

Target: PMP® Certification



Project Schedule Management

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17	ESTIMATE ACTIVITY DURATIONS		
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Project Schedule Management

* **Project Schedule Management.** Project Schedule Management includes the processes required to manage the timely completion of the project.

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PLAN SCHEDULE MANAGEMENT

* **Plan Schedule Management.** The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

14**PLAN SCHEDULE MANAGEMENT****INPUTS**

- » Project charter
- » Project management plan
 - Scope management plan
 - Development approach
- » Enterprise Environment Factors
- » Organizational Process Assets

TOOLS & TECHNIQUES

- ✓ Expert judgment
- ✓ Data analysis
- ✓ Meetings

OUTPUTS**Schedule management plan»**

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PLAN SCHEDULE MANAGEMENT



OUTPUTS

Schedule management plan»

* **Schedule Management Plan.** A component of the project management plan that establishes the criteria and the activities for developing, monitoring, and controlling the schedule.

It includes:

- Project schedule model development
- Level of accuracy
- Units of measure
- Organizational procedures links
- Project schedule model maintenance
- Control thresholds
- Rules of performance measurement
- Reporting formats
- Process descriptions

15

DEFINE ACTIVITIES

*** Define Activities.** The process of identifying and documenting the specific actions to be performed to produce the project deliverables.

15**DEFINE ACTIVITIES****INPUTS**

- » **Project management plan**
 - Schedule management plan
 - Scope baseline
- » **Enterprise Environment Factors**
- » **Organizational Process Assets**

TOOLS & TECHNIQUES

- ✓ **Expert judgment**
- ✓ **Decomposition**
- ✓ **Rolling wave planning**
- ✓ **Meetings**

OUTPUTS

- Activity list »**
- Activity attributes »**
- Milestone list »**
- Change requests »**
- Project management plan updates »**
 - Schedule baseline
 - Cost baseline

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DEFINE ACTIVITIES



TOOLS & TECHNIQUES

✓ Decomposition

* **Decomposition.** A technique used for dividing and subdividing the project scope and project deliverables into smaller, more manageable parts.

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DEFINE ACTIVITIES



TOOLS & TECHNIQUES

✓ Rolling wave planning

* **Rolling Wave Planning.** An iterative planning technique in which the work to be accomplished in the near term is planned in detail, while the work in the future is planned at a higher level.

It is a form of progressive elaboration planning.

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DEFINE ACTIVITIES



OUTPUTS

[Activity list »](#)

* **Activity List.** A documented tabulation of schedule activities that shows the activity description, activity identifier, and a sufficiently detailed scope of work description so project team members understand what work is to be performed.

Activities are, in fact extensions of the WBS and should be detailed enough for all team members to understand.

It is a project document

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DEFINE ACTIVITIES



OUTPUTS

Activity attributes »

* **Activity Attributes.** Multiple attributes associated with each schedule activity that can be included within the activity list. Activity attributes include activity codes, predecessor activities, successor activities, logical relationships, leads and lags, resource requirements, imposed dates, constraints, and assumptions.

- It can include the activity type:
 - **Apportioned Effort (AE).** * An activity where effort is allotted proportionately across certain discrete efforts and not divisible into discrete efforts.
 - **Discrete Effort (DE).** * An activity that can be planned and measured and that yields a specific output.
 - **Level of Effort (LOE).** * An activity that does not produce definitive end products and is measured by the passage of time.
- It can also include the person responsible for executing the work, geographic area or place where the work has to be performed, and schedule activity type such as level of effort, discrete effort, and apportioned effort.

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DEFINE ACTIVITIES



OUTPUTS

Milestone list »

* **Milestone List.** A list identifying all project milestones and normally indicates whether the milestone is mandatory or optional.

- Mandatory: required by contract
- Optional: based upon historical information

It is a project document

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SEQUENCE ACTIVITIES



* **Sequence Activities.** The process of identifying and documenting relationships among the project activities.

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SEQUENCE ACTIVITIES



INPUTS

- » Project management plan
 - Schedule management plan
 - Scope baseline
- » Project documents
 - Activity attributes
 - Activity list
 - Assumption log
 - Milestone list
- » Enterprise Environment Factors
- » Organizational Process Assets

TOOLS & TECHNIQUES

- ✓ Precedence diagramming method
- ✓ Dependency determination and integration
- ✓ Leads and lags
- ✓ Project management information system

OUTPUTS

- Project schedule network diagrams »
- Project documents updates »
 - Activity attributes
 - Activity list
 - Assumption log
 - Milestone list

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SEQUENCE ACTIVITIES



TOOLS & TECHNIQUES

- ✓ Precedence diagramming method (PDM)

* **Precedence Diagramming Method (PDM).** A technique used for constructing a schedule model in which activities are represented by nodes and are graphically linked by one or more logical relationships to show the sequence in which the activities are to be performed.

