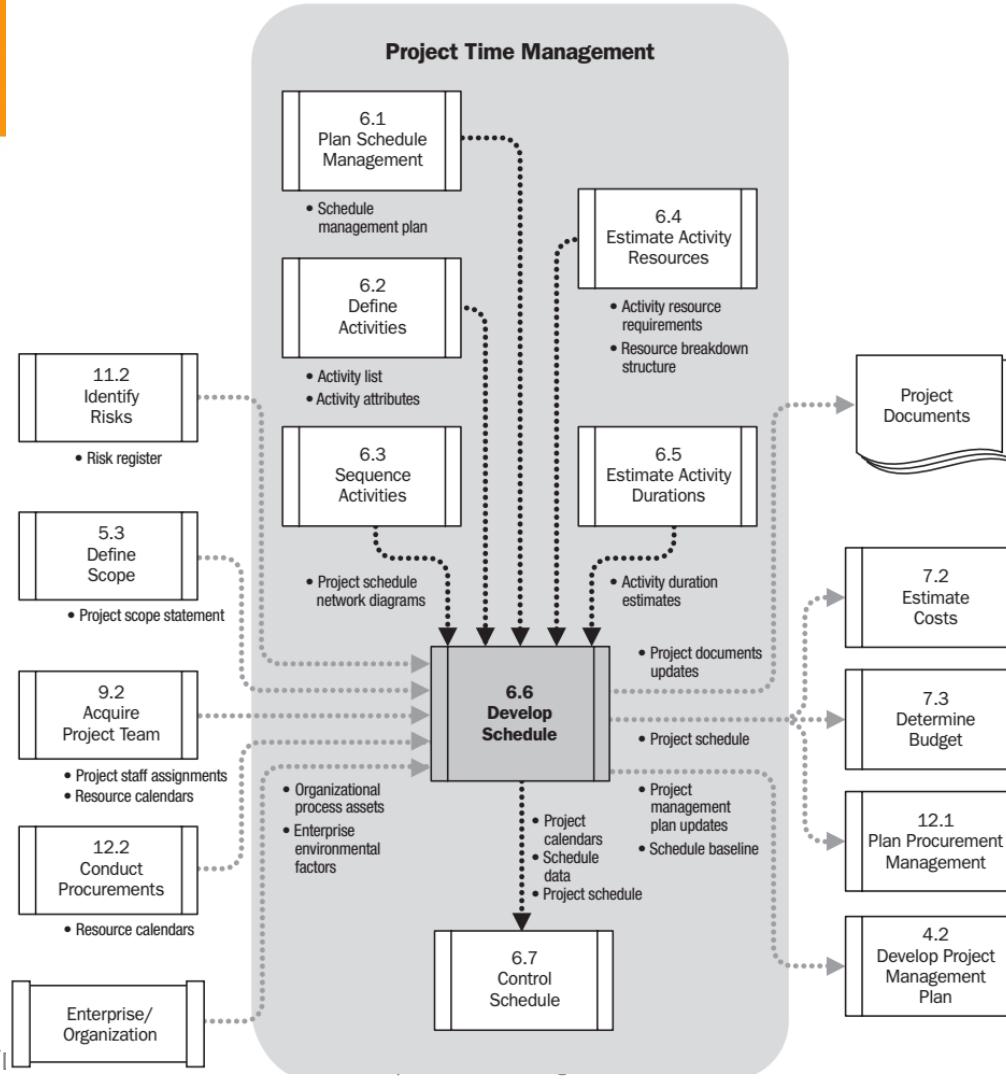


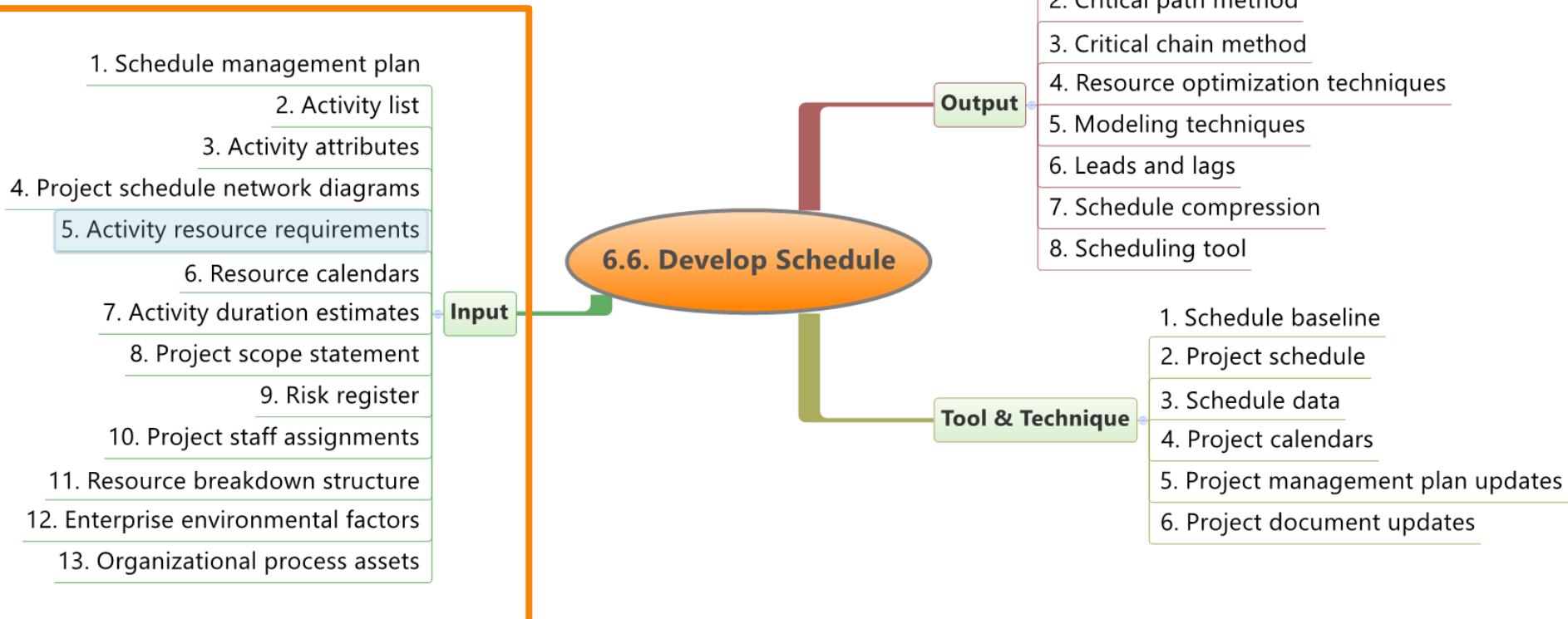
- It generates schedule model with planned dates for completing project activities

- 1. Schedule management plan
- 2. Activity list
- 3. Activity attributes
- 4. Project schedule network diagrams
- 5. Activity resource requirements
- 6. Resource calendars
- 7. Activity duration estimates
- 8. Project scope statement
- 9. Risk register
- 10. Project staff assignments
- 11. Resource breakdown structure
- 12. Enterprise environmental factors
- 13. Organizational process assets



> Process Flow





1. Schedule management plan
 - Scheduling method
 - Tool to be used & Schedule model etc.
2. Activity list
 - List of all activities to be included in the schedule model
 - Refer to [Template\3.9 Activity List.doc](#)
3. Activity Attributes
 - Detailed activity information that will be helpful to develop schedule
 - Refer to [Template\3.10 Activity Attributes.doc](#)

4. Project schedule network diagrams
 - Graphically shows activity dependencies
 - Shows predecessors and successors
5. Activity resource requirements
 - Resource type & quantity
6. Resource calendars
 - Holidays, resource vacations, resource availability
7. Activity duration estimates
 - Work periods required to complete each activity

8. Project scope statement
 - Assumptions & Constraints
9. Risk register
 - Schedule, estimation & resources related risks
10. Project staff assignments
 - Resource allocations & commitment to specific activities
11. Resource breakdown structure
 - Resource category, helpful for finding resources used during resource analysis & Reporting

