

# CRITICAL PATH METHOD (CPM) SCHEDULES

How-to for Reading, Understanding,  
and Using CPM Schedules (without  
Direct Primavera Access.)





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10/01/2015

## Objectives

- Learn to read, understand, and use CPM schedules (without direct Primavera access.)
  - Understand information and resources available.
- Deliver transportation projects on schedule and within budget.
- Foster a schedule driven culture.



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  - Understand information and resources available.
- Deliver transportation projects on schedule and within budget.
- Foster a schedule driven culture.

## Benefits

- Avoid delays, and/or reductions in project quality
- Avoid increased project costs
- Think ahead and anticipate problems
- Manage personnel/resources
- Prevent and protect against claims



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## Overview – Part 1

- General Concepts and Fundamentals
  - Work Breakdown Structure (WBS)
  - Activity Details
  - Relationship Concepts And Properties
  - CPM Schedule Components



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- General Concepts and Fundamentals
  - Work Breakdown Structure (WBS)
  - Activity Details
  - Relationship Concepts And Properties
  - CPM Schedule Components

## Overview – Part 2

- TDOT Documents and Procedures
  - TDOT Specification
  - Checklists
  - Circular Letter
    - Receiving and Storing Schedule Files
    - Conducting the Baseline CPM Schedule Review
    - Schedule Updates
    - Schedule Revisions
    - Communication with the Contractor
    - Time Impacts and Delays
    - Primavera Power-Users
- Duties/Authorities of the Engineer



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  - TDOT Specification
  - Checklists
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- Duties/Authorities of the Engineer

## Materials

- Slides: Printed with notes and intended to serve as a manual for future reference
- Affiliated documents
  - Specification
  - Circular Letter
  - Forms (2)
  - Letters
- Sample CPM Schedule submittal



**General Concepts and Fundamentals**

**Activity Details - General**

- **Activity Type** - how the activity's schedule is calculated.
- Type can be:
  - **Task Dependent** - scheduled according to the activity's calendar
  - **Resource Dependent** - scheduled according to the calendars of assigned resources
  - **Level of Effort** - duration determined by its dependent activities
  - **Start Milestone, Finish Milestone** - a zero-duration marker
  - **WBS Summary** - duration determined by a group of activities with a common WBS level.

**General Concepts and Fundamentals**

**Activity Details - General**

**Type** - the selected activity's type or how the activity's schedule is calculated. An activity's type can be Task Dependent, Resource Dependent, Level of Effort, Start Milestone, Finish Milestone, or WBS Summary.

- A **Task Dependent** activity is scheduled according to the activity's calendar rather than calendars of assigned resources.
- A **Resource Dependent** activity is scheduled according to the calendars of assigned resources. This activity type is used when several resources are assigned to the same activity, but may work separately.
- A **Level of Effort** activity has a duration which is determined by its dependent activities. Administration-type activities are typically Level of Effort.
- A **Start/Finish Milestone** is a zero-duration activity with no resources, marking a significant project event.
- A **WBS Summary** activity has a duration which is determined by a group of activities that share a common WBS level. Resources that drive activity dates cannot be assigned to WBS summary activities.

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## Materials

- Slides: Slides are printed with notes and intended to serve as a manual for future reference.
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  - Forms (2)
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# General Concepts and Fundamentals

The image displays a detailed Critical Path Method (CPM) schedule chart. The chart is a grid with activities listed on the left and time on the horizontal axis. A critical path is highlighted in red. In the foreground, there is a calculator, a ruler, and a pen, suggesting a practical application of the scheduling process. A small red square with the letters 'TN' is located in the bottom left corner of the image area.

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## General Concepts and Fundamentals

## General Concepts and Fundamentals

### Work Breakdown Structure (WBS)

- A WBS is a hierarchy of work to complete a project.
- Structured in levels of work detail,
  - beginning with the deliverable itself
  - separated into work elements.
- Provides a structured framework to breakdown a project into parts.
- Typically developed first, followed by the activities.



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### General Concepts and Fundamentals

A WBS is a hierarchy of work that must be accomplished to complete a project. The WBS is structured in levels of work detail, beginning with the deliverable itself, and is then separated into identifiable work elements. WBS provides a structured framework with which to breakdown a project into meaningful and manageable parts. The WBS is typically developed first, followed by the activities for performing the work.

## General Concepts and Fundamentals

### Work Breakdown Structure (WBS)

#### ▫ Levels

- Project
- Project Phase (e.g. Construction)
- Area/phase (e.g. Phase 1)
- Feature of work (e.g. Roadway, Bridge, Ramp)
- Work package (e.g. Earthwork, Drainage, Abutment)



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### General Concepts and Fundamentals

#### Levels

- Project
- Project Phase (e.g. Construction)
- Area/phase (e.g. Phase 1)
- Feature of work (e.g. Roadway, Bridge, Ramp)
- Work package (e.g. Earthwork, Drainage, Abutment)

## General Concepts and Fundamentals

### Work Breakdown Structure (WBS)

#### ▫ Example – Reconstruction of a State Route

- Administration
  - » Side Roads
- Procurement
  - » Ramps
  - » Storm Drainage
- Submittals
- Fabricate & Deliver
- Construction
  - Bridges
  - Walls
  - Utilities
    - » Power & Communications
    - » Water
  - Roadway / Box Culverts
    - » Grading
    - » Culverts
    - » Roadway



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### General Concepts and Fundamentals