- Activity-on-node (AON) is one method of representing a precedence diagram
- PDM includes four types of dependencies:
 - **Finish-to-start (FS):** most common relationship. If a relationship is not specifically listed on a diagram assume it is a finish to start.
 - **Finish-to-finish (FF):** the finish of one activity is driving the start of another
 - **Start-to-start (SS):** the start of one activity is driving the start of another
 - **Start-to-finish (SF):** the start of one activity is driving the finish of another

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SEQUENCE ACTIVITIES



TOOLS & TECHNIQUES

- ✓ Precedence diagramming method (PDM)

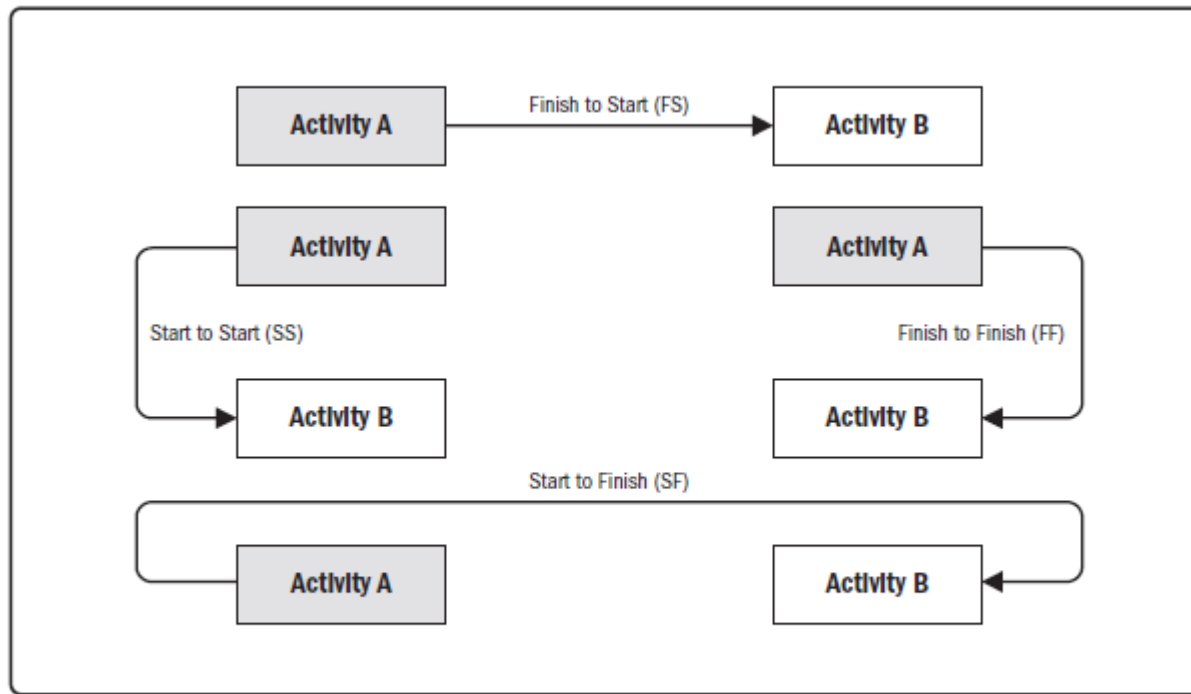


Figure 6-9. Precedence Diagramming Method (PDM) Relationship Types

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SEQUENCE ACTIVITIES

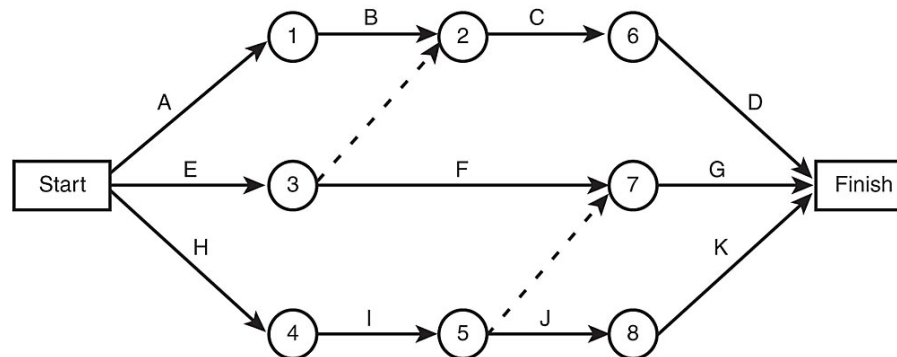


TOOLS & TECHNIQUES

- ✓ Precedence diagramming method (PDM)

Other methods to depicting relationships include:

- **Arrow diagramming method (ADM)** is a network diagramming technique in which activities are represented by arrows. ADM is also known as the activity-on-arrow (AOA) method



- **Graphical Evaluation and Review Technique (GERT):** Allow loops and conditional branches (if conditions)

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SEQUENCE ACTIVITIES



TOOLS & TECHNIQUES

✓ Dependency determination

- **Mandatory dependencies** (hard logic): * A relationship that is contractually required or inherent in the nature of the work.
- **Discretionary dependencies**: (Preferred or soft logic): * A relationship that is established based on knowledge of best practices within a particular application area or an aspect of the project where a specific sequence is desired.
- **External dependencies**: * A relationship between project activities and non-project activities
- **Internal dependencies**. Internal dependencies involve a precedence relationship between project activities and are generally inside the project team's control

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SEQUENCE ACTIVITIES

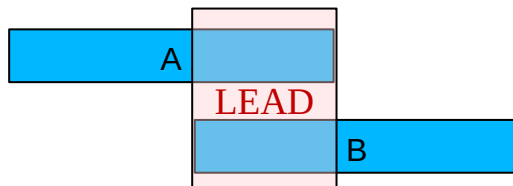
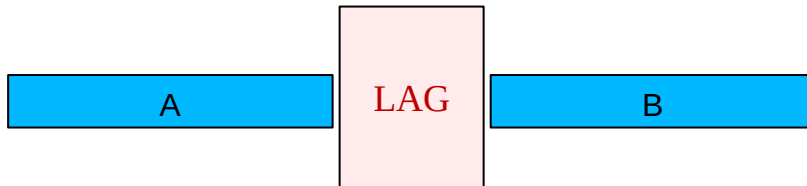


TOOLS & TECHNIQUES

✓ Leads and lags

* **Lag.** The amount of time whereby a successor activity is required to be delayed with respect to a predecessor activity.