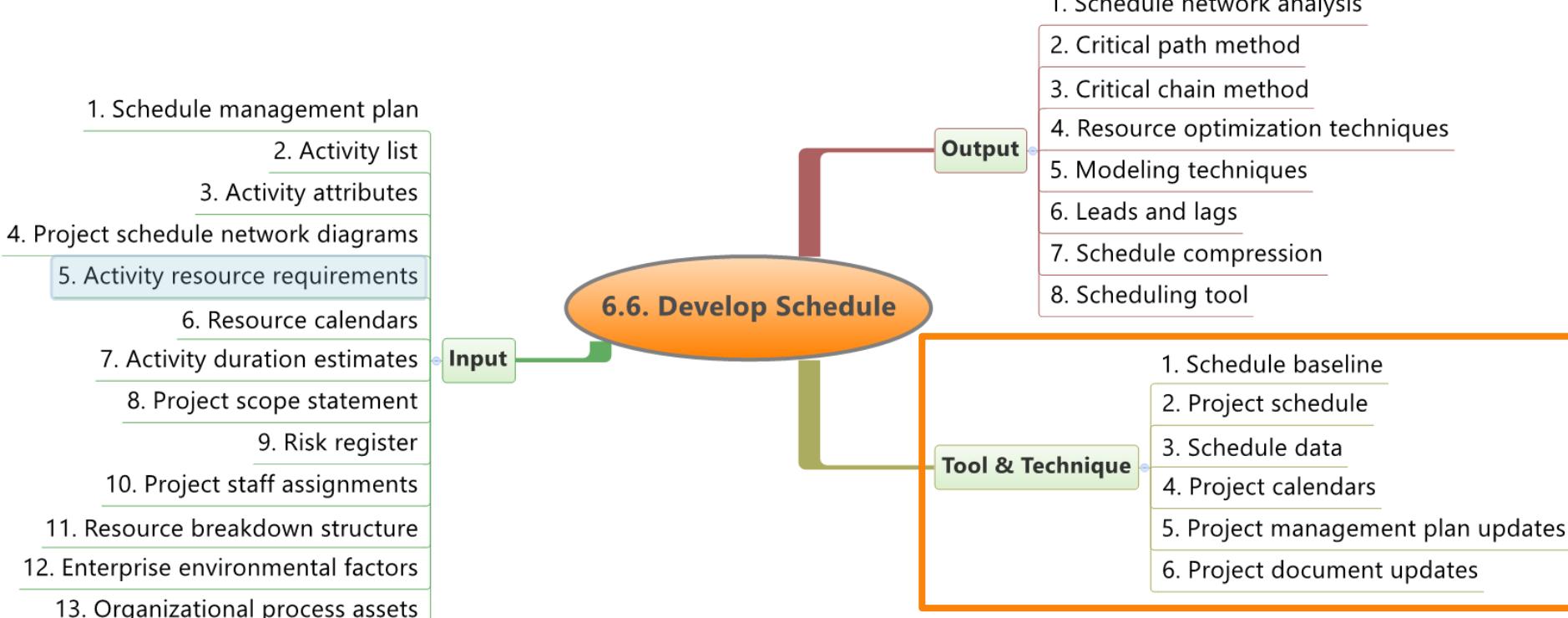
12. EEF

- Communication channel details, Scheduling tool

13. OPA

- Schedule methodology

> Tool & Technique



1. Schedule network analysis

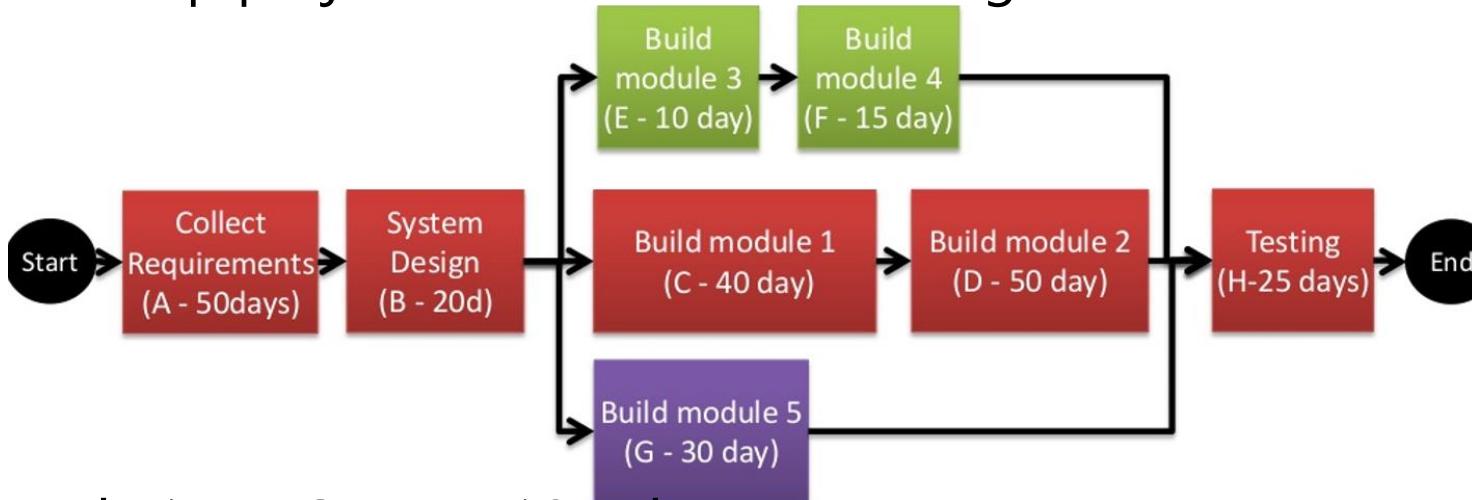
- Technique of identifying Early & Late start dates, as well as Early & Late finish dates
- Helps to develop & optimize project schedule model

Activity	Activity Description	Duration (days)	Predecessor
A	Collect Requirement	50	-
B	System Design	25	A
C	Build Module 1	40	B
D	Build Module 2	50	C
E	Build Module 3	10	B
F	Build Module 4	15	E
G	Build Module 5	30	B
H	System Testing	25	D,F,G

> Tool & Technique

1. Schedule network analysis (cont.)

- Develop project schedule network diagram

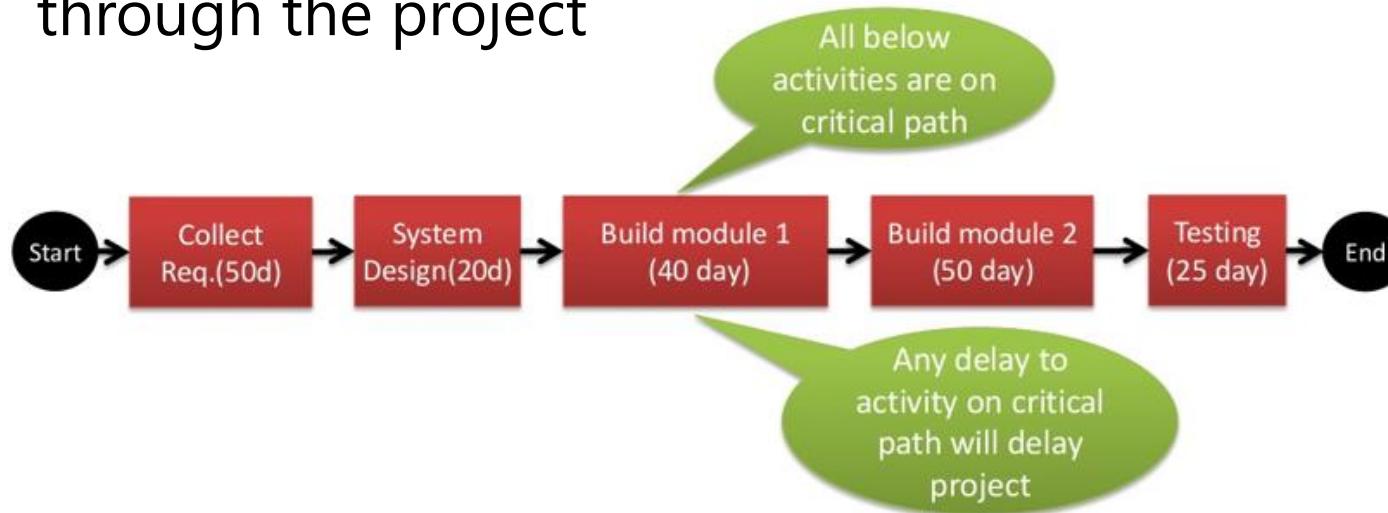


- Path 1: ABCDH = 185 days
- Path 2: ABEFH = 120 days
- Path 3: ABGH = 100 days

1. Schedule network analysis (cont.)

— Critical path

- Sequence of activities that represents longest path through the project



- Critical path is the shortest possible project duration

1. Schedule network analysis (cont.)

- Various analytical techniques are used to perform Schedule Network Analysis & optimize schedule
 - Critical path method
 - Critical chain method
 - What-if analysis
 - Resource optimization

2. Critical path method

- Method used to estimate minimum project duration
- Determine amount of scheduling flexibility (Float) on the logical network paths
- Step by step
 - Calculates Early start, Early finish, Late start & Late finish dates.
 - Performing a forward & backward pass analysis through the schedule network.
 - Does not consider resource limitations
- Slack (Float): Defines how long non-critical activities can be delayed without delaying

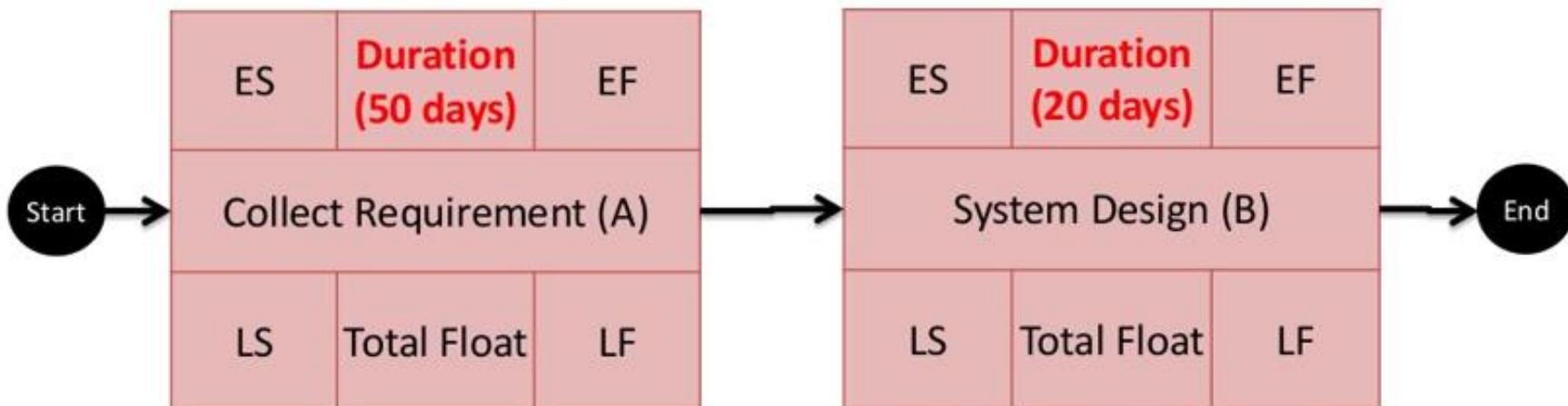
2. Critical path method (cont.)