#### Example:

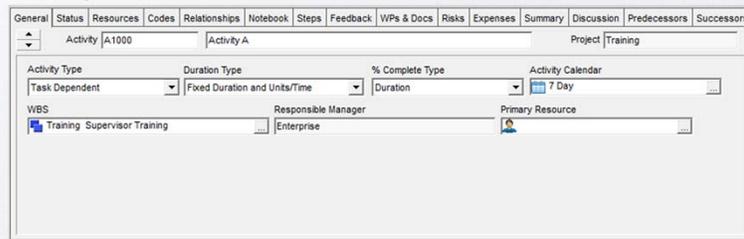
- Administration
- Procurement
  - Submittals
  - Fabricate & Deliver
- Construction
  - Roadway / Box Culverts
    - Grading
    - Culverts
    - Roadway
    - Side Roads
    - Ramps
    - Storm Drainage
  - Bridges
  - Walls
  - Utilities
    - Power & Communications
    - Water

## General Concepts and Fundamentals

### Activities

Activities= Well defined, measureable pieces of work with a measureable outcome.

- Usually developed after WBS
- Numerous details associated with each activity



The screenshot shows a software interface for defining an activity. The top menu bar includes: General, Status, Resources, Codes, Relationships, Notebook, Steps, Feedback, WPs & Docs, Risks, Expenses, Summary, Discussion, Predecessors, Successors. The main window is titled 'Activity A' and 'Project Training'. It contains several fields: 'Activity Type' (Task Dependent), 'Duration Type' (Fixed Duration and Units/Time), '% Complete Type' (Duration), and 'Activity Calendar' (7 Day). Below these are 'WBS' (Training Supervisor Training), 'Responsible Manager' (Enterprise), and 'Primary Resource'.



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### General Concepts and Fundamentals

#### Activities

Generally – Well defined, measureable pieces of work with a measureable outcome.

Activities are usually developed after the Work Breakdown Structure (WBS).

Numerous details are associated with each activity.

## General Concepts and Fundamentals

### Activity Details - General

- **ID** –
  - An assigned alphanumeric ID code
  - Uniquely identifies the activity
    - e.g. A4690
- **Name**
  - Concise description assigned to an activity
  - Activity name must clearly describe:
    - work being performed and
    - the specific location or limit of the work.
    - e.g. - A4690 - Mass Excavation ST 100+00 to 120+00



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### General Concepts and Fundamentals

#### Activity Details - General

**ID** - An alphanumeric ID code assigned to an activity that is used to uniquely identify the activity.

e.g. A4690

**Name** - A meaningful yet concise description assigned to an activity that is used to uniquely describe the work or event that the activity represents. Activity name must clearly describe the work being performed and the specific location or limit of the work.

e.g. - A4690 - Mass Excavation ST 100+00 to 120+00

## General Concepts and Fundamentals

### Activity Details - General

- **Activity Type** = how the activity's schedule is calculated.
- Type can be:
  - Task Dependent - scheduled according to the activity's calendar
  - Resource Dependent - scheduled according to the calendars of assigned resources
  - Level of Effort - duration determined by its dependent activities
  - Start Milestone, Finish Milestone - a zero-duration marker
  - WBS Summary - duration determined by a group of activities with a common WBS level.



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### General Concepts and Fundamentals

#### Activity Details - General

**Type** - the selected activity's type or how the activity's schedule is calculated. An activity's type can be Task Dependent, Resource Dependent, Level of Effort, Start Milestone, Finish Milestone, or WBS Summary.

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- A Start/Finish Milestone is a zero-duration activity with no resources, marking a significant project event.
- A WBS summary activity has a duration which is determined by a group of activities that share a common WBS level. Resources that drive activity dates cannot be assigned to WBS summary activities.

## General Concepts and Fundamentals

### Activity Details - General

- **Duration Type** - Basis for estimating the selected activity's completion time.
- An activity's duration type can be:
  - Fixed Units/Time,
  - Fixed Duration & Units/Time,
  - Fixed Units, or
  - Fixed Duration & Units.



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### General Concepts and Fundamentals

#### Activity Details - General

**Duration Type** - The basis for estimating the selected activity's completion time. An activity's duration type can be Fixed Units/Time, Fixed Duration & Units/Time, Fixed Units, or Fixed Duration & Units.

- For Fixed Units/Time, the resource units per time are constant when the activity duration or units are changed. This type is used when an activity has fixed resources with fixed productivity output per time period. You most often choose this duration type when you are using resource dependent activities.
- For Fixed Duration & Units/Time, the activity duration is constant and the units are changed. This type is used when the activity is to be completed within a fixed time period regardless of the resources assigned. You most often choose this duration type when you are using task dependent activities.
- For Fixed Units, the activity units are constant when the duration or resource units per time are changed. This type is used when the total amount of work is fixed, and increasing the resources can decrease the activity duration. You most often choose this duration type when you are using resource dependent activities.
- For Fixed Duration & Units, the activity duration is constant and the units/time are changed. This type is used when the activity is to be completed within a fixed time period and the total amount of work is

fixed. You most often choose this duration type when you are using task dependent activities.

## General Concepts and Fundamentals

### Activity Details - General

- **% Complete Type** - The way in which the percent complete for the selected activity is determined.
  - An activity's percent complete type can be:
    - Units,
    - Duration, or
    - Physical.



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### General Concepts and Fundamentals

#### Activity Details - General

**% Complete Type** - The way in which the percent complete for the selected activity is determined.

An activity's percent complete type can be Units, Duration, or Physical.