* **Lead.** The amount of time whereby a successor activity can be advanced with respect to a predecessor activity.



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SEQUENCE ACTIVITIES



OUTPUTS

Project schedule network diagrams »

* **Project Schedule Network Diagram.** A graphical representation of the logical relationships among the project schedule activities.

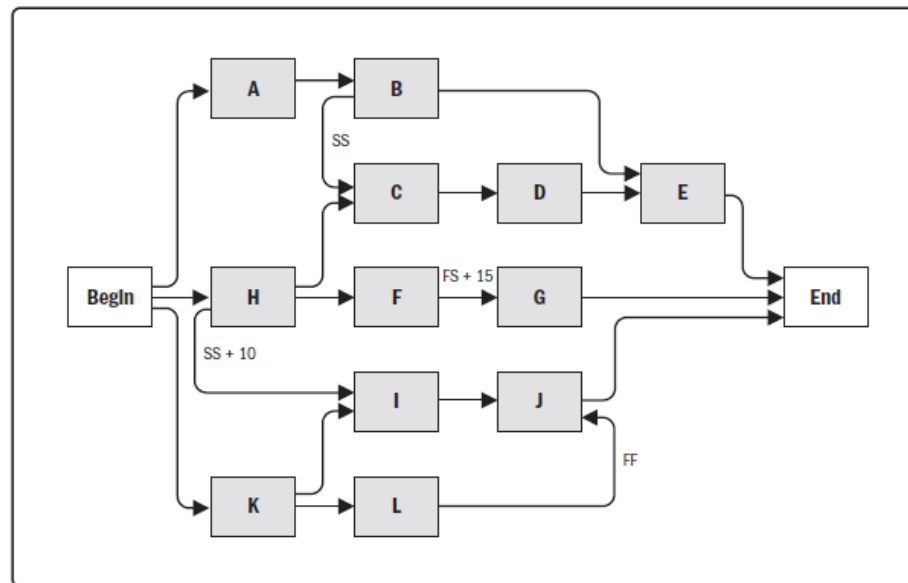


Figure 6-11. Project Schedule Network Diagram

*This definition is taken from the Glossary of the Project Management Institute, A Guide to the Project Management Body of Knowledge, (PMBOK® Guide) – Sixth Edition, Project Management Institute, Inc., 2017.

Project Management Institute, A Guide to the Project Management Body of Knowledge, (PMBOK® Guide) – Sixth Edition, Project Management Institute, Inc., 2017, Figure 6-11, Page 160.

16**SEQUENCE ACTIVITIES****OUTPUTS****Project documents updates »**

Project documents updates examples:

- Activity lists
- Activity attributes
- Milestone list
- Risk register

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ESTIMATE ACTIVITY DURATIONS

* **Estimate Activity Durations.** The process of estimating the number of work periods needed to complete individual activities with estimated resources.

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ESTIMATE ACTIVITY DURATIONS



INPUTS

- » Project management plan
 - Schedule management plan
 - Scope baseline
- » Project documents
 - Activity attributes
 - Activity list
 - Assumption log
 - Lessons learned register
 - Milestone list
 - Project team assignments
 - Resource breakdown structure
 - Resource calendars
 - Resource requirements
 - Risk register
- » Enterprise Environment Factors
- » Organizational Process Assets

TOOLS & TECHNIQUES

- ✓ Expert judgment
- ✓ Analogous estimating
- ✓ Parametric estimating
- ✓ Three-point estimating
- ✓ Bottom-up estimating
- ✓ Data analysis
 - Alternatives analysis
 - Reserve analysis
- ✓ Decision making

OUTPUTS

- Duration estimates »
- Basis of estimates »
- Project documents updates »
 - Activity attributes
 - Assumption log
 - Lessons learned register

17**ESTIMATE ACTIVITY DURATIONS****INPUTS****» Activity resource requirements**

- Efficiency and productivity must be taken into account when moving from resource requirements to duration estimates.
- For example if an activity has 16 hours of standard engineer effort estimated and there is available an above average standard engineer, the duration (in case of 100% allocation) should be less than 2 days.

17**ESTIMATE ACTIVITY DURATIONS****INPUTS**

» Project scope statement

Constraints and assumptions that are listed in the project scope statement may affect activity durations.

For example:

- Resource availability
- Contract terms and conditions

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ESTIMATE ACTIVITY DURATIONS



TOOLS & TECHNIQUES

✓ Analogous estimating

* **Analogous Estimating.** A technique for estimating the duration or cost of an activity or a project using historical data from a similar activity or project.

Characteristics:

- Limited amount of data available
- Less costly
- Quicker
- Less accurate.

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ESTIMATE ACTIVITY DURATIONS



TOOLS & TECHNIQUES

✓ Parametric estimating

* **Parametric Estimating.** An estimating technique in which an algorithm is used to calculate cost or duration based on historical data and project parameters.

Characteristics:

- Enough data to create statistics
- More costly
- Slower – because a statistical model should be developed
- More accurate

There are two ways to create a parametric estimate:

- **Regression analysis** (using a scatter diagram) in order to create a mathematical formula to use in future parametric estimates.
- **Learning curve**

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ESTIMATE ACTIVITY DURATIONS



TOOLS & TECHNIQUES

✓ Three-point estimating

- **Most likely (tM).** The duration of the activity, based on realistic effort assessment for the required work and any predicted expenses.
- **Optimistic (tO).** The activity duration based on analysis of the best-case scenario for the activity.
- **Pessimistic (tP).** The activity duration based on analysis of the worst-case scenario for the activity.