- $ES = EF$ of immediately preceding activity + 1
- LS: Latest activity can start without delaying project
- $EF = (ES + Duration) - 1$
- $LF = (LS + Duration) - 1$

ES (Early Start)	Duration	EF (Early Finish)
Activity		
LS (Late Start)	Total Float	LF (Late Finish)

2. Critical path method (cont.)

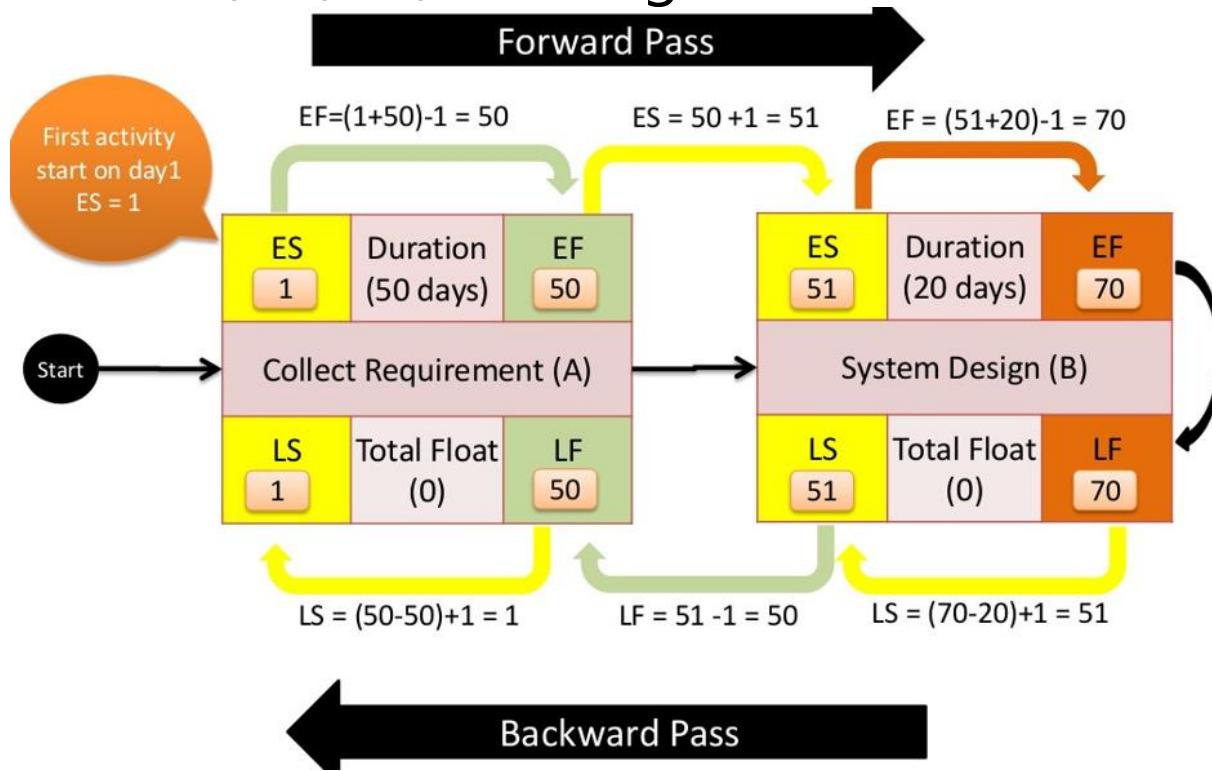
- Calculate ES, EF, LS, LF using Forward & Backward pass:



> Tool & Technique

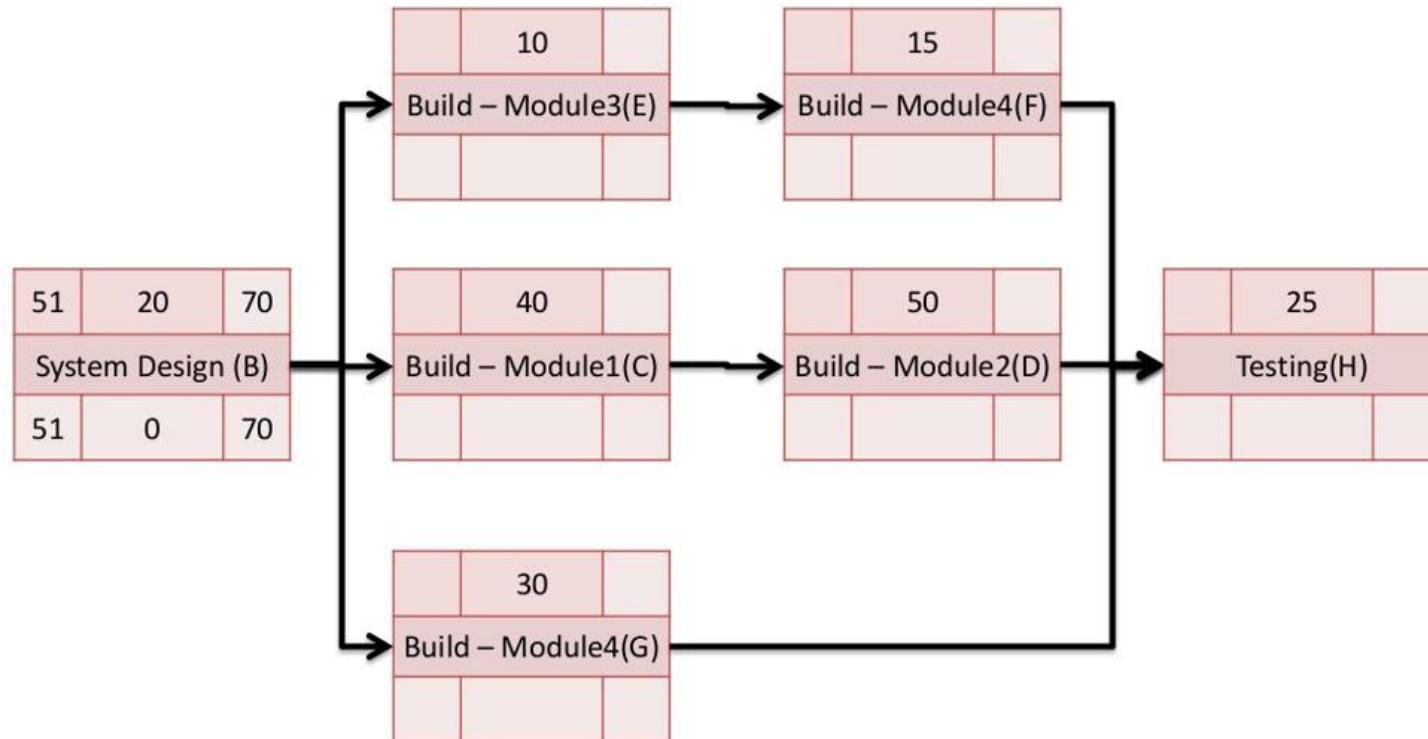
2. Critical path method (cont.)

- Calculate ES, EF, LS, LF using Forward & Backward pass:



2. Critical path method (cont.)

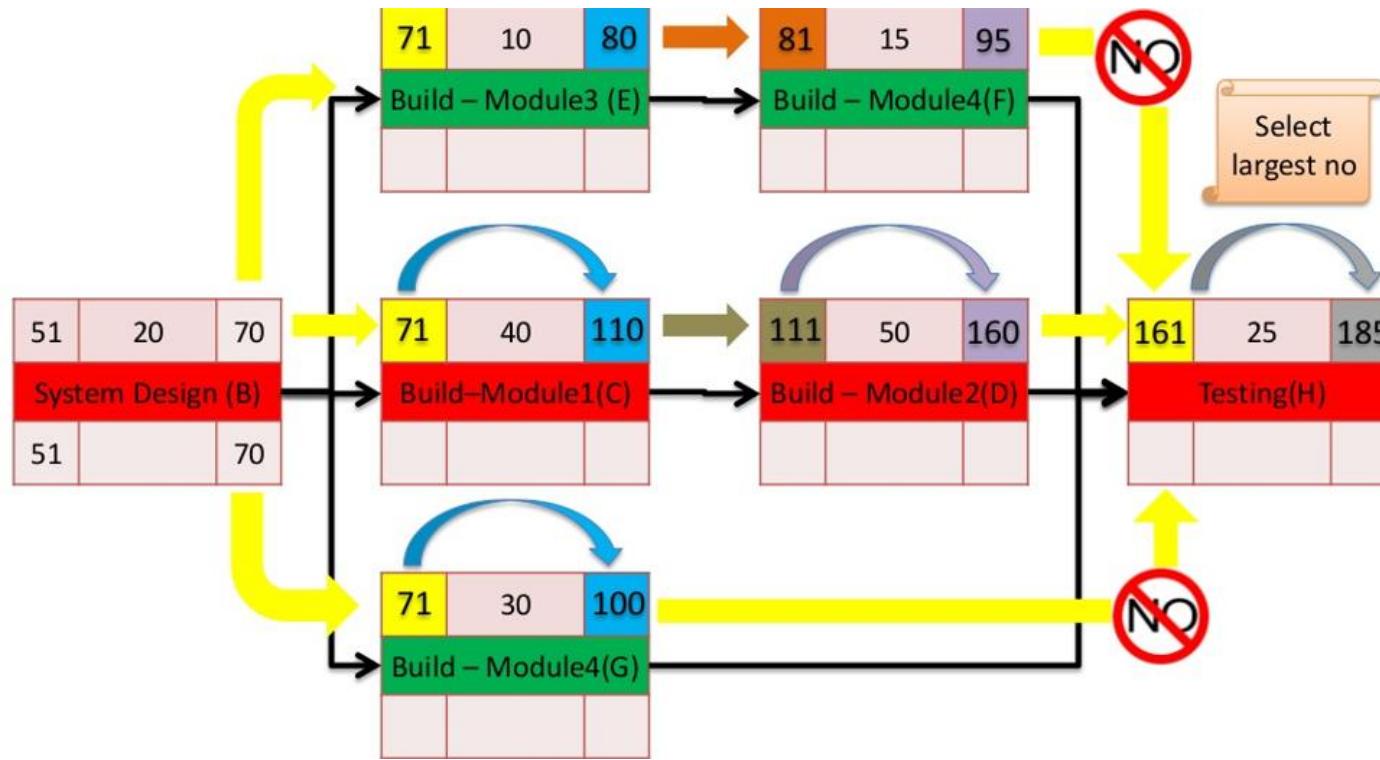
- Lets calculate ES, EF, LS, LF for remaining activities:



> Tool & Technique

2. Critical path method (cont.)

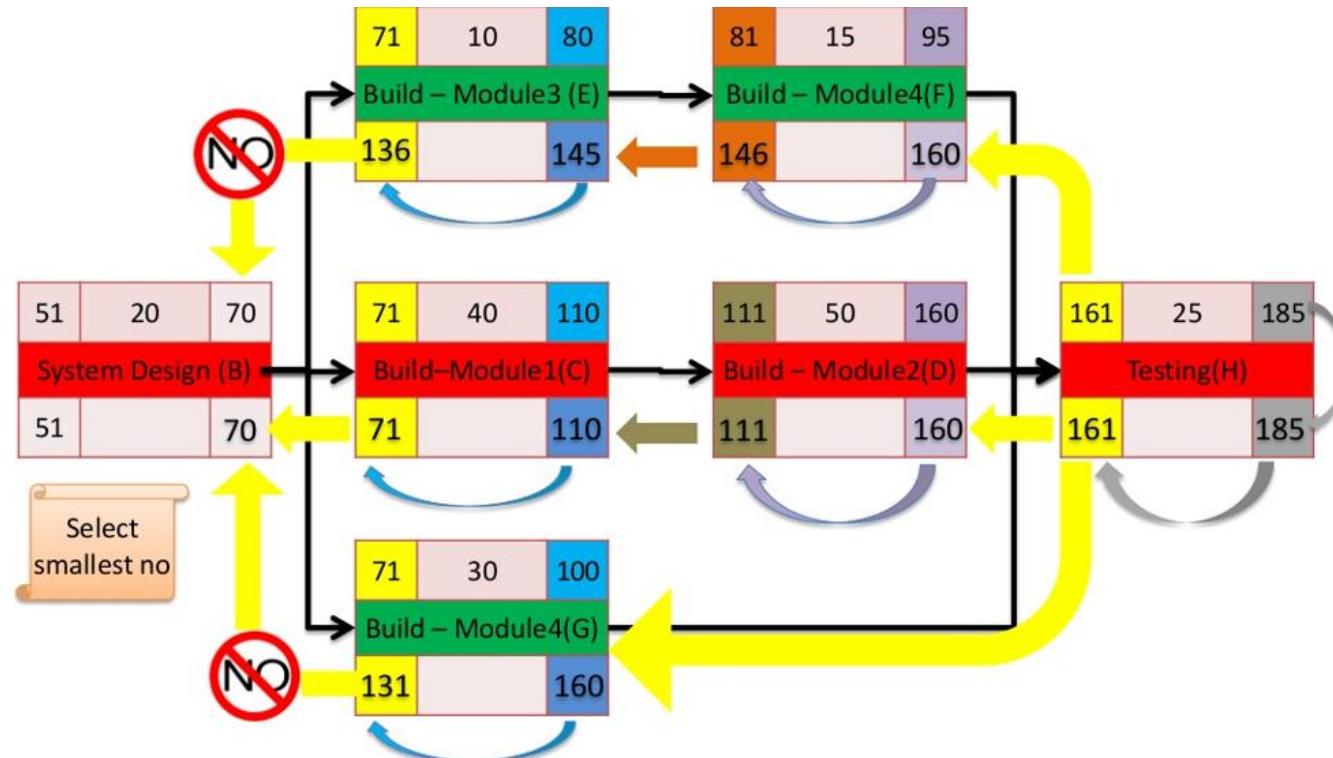
- Lets calculate ES, EF, LS, LF for remaining activities:



> Tool & Technique

2. Critical path method (cont.)

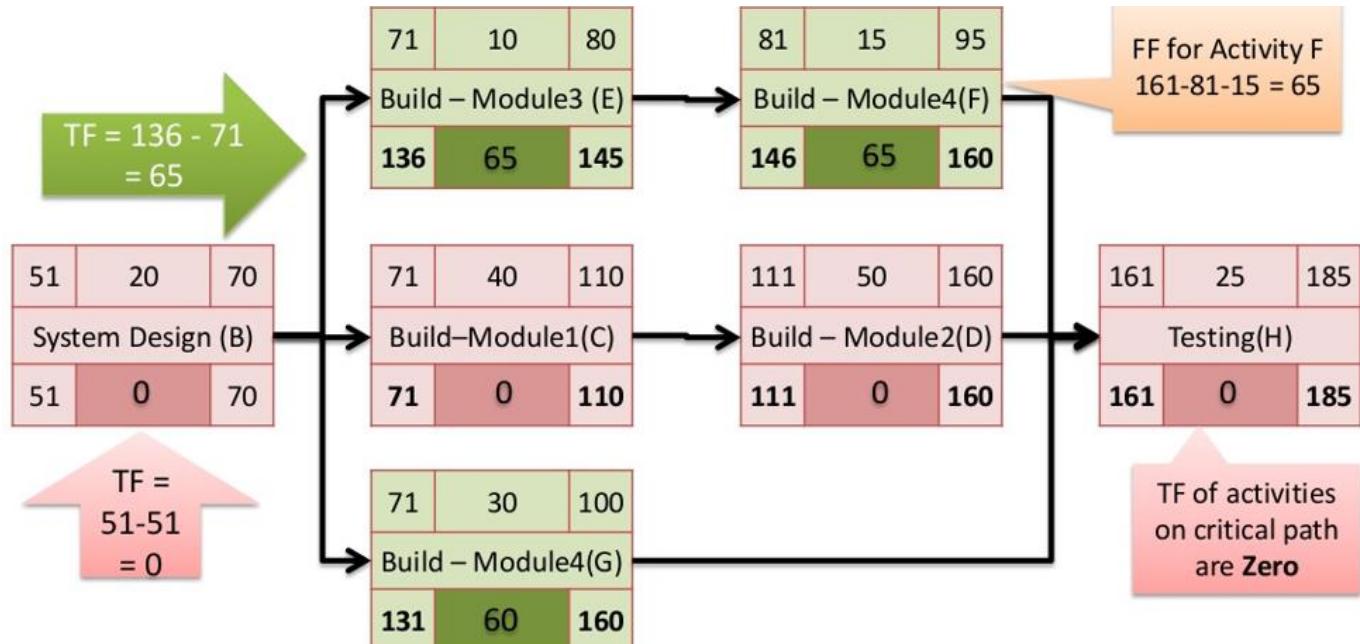
- Lets calculate ES, EF, LS, LF for remaining activities:



> Tool & Technique

2. Critical path method (cont.)

- Slack or float are same
- Amount of time activity can be delayed Without delaying next activity
- **Total float TF** = $LF - EF = LS - ES$

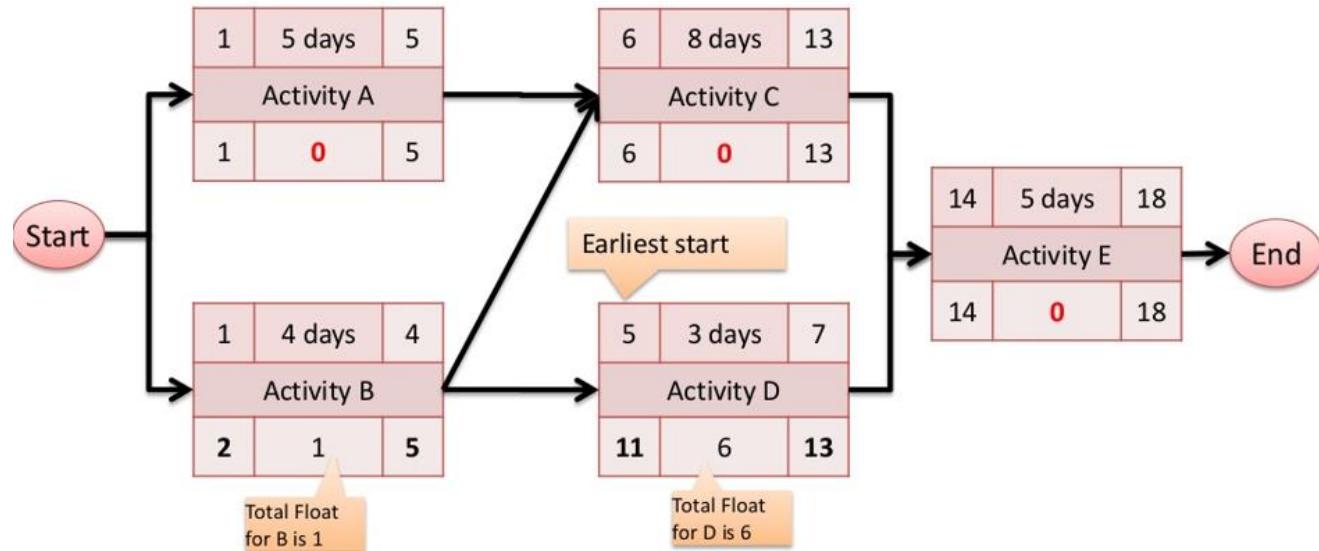


- **Free Float** = Earliest (ES of next Activity - ES of current Activity) - Duration of current activity

> Tool & Technique

2. Critical path method (cont.)

- **Activity B:** FF = 5
 $– 1 – 4 = 0$, this activity can not be delayed
- **Activity D:** FF = $14 – 5 – 3 = 6$, this activity can be delayed without delaying subsequent activity