Units % Complete = (Actual Labor Units + Actual Nonlabor Units)

Duration % Complete = (Original or Planned Duration – Remaining Duration)

Physical= A percent complete that is entered manually by the user instead of being calculated by the software.

## General Concepts and Fundamentals

### Activity Details - General

- **Calendar** - Define available working hours and workdays within which an activity can be completed.
- Each calendar defines:
  - Available work hours in each calendar day
  - Default hours per time period settings that are used as conversion factors when entering or displaying units in time increments other than hours
  - National holidays
  - Your organization's holidays
  - Project-specific work/ nonworkdays
  - Resource vacation days.



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### General Concepts and Fundamentals

#### Activity Details - General

**Calendar** - Calendars define available working hours and workdays within which an activity can be completed.

Each calendar defines:

- Available work hours in each calendar day
- Default hours per time period settings that are used as conversion factors when entering or displaying units in time increments other than hours
- National holidays
- Your organization's holidays
- Project-specific work/ nonworkdays
- Resource vacation days.

## General Concepts and Fundamentals

Activity Details –  
General/Calendar

### Standard 5-Day Work Calendar:

- defined in terms of a standard 5-day or 6-day workweek schedule
- use as the default working calendar for majority of the activities on the project

September 2015

Sun	Mon	Tue	Wed	Thr	Fri	Sat
	1	2	3	4	5	
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Work hours/day: 8.0

Standard  Nonwork  Exception



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### General Concepts and Fundamentals

#### Activity Details - General

##### Calendar - Standard 5-Day Work Calendar:

A standard calendar that defines the normal working schedule for each day, week, and month for use as the default working calendar for majority of the activities on the project. The standard work calendar may be defined in terms of a standard 5-day or 6-day workweek schedule, excluding as applicable, nonworkdays for weekends and holidays. When a 5-day or 6-day calendar is assigned to an activity, the activity duration must be specified in workdays.

## General Concepts and Fundamentals

Activity Details –  
General/Calendar

### Standard 7-Day Work Calendar:

- not constrained by weekends, holidays, weather, or other non-workday restrictions
- activity duration must be specified in calendar days

September 2015						
Sun	Mon	Tue	Wed	Thr	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Work hours/day: 10.0

Standard  Nonwork  Exception



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### General Concepts and Fundamentals

#### Activity Details - General

##### Calendar - Standard 7-Day Work Calendar:

A standard calendar that defines the normal working schedule for each day, week, and month for use on activities that are not constrained by weekends, holidays, weather, or other non-workday restrictions. Such activities may include, but are not limited to procurement/fabrication of long lead materials, curing, load test, settlement or surcharge periods, WBS summary, or level of effort. A 7-day calendar will also be used when the Contract specifies calendar day durations for certain activities. When a 7-day calendar is assigned to an activity, the activity duration must be specified in calendar days.

## General Concepts and Fundamentals

Activity Details –  
General/Calendar

### Standard 5-Day Weather Calendar:

- For activities that may be affected by adverse weather.
- reduced for the number of estimated weather days anticipated each month
- randomly changing available workdays to non-workdays.

The screenshot shows a calendar for September 2015. The days of the week are labeled: Sun, Mon, Tue, Wed, Thr, Fri, Sat. The dates 1 through 30 are displayed in a grid. A dropdown menu on the right is labeled 'Work hours/day' and is set to '8.0'. Below the calendar, there are three checkboxes: 'Standard' (checked), 'Nonwork', and 'Exception'.



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### General Concepts and Fundamentals

#### Activity Details - General

##### Calendar - Standard 5-Day Weather Calendar:

A standard calendar that defines the normal working schedule for each day, week, and month for use on activities that may be affected by adverse weather. The standard weather calendar may be defined in terms of a standard 5-day or 6-day workweek schedule, excluding as applicable, non-workdays for week-ends and holidays. Additionally, the number of workdays available each month will be reduced for the number of estimated weather days (days lost due to weather) anticipated each month by randomly changing available workdays to non-workdays.

In lieu of a weather calendar, a weather contingency activity may be added to the schedule for the total number of estimated weather days anticipated over the duration of the project. The weather contingency activity will then be linked between the project completion milestone activity and the last activity on the critical path that may be affected by adverse weather. An adjustment will be made each month to reduce the weather contingency activity duration by the number of weather days lost during the month.

## General Concepts and Fundamentals

Activity Details –  
General/Calendar

### Winter Shut-down Calendar:

- weather sensitive activities that cannot be performed during the winter periods due to temperature requirements

December 2015

Sun	Mon	Tue	Wed	Thr	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Work hours/day: 8.0

Standard  Nonwork  Exception



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General Concepts and Fundamentals

### Activity Details - General

#### Calendar - Winter Shut-down Calendar:

A calendar that defines the normal working schedule for each day, week, and month for use on weather sensitive activities such as asphalt paving that cannot be performed during the winter periods due to temperature requirements. Winter shut-down calendars may be defined based on a standard work calendar or weather calendar, excluding as applicable, non-workdays for week-ends, holidays, and weather days. Additionally, available workdays during the winter shut-down periods will be changed to non-work days accordingly.