Depending on the assumed distribution of values within the range of the three estimates the expected duration, **tE**, can be calculated using a formula. Two commonly used formulas are triangular and beta distributions. The formulas are:

- **Triangular Distribution.** $tE = (tO + tM + tP) / 3$
- **Beta Distribution** (from a traditional PERT analysis). $tE = (tO + 4tM + tP) / 6$

Other terms related to Three-point estimating:

- Activity **Standard Deviation (SD)** is the possible range for the estimate. $SD = (P-O)/6$
Higher activity SD means riskier activity.
- **Task Variance (TV) = SD²**

17**ESTIMATE ACTIVITY DURATIONS****TOOLS & TECHNIQUES**✓ **Group decision-making techniques**

More accurate estimates and greater commitment may be obtained by working as a team on estimates.
Example of techniques include:

- Delphi technique
- Nominal group technique
- Brainstorming

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ESTIMATE ACTIVITY DURATIONS



TOOLS & TECHNIQUES

✓ Reserve analysis

There are two types of reserve:

- **Contingency Reserve:** also known as contingency allowance.
 - It is used for known unknowns
 - Part of the schedule baseline
 - It is calculated as percentage of the estimated duration, a fixed number, or may be developed by using quantitative analysis methods (for example Monte Carlo simulation)
 - Contingency reserves can provide for a specific activity, for the whole project, or both.
- **Management Reserve**
 - It is used for unknown unknowns
 - It is not included in the schedule baseline but is part of the overall project duration requirements

17**ESTIMATE ACTIVITY DURATIONS****OUTPUTS**

Activity duration
estimates »

- These are the estimates for each project activity
- May include a range. For example ± 2 days, 20% probability to exceed 5 days.
- Lags are not included in the activity duration estimates

17**ESTIMATE ACTIVITY DURATIONS****OUTPUTS****Project documents updates »**

Project documents updates examples:

- Activity attributes
- Assumptions made
 - skill levels
 - availability
 - basis of estimates for durations

18

DEVELOP SCHEDULE



*** Develop Schedule.** The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model for project execution and monitoring and controlling.

18

DEVELOP SCHEDULE



INPUTS

- » Project management plan
 - Schedule management plan
 - Scope baseline
- » Project documents
 - Activity attributes
 - Activity list
 - Assumption log
 - Basis of estimates
 - Duration estimates
 - Lessons learned register
 - Milestone list
 - Project schedule network diagrams
 - Project team assignments
 - Resource calendars
 - Resource requirements
 - Risk register
- » Agreements
- » Enterprise Environment Factors
- » Organizational Process Assets

TOOLS & TECHNIQUES

- ✓ Schedule network analysis
- ✓ Critical path method
- ✓ Resource optimization
- ✓ Data analysis
 - What-if scenario analysis
 - Simulation
- ✓ Leads and lags
- ✓ Schedule compression
- ✓ Project management information system
- ✓ Agile release planning

OUTPUTS

- Schedule baseline »
- Project schedule »
- Schedule data »
- Project calendars »
- Change requests »
- Project management plan updates »
 - Schedule management plan
 - Cost baseline
- Project documents updates »
 - Activity attributes
 - Assumption log
 - Duration estimates
 - Lessons learned register
 - Resource requirements
 - Risk register

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DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Schedule network analysis

* **Schedule Network Analysis.** The technique of identifying early and late start dates, as well as early and late finish dates, for the uncompleted portions of project schedule activities.

It employs different analytical techniques:

- critical path method
- critical chain method
- what-if analysis
- resource optimization

* **Path Convergence.** A relationship in which a schedule activity has more than one predecessor.

* **Path Divergence.** A relationship in which a schedule activity has more than one successor.

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DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Critical path method

Critical Path Method (CPM). * A method used to estimate the minimum project duration and determine the amount of scheduling flexibility on the logical network paths within the schedule model.

Critical Path Activity. * Any activity on the critical path in a project schedule.

Critical Path. * The sequence of activities that represents the longest path through a project, which determines the shortest possible duration.

Total Float (Total Slack). * The amount of time that a schedule activity can be delayed or extended from its early start date without delaying the project finish date or violating a schedule constraint.

Free Float (Free Slack). * The amount of time that a schedule activity can be delayed without delaying the early start date of any successor or violating a schedule constraint.

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DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Critical path method

Critical Path Related terms

Duration (DU or DUR). * The total number of work periods (not including holidays or other nonworking periods) required to complete a schedule activity or work breakdown structure component. Usually expressed as workdays or workweeks. Sometimes incorrectly equated with elapsed time. Contrast with effort.

Early Finish Date (EF). * In the critical path method, the earliest possible point in time when the uncompleted portions of a schedule activity can finish based on the schedule network logic, the data date, and any schedule constraints.

Early Start Date (ES). * In the critical path method, the earliest possible point in time when the uncompleted portions of a schedule activity can start based on the schedule network logic, the data date, and any schedule constraints.

Late Finish Date (LF). * In the critical path method, the latest possible point in time when the uncompleted portions of a schedule activity can finish based on the schedule network logic, the project completion date, and any schedule constraints.

Late Start Date (LS). * In the critical path method, the latest possible point in time when the uncompleted portions of a schedule activity can start based on the schedule network logic, the project completion date, and any schedule constraints.