→ Hence, Float & Free float are not same

2. Critical path method (cont.)

– Difference between Total & Free float

Total float

- Total amount of time activity can be delayed Without delaying **Project finish date**
- $TF = \text{Late Start} - \text{Early Start}$
- $TF = \text{Late Finish} - \text{Early Finish}$

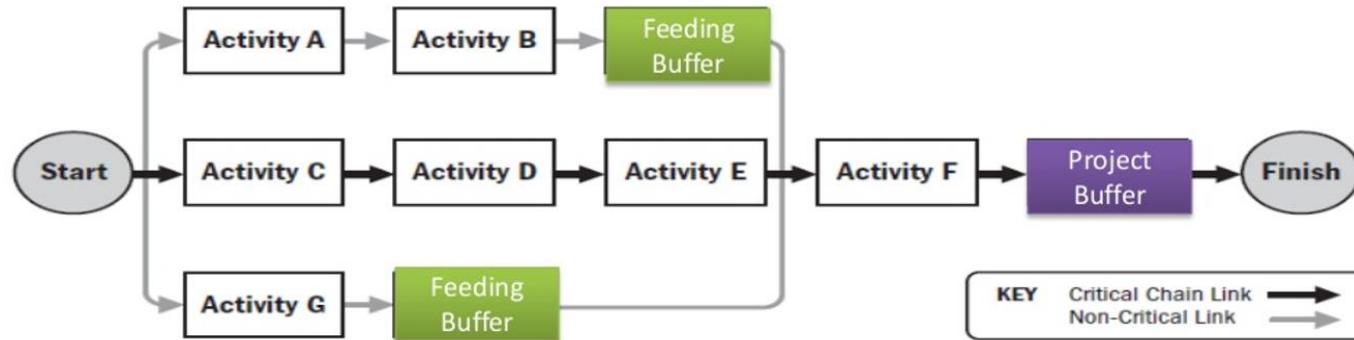
Free float

- Amount of time activity can be delayed Without delaying **next activity**
- $FF = \text{Earliest ES of next activity} - \text{ES of current activity} - \text{Duration of current activity}$

3. Critical chain method

- Placing buffers on any project schedule path to account for limited resources & project uncertainties
- It considers effects of resource allocation, optimization, levelling
- Two types
 - Feeding buffer
 - Project buffer

3. Critical chain method (cont.)



- Feeding buffer
 - Placed at point where a chain of activities are not on critical chain
 - Feeds into the critical chain
- Project buffer
 - Single buffer.
 - Placed at the end of the critical chain.
 - Protect slippage along the critical chain

3. Critical chain method (cont.)

Develop Schedule T & T / Usage	CPM (Critical Path Method)	CCM (Critical Chain Method)
Consideration for	Duration & relation	Consider resources conditions & the uncertainty in addition
Resources Conditions	Considers the optimum status	Consider resource allocation, resource optimization, resource levelling
Paths Concept	Calculation	Customized by buffers
Criticality	Critical path (zero float)	Critical chain (group of buffer assigned paths)
Calculation	Forward path & backward path	Depend on CPM calculations plus buffers
Buffers	Not customized, just float calculation	Calculated to cover resources conditions and uncertainty

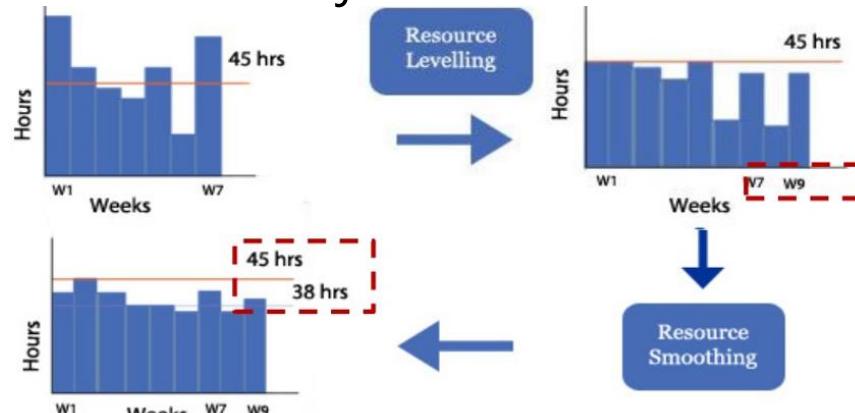
4. Resource optimization techniques

- How to allocate resources in a way to bring maximum output
- **Resource Levelling**
 - Start and finish dates are adjusted based on resource constraints
 - Goal is to balance demand for resources with the available supply
- **Resource smoothing**
 - Adjusts schedule activities
 - Ensure requirements for resources do not exceed certain predefined resource limits
 - May not be able to optimize all resources

4. Resource optimization techniques (cont.)

— Resource Levelling

- Notice Change in Duration (Critical path changed)
- Timelines extended to adjust resource constraint



— Resource smoothing

- Critical path is not changed & completion date is same
- Activities may be delayed within their free & total float

5. Modelling techniques

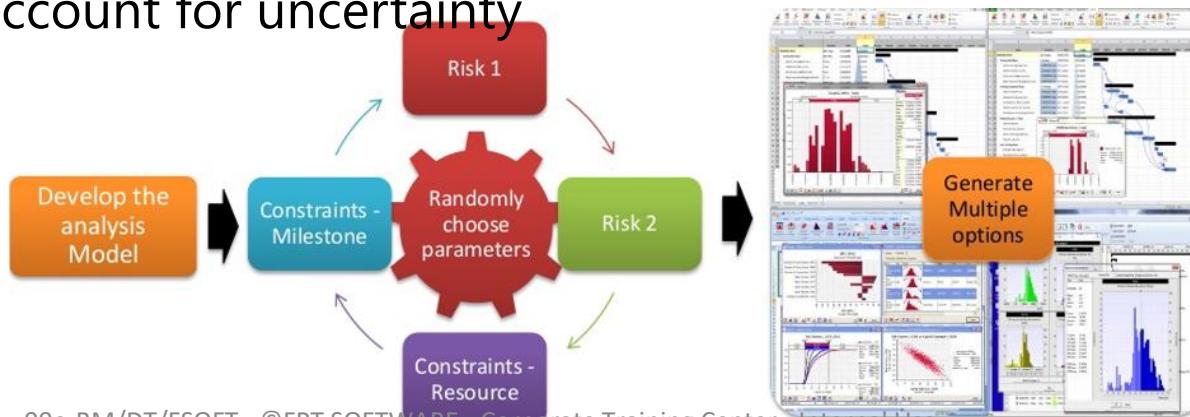
— **What-If Scenario Analysis**

- Evaluating scenarios to predict their effect on schedule
- Achieved by performing Network analysis
- Used to assess feasibility of project schedule under adverse conditions
- Used in contingency & response planning
- Step by step
 - Enter schedule in Scheduling tool
 - Enter various scenarios
 - Simulate-Scenario

5. Modelling techniques (cont.)

– Simulation (Monte Carlo)

- Monte Carlo is simulation technique
- It calculate multiple project durations with different sets of activity assumptions
- Uses probability distributions constructed from 3 Point estimates to account for uncertainty

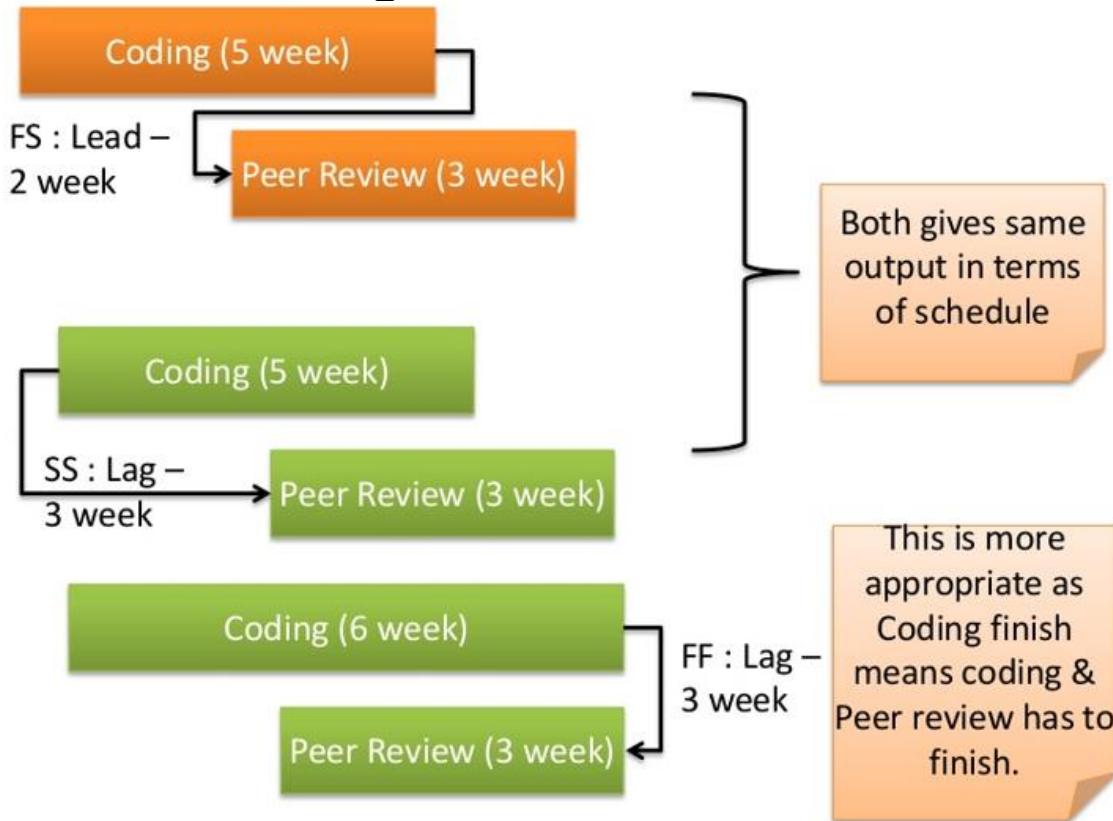


6. Leads and lags

- Lead: It is amount of time where successor activity can be advanced with regard to predecessor activity.
- Lag: It is amount of time whereby a successor activity will be delayed with regard to a predecessor activity.