## General Concepts and Fundamentals

Activity Details –  
General/Calendar

### Special Event or Environmental Calendar:

- Activities with special event, environmental, or other specified time of year restriction.
  - e.g. CMA Festival June 11-14

June 2015							Work hours/day
Sun	Mon	Tue	Wed	Thr	Fri	Sat	8.0
	1	2	3	4	5	6	
7	8	9	10	11	12	13	
14	15	16	17	18	19	20	
21	22	23	24	25	26	27	
28	29	30					

Standard  Nonwork  Exception



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### General Concepts and Fundamentals

#### Activity Details - General

##### Calendar -Special Event or Environmental Calendar:

A calendar that defines the normal working schedule for each day, week, and month for use on activities with special event, environmental, or other specified time of year restriction. Special event or environmental calendars may be defined based on a standard work calendar or weather calendar, excluding as applicable, non-workdays for week-ends, holidays, and weather days. Additionally, available workdays will be changed to non-work days accordingly, for the specified time of year restriction. A separate calendar must be defined for each special event or environmental time of year restriction, if the times of year restrictions are not concurrent.

## General Concepts and Fundamentals

### Activity Details - Status

#### Duration

- Original or Planned: The expected number of work periods required to complete the selected activity.
- Actual: actual number of work periods spent
- Remaining: remaining number of work periods needed.
- At Complete: An estimate of the duration at completion time for the selected activity.
  - At Complete Duration = Actual Duration + Remaining Duration



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### General Concepts and Fundamentals

#### Activity Details - Status

##### Duration

- Original or Planned: The expected number of work periods required to complete the selected activity.
- Actual: The actual number of work periods spent on the selected activity.
- Remaining: The remaining number of work periods needed to complete the selected activity.
- At Complete: An estimate of the duration at completion time for the selected activity. (At Complete Duration = Actual Duration + Remaining Duration).

## General Concepts and Fundamentals

### Activity Details - Status

#### Float

- Total Float: Time an activity can be delayed, without delaying the project's finish date.
- Free Float: Time an activity can be delayed, without delaying the immediate successor activities.



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### General Concepts and Fundamentals

#### Activity Details - Status

##### Float

- Total Float: The amount of time the selected activity can be delayed, without delaying the project's finish date.
- Free Float: The amount of time the selected activity can be delayed, without delaying the immediate successor activities.

## General Concepts and Fundamentals

### Activity Details - Status

#### Status Dates

- Started: Indicates that the selected activity has started.
- Finished: Indicates that the selected activity is complete.
- Exp. Finish: Indicates expected finish date.
  
- %: Indicates % complete based on % complete type
  - E.g. A 10-day duration based activity with 5 days remaining would be 50% complete
  
- Suspend: The date the activity's progress stopped.
- Resume: The date the suspended activity's progress resumed.



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### General Concepts and Fundamentals

#### Activity Details - Status

##### Status Dates

- Started: Indicates that the selected activity has started. If the activity has started or is complete, the activity's actual start date shows.
- Finished: Mark to indicate that the selected activity is complete. The field beside this checkbox displays the activity's remaining finish date. If the activity is complete, the activity's actual finish date shows.
- Exp Finish: Indicates expected finish date.
- %: Indicates % complete based on % complete type
  - For example, a 10-day duration based activity with 5 days remaining would be 50% complete.
- Suspend: The date on which the activity's progress stopped.
- Resume: The date on which the suspended activity's progress resumed.

## General Concepts and Fundamentals

### Activity Details - Status

### Constraints

- Network logic alone cannot reflect all project situations.
- Sometimes activities must be accomplished according to specific dates rather than on dates determined by other activities in the project.



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### General Concepts and Fundamentals

#### Activity Details - Status

**Constraints** –Network logic alone cannot reflect all project situations. Sometimes activities must be accomplished according to specific dates rather than on dates determined by other activities in the project.

## General Concepts and Fundamentals

### Activity Details - Status

### Constraint Types

- Types:
  - Start on
  - Start on or after
  - Start on or before
  - Finish on



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### General Concepts and Fundamentals

#### Activity Details - Status

#### Constraints Types

- Start on - A restriction you place on an activity by imposing a start date. The start on constraint can delay an early start or accelerate a late start to satisfy the imposed date.
- Start on or after - A restriction you impose on an activity that limits the earliest time it can begin. When calculating a schedule, the start on or after constraint is used in the forward pass only if the calculated early start date will be earlier than the imposed date. This constraint affects only early dates.
- Start on or before - A restriction you impose on an activity that limits the latest date it can start. When calculating a schedule, the start on or before constraint is used in the backward pass only if the calculated late start date will be later than the imposed date. This constraint may decrease total float. It only affects late dates.
- Finish on - A restriction you place on an activity by imposing a finish date. The finish on constraint can delay an early finish or accelerate a late finish to satisfy the imposed date.

## General Concepts and Fundamentals

### Activity Details - Status

### Constraint Types continued

- Types:
  - Finish on or after
  - Finish on or before
  - As late as possible



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### General Concepts and Fundamentals

#### Activity Details - Status

#### Constraints Types

- finish on or after- A restriction you impose on an activity that limits the earliest time it can complete. The finish on or after constraint reduces float to coordinate parallel activities, ensuring that the finish of an activity is not scheduled before the specified date. It is usually applied to activities that have few predecessors that must finish before the next phase of a project.
- finish on or before - A restriction you impose on an activity that limits the latest time it can be finished. The finish on or before constraint affects only late dates. Use this constraint to ensure that the late finish date of an activity is not later than the date you impose.
- as late as possible - A restriction you impose on an activity or work unit with positive float that allows it to start as late as possible without delaying its successors. This constraint sets the early dates as late as possible without affecting successor activities.