18**DEVELOP SCHEDULE****TOOLS & TECHNIQUES**✓ **Critical path method**

EARLY START	DURATION	EARLY FINISH
A		
LATE START	TOTAL FLOAT	LATE FINISH

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DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Critical path method

Critical Path Related terms

Total Float (Total Slack). * The amount of time that a schedule activity can be delayed or extended from its early start date without delaying the project finish date or violating a schedule constraint.

Free Float (Free Slack). * The amount of time that a schedule activity can be delayed without delaying the early start date of any successor or violating a schedule constraint.

Total Float = LS – ES or LF - EF

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DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Critical path method

Critical Path Related terms

Forward Pass. * A critical path method technique for calculating the early start and early finish dates by working forward through the schedule model from the project start date or a given point in time.

Backward Pass. * A critical path method technique for calculating the late start and late finish dates by working backward through the schedule model from the project end date.

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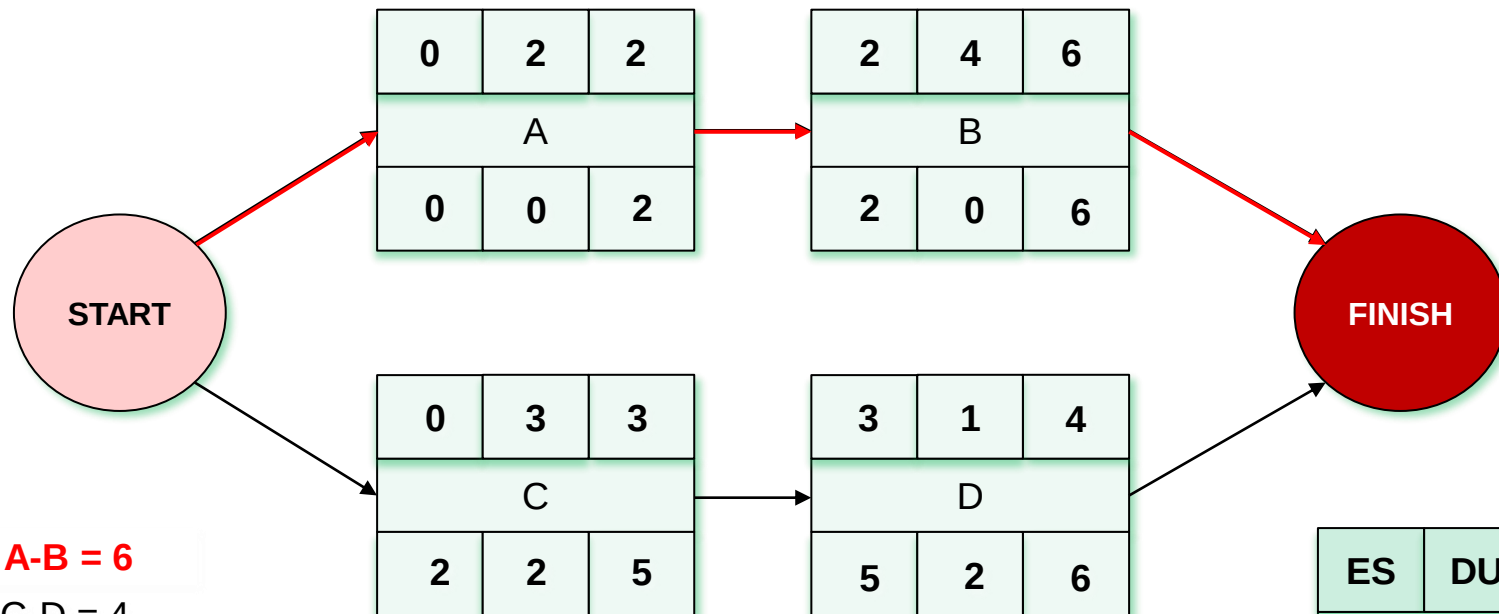
DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Critical path method

Forward Pass



Path A-B = 6

Path C-D = 4

Total Float = LS – ES or

Total Float = LF - EF

Backward Pass

ES	DU	EF
ACTIVITY NAME		
LS	F	LF

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DEVELOP SCHEDULE

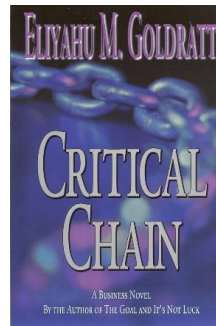


TOOLS & TECHNIQUES

✓ Critical chain method

Critical Chain Method (CCM). * A schedule method that allows the project team to place buffers on any project schedule path to account for limited resources and project uncertainties.

- There are two types of buffers:
 - **Feeding buffer:**
 - Placed at the end of a path feeding into the critical chain
 - These buffers help protect the critical path from any slippages on the feeding path
 - **Project buffer:**
 - Placed at the end of critical chain
 - These buffers help protect the end date from any slippages on the critical chain
- Instead of managing the total float of network paths, the critical chain method focuses on managing the remaining buffer durations against the remaining durations of chains of activities.
- The method was developed by Goldratt
- This method tries to strike a balance between what is anticipated for the project from:
 - Parkinson's Law – work will expand to fill the time available
 - Student syndrome: procrastination



**This definition is taken from the Glossary of the Project Management Institute, A Guide to the Project Management Body of Knowledge, (PMBOK® Guide) – Sixth Edition, Project Management Institute, Inc., 2017.*

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DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Resource optimization techniques

Resource Optimization Techniques. * A technique that is used to adjust the start and finish dates of activities that adjust planned resource use to be equal to or less than resource availability.