6. Leads and lags (cont.)



7. Schedule compression

- Reduce schedule duration without reducing project scope
- Adhere to schedule constraints, imposed dates, or other schedule objectives



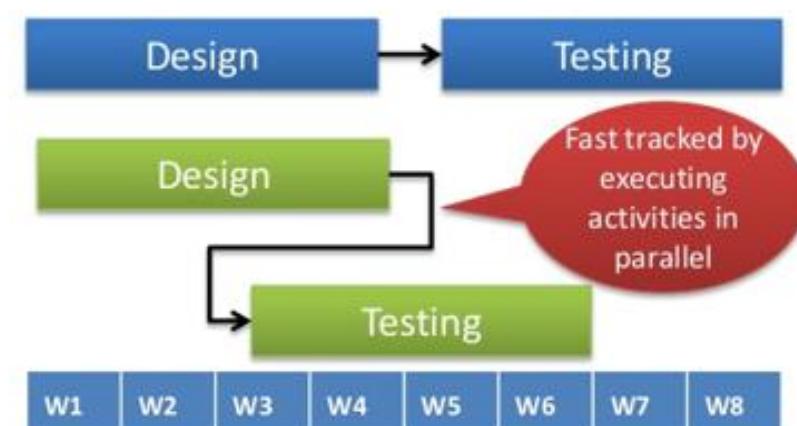
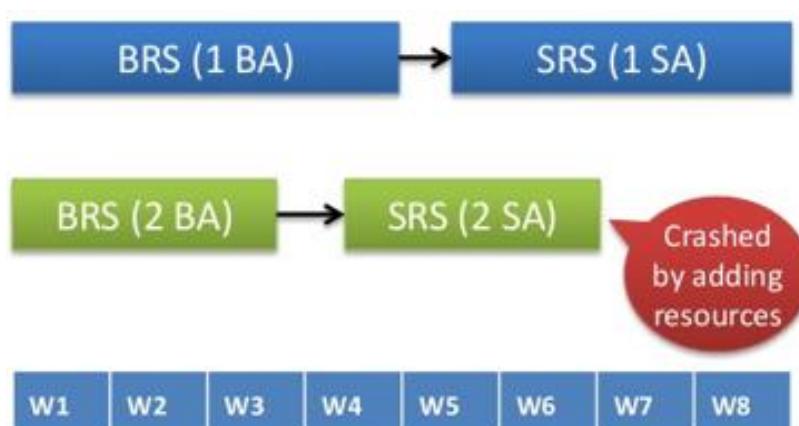
Crashing



Fast tracking

7. Schedule compression (cont.)

- Crashing: Shorten schedule duration for least cost by adding resources
- Fast tracking: Activities done in sequence are performed in parallel for at least some portion of their duration



7. Schedule compression (cont.)

- Difference between Crashing & Fast tracking

Crashing

- Adding resources
- Increases cost
- Works with activity on critical path

Fast tracking

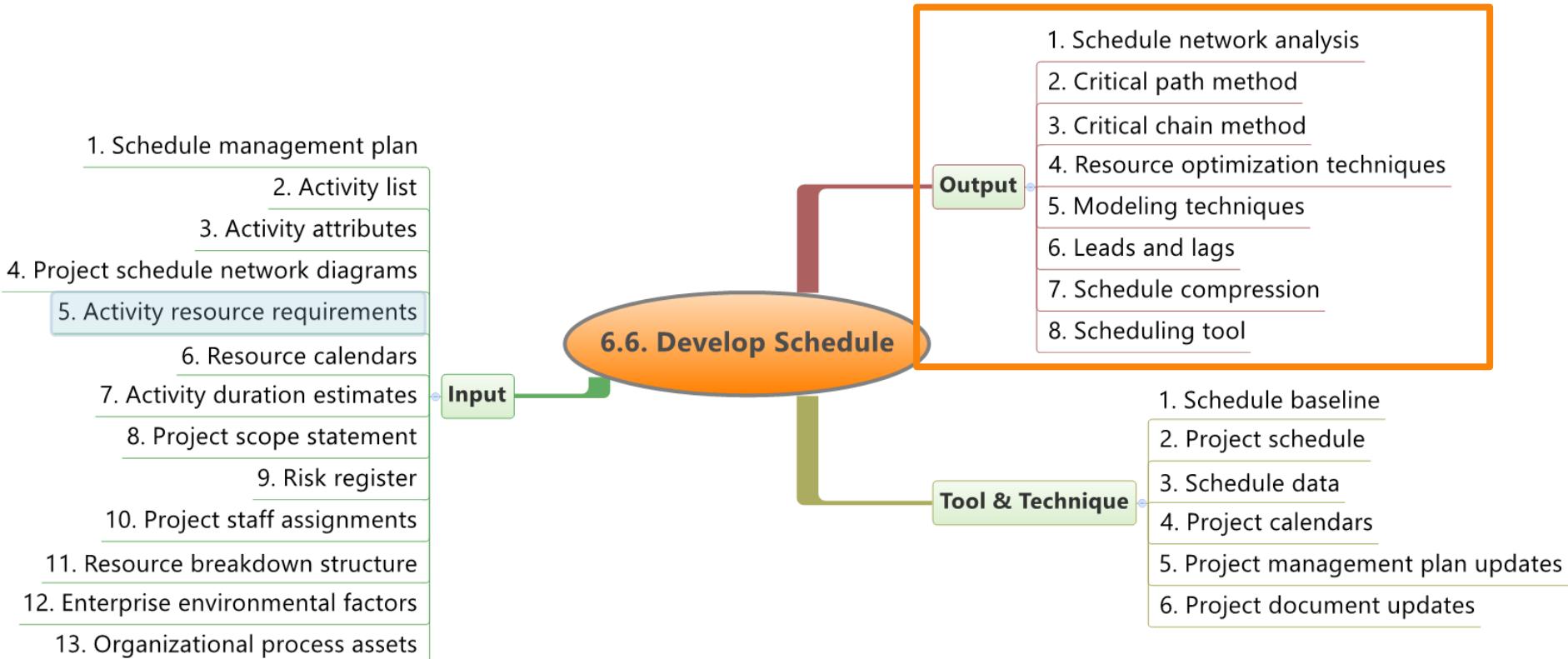
- May result in rework
- Increase Risk
- Assign activity with negative float

8. Scheduling tool

- It contain schedule model & expedite scheduling process
- It generate start and finish dates based on the inputs of activities, resources, activity durations etc.



> Output



1. Schedule baseline

- The approved version of a schedule model that can be changed only through formal change control procedures.
- It is approved by stakeholders as the schedule baseline
- Approved baseline dates are compared to the actual to determine variance.
- The schedule baseline is a component of the project management plan

2. Project schedule

- Presents linked activities with planned dates, durations, milestones, & resources in the form of Presentation
- It is not completed until resources are assigned
- Should be completed along with PM plan
- Schedule may be summary or in detail
- Presented in Graphical formats - Below three forms

3. Schedule data

- Supporting data generated during preparation of the schedule
 - Milestones + Schedule activities + Activity attributes
 - Assumptions + Constraints
- Resource requirements by time period – Resource histogram
- Scheduling of contingency reserves

4. Project calendars

- A calendar that identifies working days and shifts that are available for scheduled activities
- Identify available work days
- Marked holidays
- Multiple Project calendars may be used
- Get updated throughout the project
- May identify need of maintaining resource calendars

5. Project management plan updates

- Update Schedule Management plan: If any change is identify in project schedule management
- Update Schedule baselines:
 - Scope changes
 - Resources assigned to activities

6. Project document updates

- Activity attributes
 - Duration estimates
 - Basis of estimates
- Activity Resource requirements
 - New recourse
- Risk register
 - Assumptions
 - Contingencies
- Calendars
 - Changes to Calendar

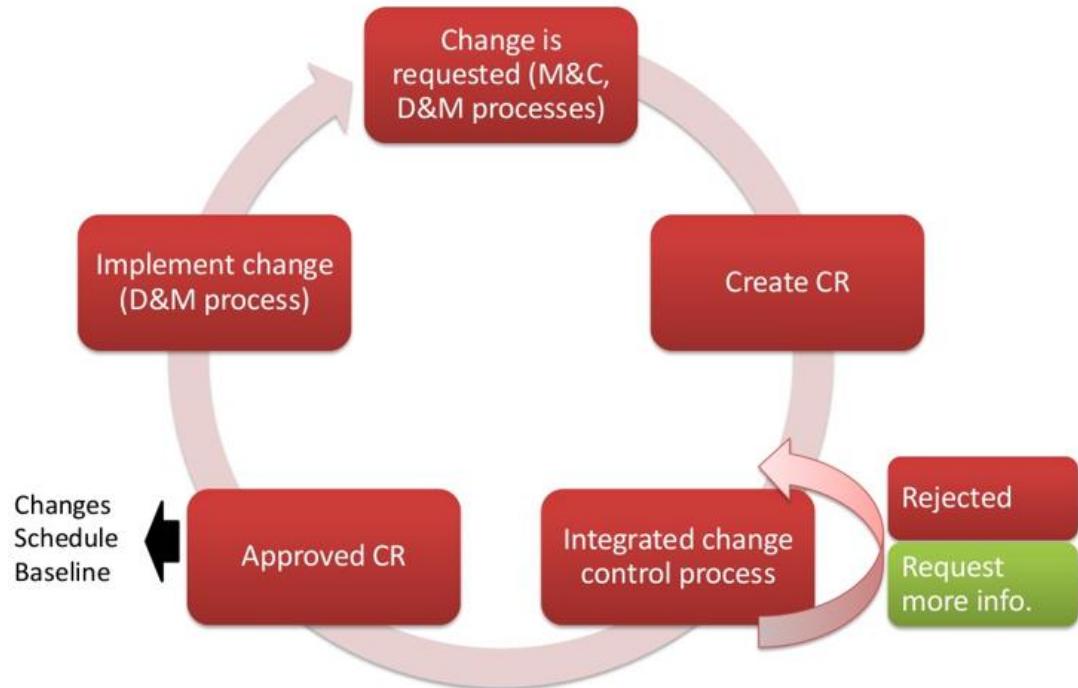
8. Control Schedule

- Determine: The current status of the project schedule
- Monitor: If the project schedule has changed
- Influence: The factors that create schedule changes
- Managing: The actual changes as they occur & minimize Risks