## General Concepts and Fundamentals

### Activity Details - Status

### Constraint Types continued

- Types:
  - Mandatory start
  - Mandatory finish



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### General Concepts and Fundamentals

#### Activity Details - Status

#### Constraints Types

- mandatory start - A restriction you impose on an activity that sets its early and late start dates equal to the date you specify. The mandatory early start date is used regardless of its effect on network logic. A mandatory early start date could affect the late dates for all activities that lead to the constrained activity and all early dates for the activities that lead from the constrained activity.
- mandatory finish - A restriction you impose on an activity that sets its early and late finish dates equal to the date you specify. The mandatory finish date is used regardless of its effect on network logic. This constraint affects the late dates for all activities that lead to the constrained activity and all early dates for the activities that lead from the constrained activity.

## Relationship Concepts And Properties

- Logic is added to the schedule to provide the order in which the activities must be undertaken. This logic is designated by the relationships or inter-dependencies between activities.



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### Relationship Concepts And Properties

Logic is added to the schedule to provide the order in which the activities must be undertaken. This logic is designated by the relationships or inter-dependencies between activities.

## Relationship Concepts And Properties

### **Precedence Diagramming Method (PDM) –**

The method used by software, such as Primavera, to sequence the activities.

- A technique that uses a directed graph to describe the precedence of project activities.
- Characteristics:
  1. Discrete or distinct activities
  2. Deterministic – Known durations and relationships



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Relationship Concepts And Properties

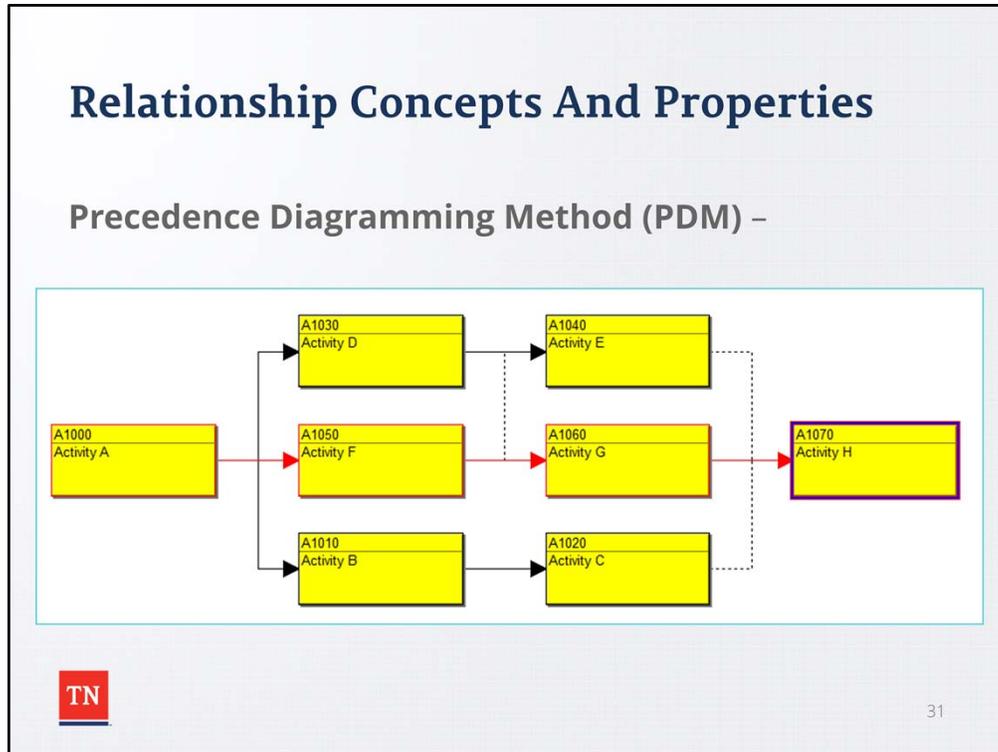
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The method used by software, such as Primavera, to sequence the activities.

A technique that uses a directed graph to describe the precedence of project activities.

Characteristics:

1. Discrete or distinct activities
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### Relationship Concepts And Properties

#### **Precedence Diagramming Method (PDM) –**

The method used by software, such as Primavera, to sequence the activities.

A technique that uses a directed graph to describe the precedence of project activities.

Characteristics:

1. Discrete or distinct activities
2. Deterministic – Known durations and relationships

The Activity-on-Arrow Network shown is an example of PDM.

## Relationship Concepts And Properties

### Relationships

- A relationship defines how an activity relates to the start or finish of another activity or assignment.
- Creates paths through the entire schedule.
- These relationships, which form the logic of the project network, are used together with activity durations/details to determine schedule dates.
- An activity can have as many relationships as necessary to model the work that must be done.



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### Relationship Concepts And Properties

#### **Relationships –**

A relationship defines how an activity relates to the start or finish of another activity or assignment. Relationships are added between activities to create a path through the schedule from the first activity to the last activity. These relationships, which form the logic of the project network, are used together with activity durations/details to determine schedule dates. An activity can have as many relationships as necessary to model the work that must be done.

## Relationship Concepts And Properties

### Relationships

Activities take one of two forms in a relationship:

- Predecessor – An activity that controls the start or finish of another immediate subsequent activity. Precedes another activity/s.
- Successors – An activity where the start or finish depends on the start or finish of another immediately preceding activity.



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Relationship Concepts And Properties

### **Relationships**

Activities take one of two forms in a relationship:

Predecessor – An activity that controls the start or finish of another immediate subsequent activity. Precedes another activity/s.

Successors – An activity where the start or finish depends on the start or finish of another immediately preceding activity.