Resource Leveling	Resource Smoothing
* A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing demand for resources with the available supply.	* A technique which adjusts the activities of a schedule model such that the requirement for resources on the project do not exceed certain predefined resource limits.
Resources constrained	Time constrained
Critical path may change	Critical path not allowed to change
All resources issues resolved	Not all resources may be optimized

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DEVELOP SCHEDULE

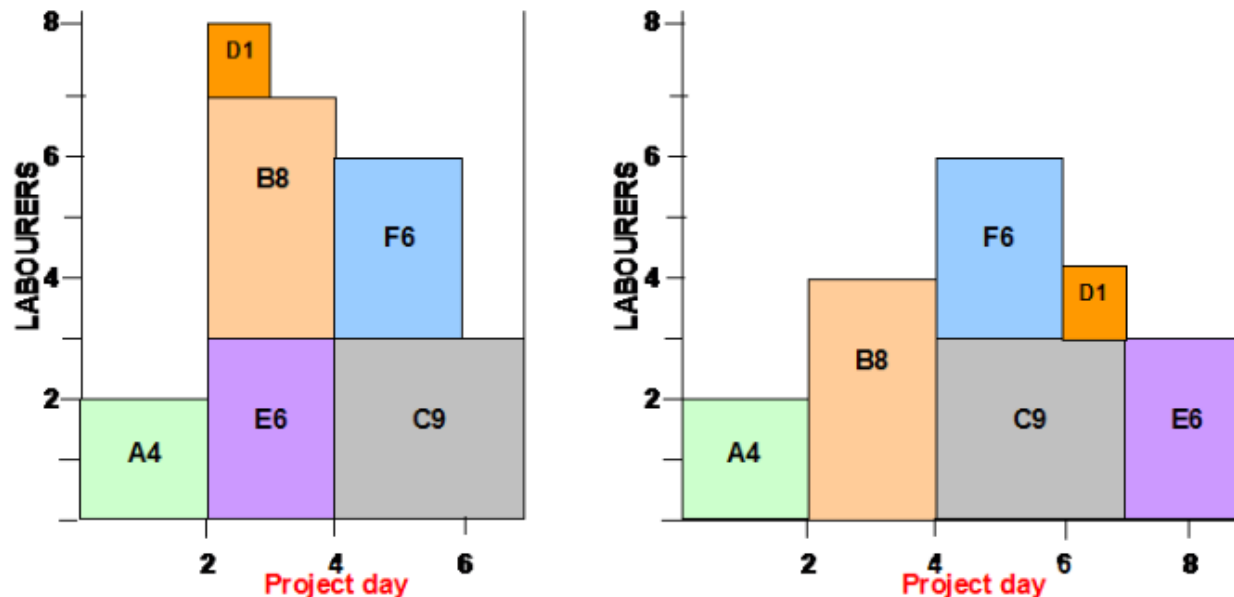


TOOLS & TECHNIQUES

✓ Resource optimization techniques

Resource Optimization Techniques. * A technique that is used to adjust the start and finish dates of activities that adjust planned resource use to be equal to or less than resource availability.

Resource Leveling



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DEVELOP SCHEDULE



TOOLS & TECHNIQUES

✓ Modeling techniques

- **What-If Scenario Analysis.** It is the process of evaluating scenarios in order to predict their effect, positively or negatively, on project objective
- **Simulation.** It involves calculating multiple project durations with different sets of activity assumptions, usually using probability distributions constructed from the three-point estimates
 - **Monte Carlo Simulation.** * A process which generates hundreds or thousands of probable performance outcomes based on probability distributions for cost and schedule on individual tasks. The outcomes are then used to generate a probability distribution for the project as a whole.

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DEVELOP SCHEDULE



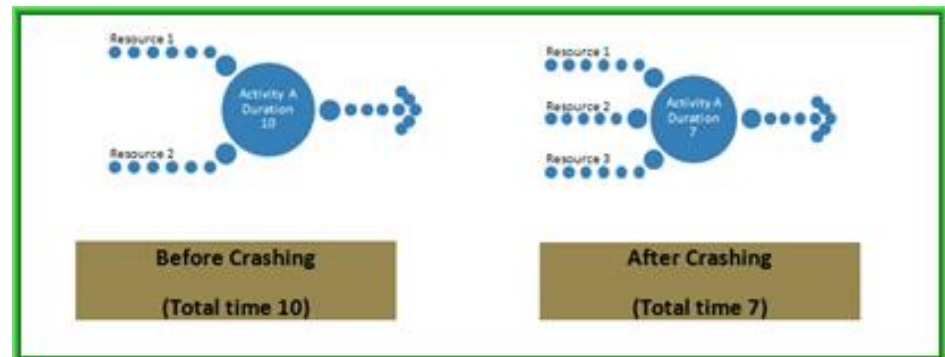
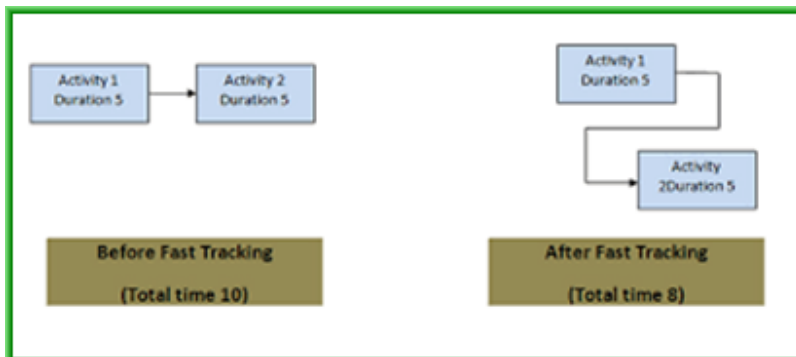
TOOLS & TECHNIQUES

✓ Schedule compression

Schedule Compression. * Techniques used to shorten the schedule duration without reducing the project scope.