> Overview

- Control Schedule is part of Perform Integrated Change Control process
 - Review, Manage & approve changes
 - Changes can be to completed or planned work



- If any agile approach is utilized, control schedule is concerned with below
 - Determining current status of project schedule by comparing total amount of work delivered & accepted against estimates of work completed for elapsed time cycle
 - Conducting retrospective reviews (scheduled reviews to record lessons learned) for correcting processes and improving, if required
 - Reprioritizing the remaining work plan (backlog)
 - Determining the rate at which the deliverables are produced, validated, and accepted (velocity) in given time per iteration
 - Determining that the project schedule has changed
 - Managing the actual changes as they occur

> Overview

- Monitoring the status of project activities to update project progress & manage changes to schedule baseline to achieve plan



- It provides the means to recognize the deviation from the plan, & take corrective & preventive actions & thus minimize the risk.

6.7. CONTROL SCHEDULE



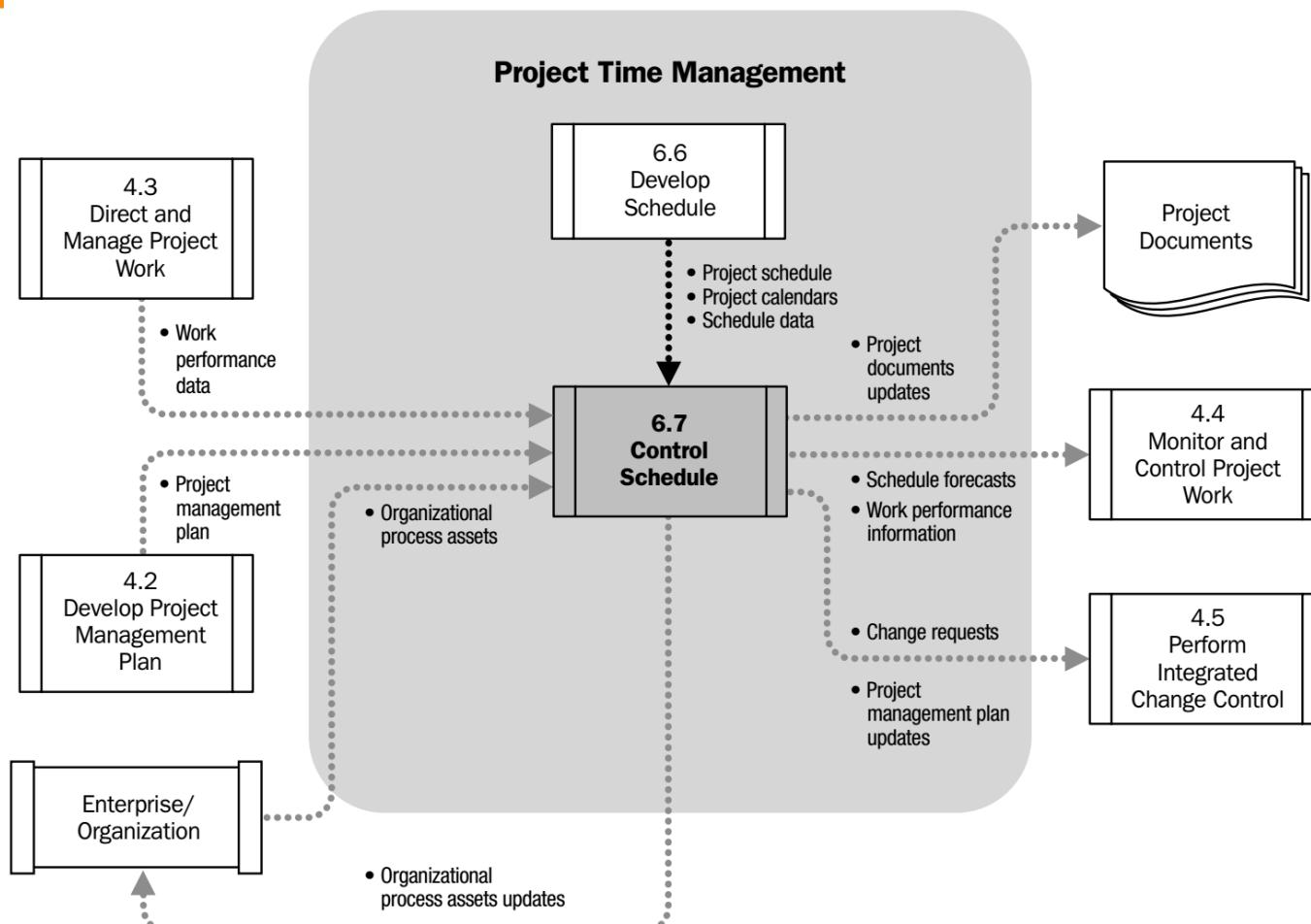
1. Project management plan
2. Project schedule
3. Work performance data
4. Project calendars
5. Schedule data
4. Organizational process assets



1. Performance reviews
2. Project management software
3. Resource optimization techniques
4. Modeling techniques
5. Leads and lags
6. Schedule compression
7. Scheduling tool



1. Work performance information
2. Schedule forecasts
3. Change requests
4. Project management plan updates
5. Project document updates
6. Organizational process assets updates



> Input



1. Project management plan
2. Project schedule
3. Work performance data
4. Project calendars
5. Schedule data
4. Organizational process assets



1. Performance reviews
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1. Work performance information
2. Schedule forecasts
3. Change requests
4. Project management plan updates
5. Project document updates
6. Organizational process assets updates

1. Project management plan
 - Schedule Management Plan
 - How to manage Schedule
 - How to control Schedule
 - Schedule baselines
 - Planned & actual dates
 - Used for comparisons

2. Project schedule

- Presents linked activities with planned dates, durations, milestones, & resources in the form of Presentation
- Having most recent data is key to control the schedule
 - Latest version of the document
 - Latest activity details (start & completed activity dates)

3. Work performance data

- The raw observations & measurements identified during execution of activities
- It is the raw data of the project's status → actual cost; actual duration

4. Project calendars

- Identify available work days
- Marked holidays
- Multiple Project calendars may be used
- Get updated throughout the project
- May identify need of maintaining resource calendars



5. Schedule data

- All information which are useful to control schedule activities
- It is constantly reviewed & updated
 - List of activities & attributes
 - Milestones
 - Assumptions
 - Constraints

6. Organizational process assets

- Schedule control related organizational policies
- Schedule control tools
- Monitoring & reporting methods used in organization



> Tool & Technique



1. Project management plan
2. Project schedule
3. Work performance data
4. Project calendars
5. Schedule data
4. Organizational process assets



1. Performance reviews
2. Project management software
3. Resource optimization techniques
4. Modeling techniques
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6. Schedule compression
7. Scheduling tool



1. Work performance information
2. Schedule forecasts
3. Change requests
4. Project management plan updates
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1. Performance reviews

- It measure, compare, & analyze schedule performance
- E.g., Actual start & finish dates, % complete & remaining duration for work in progress
- Determine any Deviation from the plan
- Help take corrective & preventive action
- Methods as
 - Trend Analysis + Earn value management
 - Critical chain method + Critical path method

1. Performance reviews (cont.)

- Trend analysis
 - Examines project performance over time
 - Determine whether performance is improving or deteriorating
 - Detect Trends in work performance data
 - Valuable for understanding current performance & for comparison to future performance goals.

1. Performance reviews (cont.)

- Earn value management
 - Schedule & Cost performance measurements
 - As per PMI this is best technique to measure project performance
 - Percentage complete method
 - Comparing planned activity dates against actual dates.
 - Identify variances between baseline & actuals
 - Difficult to estimate & may not provide actual picture
 - Schedule performance measurements (SV & SPI)
 - Schedule variance (SV)
 - Schedule performance index (SPI)
 - Assess the magnitude of variation to baseline

1. Performance reviews (cont.)

— **Critical path Method**

- Comparing progress along critical path can help determine schedule status.
- The variance on critical path will have a direct impact on the project end date

— **Critical chain method**

- Comparing amount of buffer remaining to amount of buffer needed to protect delivery dates.
- Difference between buffer needed & buffer remaining can determine whether corrective action is required or not

2. Project management software

- Software used for project planning, scheduling, resource allocation, change management , communication etc.