## Relationship Concepts And Properties

### Relationship Types

- Finish to start (FS) relationship
- Finish to finish (FF) relationship
- Start to start (SS) relationship
- Start to finish (SF) relationship
- Lag



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### Relationship Concepts And Properties

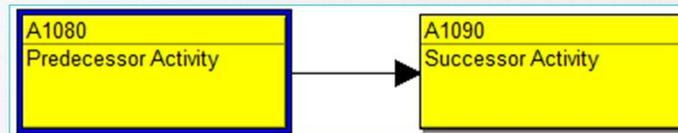
#### Relationship Types

- Finish to start (FS) relationship
- Finish to finish (FF) relationship
- Start to start (SS) relationship
- Start to finish (SF) relationship
- Lag

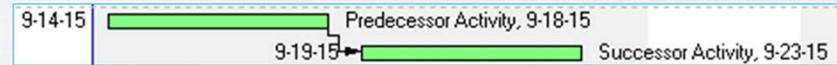
## Relationship Concepts And Properties

### Relationship Types

- Finish to start (FS) relationship-
  - The start of a successor activity depends on the completion of its predecessor activity.
  - Activity Network view



- Bar Chart view



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### Relationship Concepts And Properties

#### Relationship Types

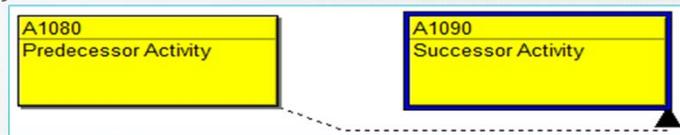
Finish to start (FS) relationship-

A relationship in which the start of a successor activity depends on the completion of its predecessor activity.

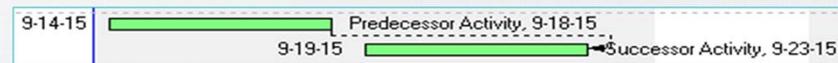
## Relationship Concepts And Properties

### Relationship Types

- Finish to finish (FF) relationship –
  - The finish of a successor activity depends on the finish of its predecessor activity.
  - Activity Network view



- Bar Chart view



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### Relationship Concepts And Properties

#### Relationship Types

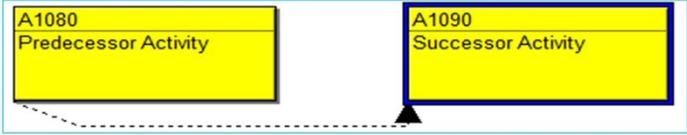
Finish to finish (FF) relationship –

A relationship in which the finish of a successor activity depends on the finish of its predecessor activity.

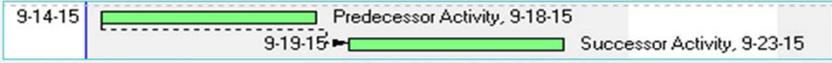
## Relationship Concepts And Properties

**Relationship Types**

- Start to start (SS) relationship –
  - The start of a successor activity depends on the start of its predecessor.
  - Activity Network view



- Bar Chart view



**TN**

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### Relationship Concepts And Properties

#### **Relationship Types**

Start to start (SS) relationship –

A relationship between activities in which the start of a successor activity depends on the start of its predecessor.

## Relationship Concepts And Properties

**Relationship Types**

- Start to finish (SF) relationship –
  - A successor activity cannot complete until its predecessor activity starts.
  - Activity Network view
  - Bar Chart view

**TN**

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### Relationship Concepts And Properties

#### **Relationship Types**

Start to finish (SF) relationship –

A relationship between activities in which a successor activity cannot complete until its predecessor activity starts.

## Relationship Concepts And Properties

### Relationship Types

- Lag - An offset or delay from an activity to its successor.
- Lag can be positive or negative and it is based on the calendar of the successor activity.
- A negative lag is also known as a “lead”.
- Lags may be applied to any of the relationship types.



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### Relationship Concepts And Properties

#### **Relationship Types**

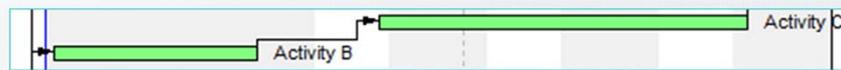
Lag - An offset or delay from an activity to its successor. Lag can be positive or negative and it is based on the calendar of the successor activity. A negative lag is also known as a “lead”. Lags may be applied to any of the relationship types.

## Relationship Concepts And Properties

### Relationship Types

#### Lag Example

- e.g. - An activity requiring a 4-day delay between the finish of one activity and start of another will require a positive lag of 4 days.
- This illustration shows a lag between the finish of Activity B and the Start of Activity C.



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### Relationship Concepts And Properties

#### Relationship Types

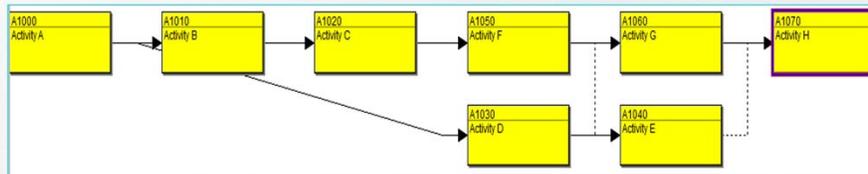
Lag - e.g. - An activity requiring a 4-day delay between the finish of one activity and start of another will require a positive lag of 4 days.

This illustration shows a lag between the finish of Activity B and the Start of Activity C.