Example of schedule compression techniques:

- **Crashing.** * A technique used to shorten the schedule duration for the least incremental cost by adding resources.
 - Effect: increased costs
- **Fast Tracking.** * A schedule compression technique in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration.
 - Effect: increased risks



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DEVELOP SCHEDULE



OUTPUTS

Schedule baseline »

Schedule Baseline. * The approved version of a schedule model that can be changed only through formal change control procedures and is used as a basis for comparison to actual results.

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DEVELOP SCHEDULE



OUTPUTS

Project schedule »

Project Schedule. * An output of a schedule model that presents linked activities with planned dates, durations, milestones, and resources.

- It is the working schedule.
- It is expected to change and to be updated with the actual data.
- It may be expressed in different forms:
 - **Bar charts** (For example: Gantt chart): simple, easy to read, good to show progress
 - For control and management communications in bar charts are used Summary Activities (known also as **Hammock Activities**). * A group of related schedule activities aggregated and displayed as a single activity.
 - **Milestone charts:** simple, easy to read, good for management presentation
 - **Project schedule network diagram:** more complex, show logical relationships, good for working with team

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DEVELOP SCHEDULE

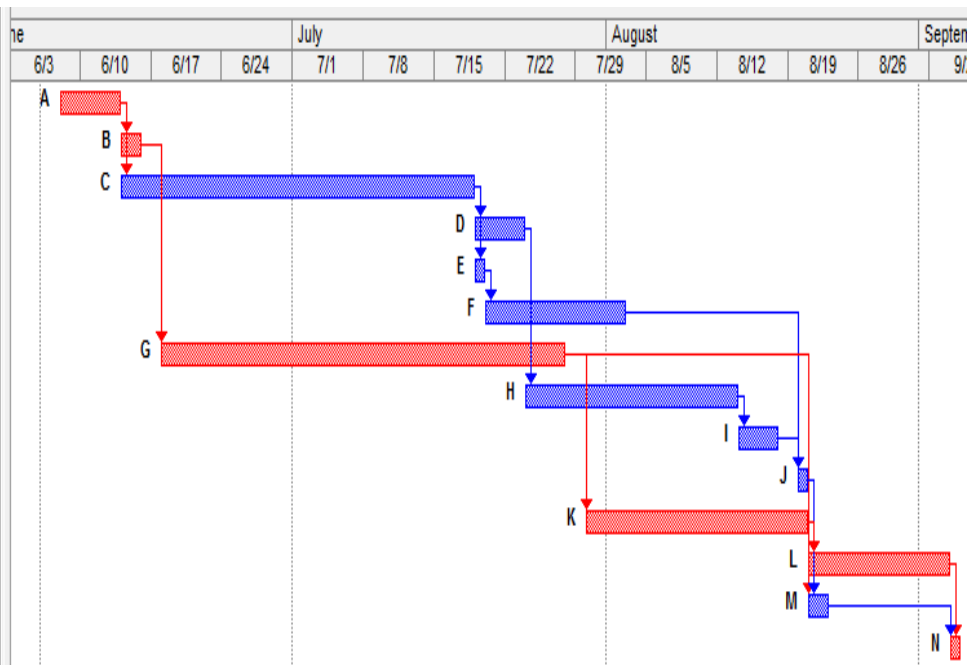


OUTPUTS

Project schedule »

Bar chart example:

WP ere	Task Name	Free Slack	Total Slack	Predecessors	Duration
1	A Define services	0 days	0 days		4 days
2	B Decide staffing levels	0 days	0 days	1	2 days
3	C Locate suitable location for the team	0 days	8 days	1	25 days
4	D Plan building work	0 days	8 days	3	3 days
5	E Order equipment (PCs, phones, etc)	0 days	18 days	3	1 day
6	F Await delivery of equipment	10 days	18 days	5	10 days
7	G Recruit staff	0 days	0 days	2	30 days
8	H Carry out building work	0 days	8 days	4	15 days
9	I Install desks	0 days	8 days	8	3 days
10	J Install equipment (PCs, phones, etc)	0 days	8 days	6,9	1 day
11	K Train new hires	0 days	0 days	7	15 days
12	L Shadowing	0 days	0 days	11	10 days
13	M Test operation	8 days	8 days	7,10	2 days
14	N Transfer services to MS GF Ro	0 days	0 days	12,13	1 day



18**DEVELOP SCHEDULE****OUTPUTS**

Project schedule »

- ✓ Microsoft Project - <https://products.office.com/en/project/project-and-portfolio-management-software>
- ✓ Oracle Primavera EPPM - <https://www.oracle.com/applications/primavera/products/project-management.html>
- ✓ ProjectManager.com - <https://www.projectmanager.com/>
- ✓ Planhammer - <https://planhammer.io>

- ✓ GanttProject - <http://www.ganttproject.biz/>
- ✓ Asana - <https://asana.com/>
- ✓ OpenProj - <https://sourceforge.net/projects/openproj/>
- ✓ LibrePlan - <http://www.libreplan.org/>

Comparison of project management software:

- ✓ https://en.wikipedia.org/wiki/Comparison_of_project_management_software

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DEVELOP SCHEDULE



OUTPUTS

Schedule data »

Schedule Data. * The collection of information for describing and controlling the schedule.