Control costs and schedule

- Baseline comparison
- SV, SPI and CV, CPI
- Cash flow management

Monitor & Inform

- Schedule progress
- Missed milestones
- Changes to Critical path

- Also used for collaboration and communication
 - Project planning; Task management; Document sharing and collaboration; Calendar and contact sharing; Risk and issue management

3. Resource optimization techniques

- It primarily focus on how to allocate resources in a way to bring maximum output
- Resource Levelling
 - Start and finish dates are adjusted based on resource constraints
 - Goal is to balance demand for resources with the available supply
- Resource Smoothing
 - Adjusts activities of a schedule model
 - Ensure requirements for resources on project do not exceed certain predefined resource limits

4. Modeling techniques

- What-If Scenario Analysis
 - Process of evaluating scenarios in order to predict their effect
 - This is achieved by performing Network analysis
 - Used to assess the feasibility of project schedule under adverse conditions,
 - Also used in preparing contingency & response plans
- Simulation
 - Calculating multiple project durations with different sets of activity assumptions.
 - Uses probability distributions constructed from 3 Point estimates to account for uncertainty.
 - Common simulation technique is Monte Carlo

5. Leads and Lags

- **Lead:** It is amount of time where successor activity can be advanced w.r.t. predecessor activity
- **Lag:** It is amount of time whereby a successor activity will be delayed w.r.t. a predecessor activity



6. Schedule compression

- Crashing
 - Shorten the schedule duration for the least incremental cost by adding resources
- Fast tracking
 - Activities or phases normally done in sequence are performed in parallel for at least a portion of their duration

7. Scheduling tool

- It contain the schedule model and expedite the scheduling process.
- It generate start and finish dates based on the inputs of activities, network diagrams, resources and activity durations



> Output



1. Project management plan
2. Project schedule
3. Work performance data
4. Project calendars
5. Schedule data
4. Organizational process assets



1. Performance reviews
2. Project management software
3. Resource optimization techniques
4. Modeling techniques
5. Leads and lags
6. Schedule compression
7. Scheduling tool



1. Work performance information
2. Schedule forecasts
3. Change requests
4. Project management plan updates
5. Project document updates
6. Organizational process assets updates

1. Work performance information
 - The calculated SV and SPI for the WBS components (Control account, work package)
 - Documented and communicated to stakeholders
2. Schedule forecasts
 - Predictions of projects future conditions & events
 - Projects execution data is constantly analyzed which results in WPI.
 - Forecasts are updated and reissued based on WPI

3. Change requests

- Modifications to the project scope or project schedule may result in change requests
 - Schedule baseline
 - Scope baseline
 - Components of PMP



4. Project management plan updates
 - Schedule baseline – Schedule management plan
 - Cost baseline
5. Project document updates
 - Schedule data – Project schedule
 - Risk register
6. Organizational process assets updates
 - Cause of variances
 - Corrective action chosen and the reasons
 - Other types of lessons learned from project schedule control

Processes in scope management

6.1. PLAN SCHEDULE MANAGEMENT

- 1. Project management plan
- 2. Project charter
- 2. Enterprise environmental factors
- 3. Organizational process assets

- 1. Expert judgment
- 2. Analytical techniques
- 3. Meetings

- 1. Schedule management plan

6.2. DEFINE ACTIVITIES

- 1. Schedule management plan
- 2. Scope baseline
- 3. Enterprise environmental factors
- 4. Organizational process assets

- 1. Decomposition
- 2. Rolling wave planning
- 3. Expert judgment

- 1. Activity list
- 2. Activity attributes
- 3. Milestone list

6.3. SEQUENCE ACTIVITIES

- 1. Schedule management plan
- 2. Activity list
- 3. Activity attributes
- 4. Milestone list
- 5. Project scope statement
- 6. Enterprise environmental factors
- 7. Organizational process assets

- 1. Precedence diagramming method (PDM)
- 2. Dependency determination
- 3. Leads and lags

- 1. Project schedule network diagrams
- 2. Project document updates

6.4. ESTIMATE ACTIVITY RESOURCES

- 1. Schedule management plan
- 2. Activity list
- 3. Activity attributes
- 4. Resource calendars
- 5. Risk register
- 6. Activity cost estimates
- 7. Enterprise environmental factors
- 8. Organizational process assets

- 1. Expert judgment
- 2. Alternatives analysis
- 3. Published estimating data
- 4. Bottom-up estimating
- 5. Project management software

- 1. Activity resource requirements
- 2. Resource breakdown structure
- 3. Project document updates

6.5. ESTIMATE ACTIVITY DURATIONS

- 1. Schedule management plan
- 2. Activity list
- 3. Activity attributes
- 4. Activity resource requirements
- 5. Resource calendars
- 6. Project scope statement
- 7. Risk register
- 8. Resource breakdown structure
- 9. Enterprise environmental factors
- 10. Organizational process assets

- 1. Expert judgment
- 2. Analogous estimating
- 3. Parametric estimating
- 4. Three-point estimates
- 5. Group decision-making techniques
- 6. Reserve analysis

- 1. Activity duration estimates
- 2. Project document updates

Processes in scope management



6.7. CONTROL SCHEDULE



1. Project management plan
2. Project schedule
3. Work performance data
4. Project calendars
5. Schedule data
6. Organizational process assets



1. Performance reviews
2. Project management software
3. Resource optimization techniques
4. Modeling techniques
5. Leads and lags
6. Schedule compression
7. Scheduling tool



1. Work performance information
2. Schedule forecasts
3. Change requests
4. Project management plan updates
5. Project document updates
6. Organizational process assets updates



6.6. DEVELOP SCHEDULE



1. Schedule management plan
2. Activity list
3. Activity attributes
4. Project schedule network diagrams
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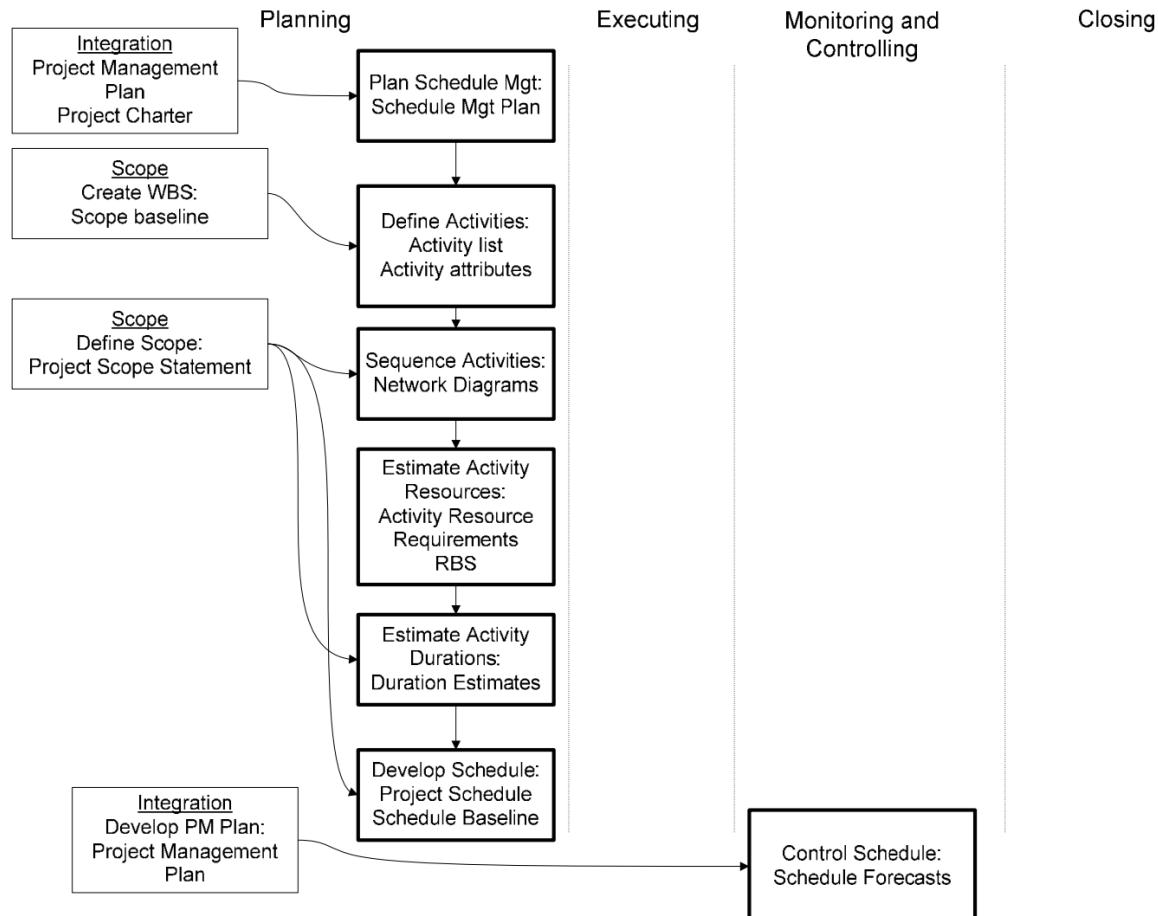


1. Schedule network analysis
2. Critical path method
3. Critical chain method
4. Resource optimization techniques
5. Modeling techniques
6. Leads and lags
7. Schedule compression
8. Scheduling tool



1. Schedule baseline
2. Project schedule
3. Schedule data
4. Project calendars
5. Project management plan updates
6. Project document updates

Process Interaction



- Time management process
 - Schedule baseline
 - Schedule compression
 - Crashing
 - Fast tracking
 - Network diagram
 - Precedence diagramming method (PDM)
 - Critical path
 - Float (Slack)
 - Three-point estimating
 - Monte Carlo analysis
 - Delphi technique
 - Bar charts
 - Milestone charts
 - Schedule model
 - Schedule management plan
 - Resource optimization
- Next slide

- Critical path method
- Leads and Lags
- Resource breakdown structure (RBS)
- Reserve analysis
- Padding
- Analogous estimating
- Parametric estimating
- Heuristics
- Critical chain method
- Activity resource requirements
- Activity attributes
- Re-estimating
- Rolling wave planning
- GERT

- Cost management process
 - Earned value measurement
 - Cost baseline
 - Cost budget
 - Performance measurement baseline
 - Estimating
 - Rough order of magnitude estimate
 - Definitive estimate
 - Budget estimate
 - Reserve analysis
 - Contingency reserves
 - Management reserves
 - Cost of Quality
 - Control thresholds
 - Return on investment (ROI)
- And More**



Thank you