## Relationship Concepts And Properties

### Closed Networks –

- The logic should create a closed network. In a closed network, all activities have one or more predecessors and one or more successors except:
  - The Notice to Proceed, or start milestone (has no predecessors), and
  - Completion Notice, or finish milestone, (has no successors).



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### Relationship Concepts And Properties

#### Closed Networks –

The logic should create a closed network. In a closed network, all activities have one or more predecessors and one or more successors except:

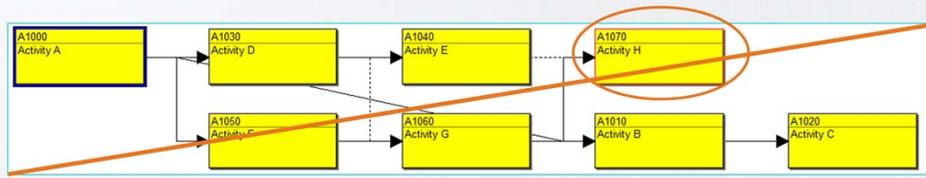
- The Notice to Proceed, or start milestone (has no predecessors), and
- Completion Notice, or finish milestone, (has no successors).

The illustration is an example of a closed network.

## Relationship Concepts And Properties

*\*\*\*When the network is not closed, the Critical Path, Total Float, and Free Float will not calculate correctly.*

Notice that Activity H does not have any successors and is not linked to the Project Completion.



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### Relationship Concepts And Properties

*\*\*\*When the network is not closed, the Critical Path, Total Float, and Free Float will not calculate correctly.*

Notice that Activity H in the illustration does not have any successors and is not linked to the Project Completion.

## Relationship Concepts And Properties

### Critical Path Method (CPM) Network Properties

1. All activities and relationships are identified
2. A closed network is created
3. The scheduling software calculates the shortest path or earliest completion time
4. Activities are moved forward in time until they meet a relationship or constraint or a calendar restriction.
  - Note: Un-started activities without logic or constraints are scheduled to start at the Start Milestone, or as allowed by the calendar.

**As the schedule is calculated, various network properties are produced.**



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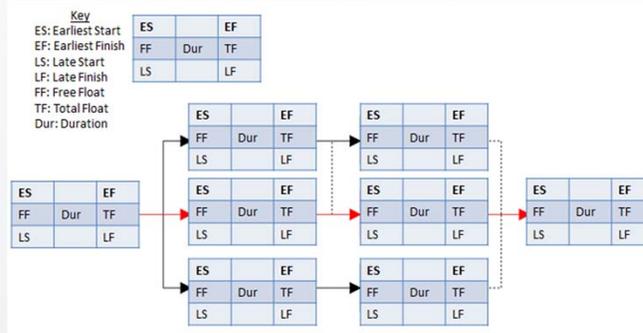
### Relationship Concepts And Properties

**Critical Path Method (CPM) Network Properties** – Once all activities and relationships are identified in a manner that creates a closed network, the scheduling software calculates the shortest time that the project can be completed. Activities are moved forward in time until they meet a relationship or constraint or a calendar restriction. Un-started activities without logic or constraints are scheduled to start at the Start Milestone, or as allowed by the calendar.

## Relationship Concepts And Properties

### Critical Path Method (CPM) Network Properties

- Early Dates
  - Early Start
  - Early Finish
- Late Dates
  - Late Start
  - Late Finish
- Float
  - Free Float:
  - Total Float
  - Negative Float



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### Relationship Concepts And Properties

Properties produced after calculating the schedule include:

- Early Dates
  - Early Start
  - Early Finish
- Late Dates
  - Late Start
  - Late Finish
- Float
  - Free Float:
  - Total Float
  - Negative Float

## Relationship Concepts And Properties

### Critical Path Method (CPM) Network Properties

- Early Start - Earliest possible date an activity can begin.
- Early Finish - Earliest possible date the activity can finish.
  - These dates are calculated by the project scheduler based on activity relationships, schedule constraints, and resource availability.



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### Relationship Concepts And Properties

#### Early Dates

Early Start - The earliest possible date the remaining work for the activity can begin. This date is calculated by the project scheduler based on activity relationships, schedule constraints, and resource availability. The Early Start equals the Remaining Start unless the scheduler preserves the scheduled early dates during leveling.

Early Finish - The earliest possible date the activity can finish. This date is calculated by the project scheduler based on activity relationships, schedule constraints, and resource availability. The Early Finish equals the Remaining Finish unless the scheduler preserves the scheduled early dates during leveling.

## Relationship Concepts And Properties

### Critical Path Method (CPM) Network Properties

- Late Start - Latest possible date the activity must begin without delaying the project finish date.
- Late Finish - Latest possible date the activity must finish without delaying the project finish date.
  - These dates are calculated by the project scheduler based on activity relationships, schedule constraints, and resource availability.



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### Relationship Concepts And Properties

#### Late Dates

Late Start - The latest possible date the remaining work for the activity must begin without delaying the project finish date. This date is calculated by the project scheduler based on activity relationships, schedule constraints, and resource availability. The Late Start equals the Remaining Late Start unless the scheduler preserves the scheduled late dates during leveling.

Late Finish - The latest possible date the activity must finish without delaying the project finish date. This date is calculated by the project scheduler based on activity relationships, schedule constraints, and resource availability. The Late Finish equals the Remaining Late Finish unless the scheduler preserves the scheduled late dates during leveling.