Example of information that may be contained:

- Resource requirements by time period, often in the form of a resource histogram
- Alternative schedules, such as best-case or worst-case, not resource-leveled, or resource-leveled, with or without imposed dates
- Scheduling of contingency reserves

18**DEVELOP SCHEDULE****OUTPUTS****Project calendars »**

The project calendars identify working days, time periods and shifts that are available for scheduled activities.

18**DEVELOP SCHEDULE****OUTPUTS****Project documents updates »**

Project documents updates examples:

- Activity resource requirements
- Activity attributes
- Calendars
- Risk register

19

CONTROL SCHEDULE



* **Control Schedule.** The process of monitoring the status of the project to update the project schedule and manage changes to the schedule baseline.

It is concerned with:

- Determining the current status of the project schedule
- Influencing the factors that create schedule changes
- Determining if the project schedule has changed
- Managing the actual changes as they occur

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CONTROL SCHEDULE



“If it is an agile approach it concerns with:

- Determining the current status of the project schedule by comparing the total amount of work delivered and accepted against the estimates of work completed for the 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 (agreed work cycle duration, typically two weeks or one month)
- Determining that the project schedule has changed
- Managing the actual changes as they occur”

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CONTROL SCHEDULE



INPUTS

- » Project management plan
 - Schedule management plan
 - Schedule baseline
 - Scope baseline
 - Performance measurement baseline
- » Project documents
 - Lessons learned register
 - Project calendars
 - Project schedule
 - Resource calendars
 - Schedule data
- » Work performance data
- » Organizational Process Assets

TOOLS & TECHNIQUES

- ✓ Data analysis
 - Earned value analysis
 - Iteration burndown chart
 - Performance reviews
 - Trend analysis
 - Variance analysis
 - What-if scenario analysis
- ✓ Critical path method
- ✓ Project management information system
- ✓ Resource optimization
- ✓ Leads and lags
- ✓ Schedule compression

OUTPUTS

- Work performance information »
- Schedule forecast »
- Change requests »
- Project management plan Updates »
 - Schedule management plan
 - Schedule baseline
 - Cost baseline
 - Performance measurement baseline
- Project documents updates »
 - Assumption log
 - Basis of estimates
 - Lessons learned register
 - Project schedule
 - Resource calendars
 - Risk register
 - Schedule data

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CONTROL SCHEDULE



The pattern of the CONTROL PROCESS:

- **Inputs:** „Baseline” and „Actual”
- Analyze the gap between „Actual” and „Baseline”
- **Outputs:** „Change requests”, „Project documents updates”, „PMP Updates”, „OPA updates”, „Work Performance Information”

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CONTROL SCHEDULE



TOOLS & TECHNIQUES

✓ Performance reviews

Performance Reviews. * A technique that is used to measure, compare, and analyze actual performance of work in progress on the project against the baseline.

- **Trend Analysis.** * An analytical technique that uses mathematical models to forecast future outcomes based on historical results. It is a method of determining the variance from a baseline of a budget, cost, schedule, or scope parameter by using prior progress reporting periods' data and projecting how much that parameter's variance from baseline might be at some future point in the project if no changes are made in executing the project.
- **Critical path method**
- **Critical chain method**
- **Earned value management** is used to assess the magnitude of variation to the original schedule baseline (will be detailed in Cost Management Area)

19**CONTROL SCHEDULE****TOOLS & TECHNIQUES**✓ **Project management software**

Project management software is used to:

- track planned dates versus actual dates
- report variances to and progress made against the schedule baseline
- forecast the effects of changes to the project schedule model

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CONTROL SCHEDULE



OUTPUTS

Schedule forecast »

Schedule Forecasts. * Estimates or predictions of conditions and events in the project's future based on information and knowledge available at the time the schedule is calculated.

19**CONTROL SCHEDULE****OUTPUTS****Project documents updates »**

Project documents updates examples:

- Schedule Data
- Project schedule
- Risk register

Project Schedule Management

14	PLAN SCHEDULE MANAGEMENT		
15	DEFINE ACTIVITIES		
16	SEQUENCE ACTIVITIES		
17	ESTIMATE ACTIVITY DURATIONS		
18	DEVELOP SCHEDULE		
19	CONTROL SCHEDULE		



Project Schedule Management



- Schedule Management Plan content
- Apportioned Effort (AE)
- Discrete Effort (DE)
- Level of Effort (LOE)
- Precedence Diagramming Method (PDM)
- Arrow diagramming method (ADM)
- Graphical Evaluation and Review Technique (GERT)
- Dependencies
- Lead and Lag
- Project Schedule Network Diagram
- Project calendar vs Resource calendars
- Analogous estimating vs Parametric estimating
- Regression analysis
- Learning curve
- Triangular Distribution vs Beta Distribution
- Pert formula = $(P+4M+O)/6$
- Standard Deviation (SD) = $(P-O)/6$
- Task Variance = SD²
- Schedule Network Analysis
- Critical Path Method (CPM)
- Total Float (Total Slack)
- Free Float (Free Slack)
- Total Float = LS – ES or LF - EF
- Critical Chain Method (CCM)
- Feeding buffer vs Project buffer
- Parkinson"s Law
- Resource Leveling vs Resource Smoothing
- What-If Scenario Analysis vs Simulation
- Monte Carlo Simulation
- Crashing vs Fast Tracking
- Schedule Baseline vs Project Schedule
- Hammock Activity

S Project Schedule Management

**Even if you have Questions
still**

**25 Questions
30 minutes**