## Relationship Concepts And Properties

### Critical Path Method (CPM) Network Properties

- Free Float: The amount of time the selected activity can be delayed, without delaying the immediate successor activities.
- Total Float - The amount of time the selected activity can be delayed, without delaying the project's finish date.
  - According to Section 108.03(C)(1) of the Specifications,
    - Float is a shared commodity between the contractor and the department,
    - Either party has full use of the float until it is depleted.
    - E.g. - 30 days for approval of Shop/Working Drawings



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### Relationship Concepts And Properties

#### Float

Free Float: The amount of time the selected activity can be delayed, without delaying the immediate successor activities.

Total Float - The amount of time the selected activity can be delayed, without delaying the project's finish date.

- According to Section 108.03 C.1. of the Specifications, float is a shared commodity between the Contractor and the Department, and either party has full use of the float until it is depleted.
- E.g. - Complete Shop Drawing, Working Drawing, or Erection Plan packages submitted for review, acceptance, or approval by the Department will be approved or denied within thirty (30) days of receipt per submittal. If approval is given in fewer than 30 days, those days move the contractor ahead of schedule, which can be used later to offset delays or claims for extensions of time.

## Relationship Concepts And Properties

### Critical Path Method (CPM) Network Properties

- Negative Float - Exist when an activity's scheduled early start date is later than its late start date.
  - Negative float does not necessarily indicate that the activity is critical.
- Furthermore:
  - Occurs only when an activity's scheduled start date is later than:
    - the activity's constraint date, or
    - the constraint date of any activity on its network path.
  - The value is the number of workdays that an activity is late based on the constraint date of a related milestone or project completion.



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### Relationship Concepts And Properties

#### Float

Negative Float - Exist when an activity's scheduled early start date is later than its late start date. That is, the earliest that an activity can be started is later than the date that it must be started to avoid delaying completion of a milestone or the project. Negative float does not necessarily indicate that the activity is critical.

Furthermore:

1. Negative float occurs only when an activity's scheduled start date is later than the activity's constraint date or the constraint date of any activity on its network path.
2. Negative float value is the number of workdays that an activity is late based on the constraint date of a related milestone or project completion.

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

Let's now discuss how the CPM calculations are done and work through an example.



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Relationship Concepts And Properties

**Methods for Calculating CPM Network Properties**

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

Data Date - The last date progress is recorded in the form of actual dates, percent of work completed, revised remaining duration, or actual quantities or costs.

- For the baseline schedule, the data date is the date of the Notice to Proceed.
- Starts the work period.
- A schedule update reflects all work accomplished prior to the data date.



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### Relationship Concepts And Properties

#### Methods for Calculating CPM Network Properties

Data Date - The data date is the last date progress is recorded in the form of actual dates, percent of work completed, revised remaining duration, or actual quantities or costs. For the initial or baseline schedule, the data date is the date of the Notice to Proceed. The data date starts the work period. A schedule update will reflect all work accomplished prior to the data date. Activities completed on or after the data date will not be treated as finished on the schedule.

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

Calculation/ Forward Pass - The calculation of early dates for a project.

- Starts at the beginning of the project and continues to the end.
- Calculates the earliest start and finish dates for each activity.



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Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

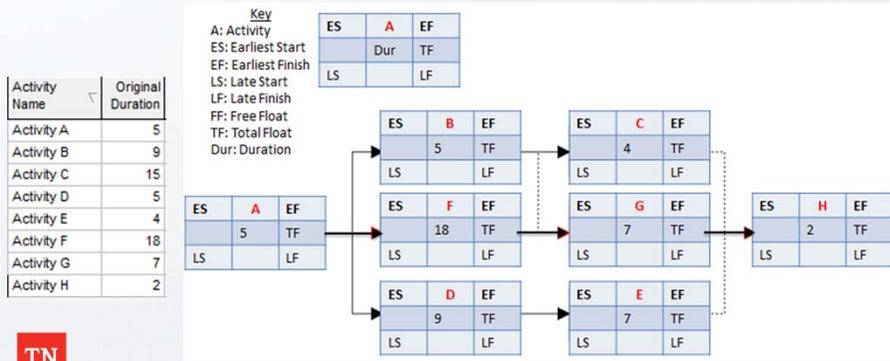
Calculation/ Forward Pass - The calculation of early dates for a project. The forward pass starts at the beginning of the project and continues to the end to calculate the earliest start and finish dates for each activity.

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

#### Calculation/ Forward Pass :

#### Step 1: Enter Durations



### Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

#### Calculation/ Forward Pass

#### Step 1: Enter Durations

## Relationship Concepts And Properties

**Methods for Calculating CPM Network Properties**

Calculation/ Forward Pass :

Step 2: Consider all predecessors to fill in each ES & EF

**Key**

A: Activity

ES: Earliest Start

EF: Earliest Finish

LS: Late Start

LF: Late Finish

FF: Free Float

TF: Total Float

Dur: Duration

ES	<b>A</b>	EF
	Dur	TF
LS		LF

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Relationship Concepts And Properties

**Methods for Calculating CPM Network Properties**

Calculation/ Forward Pass

Step 2: Consider all predecessors to fill in each ES & EF

1. Place the project start time or date in the ES and EF positions of the start activity. The start time is zero for relative calculations.
2. Once all predecessors have been marked in the EF and ES positions, mark an activities ES position with the largest number marked in the EF of those predecessors.
3. Add the duration to the ES time and write this in the EF box for each activity.

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

Calculation/ Backward Pass - The calculation of late dates of activities in a project.

- Begins with the latest early finish date of the last activity, or the imposed project finish date if one exists.
- Works backward to the first activity in the project.
- The late start and finish dates of each activity calculate based on durations, constraints, and relationships.



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Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

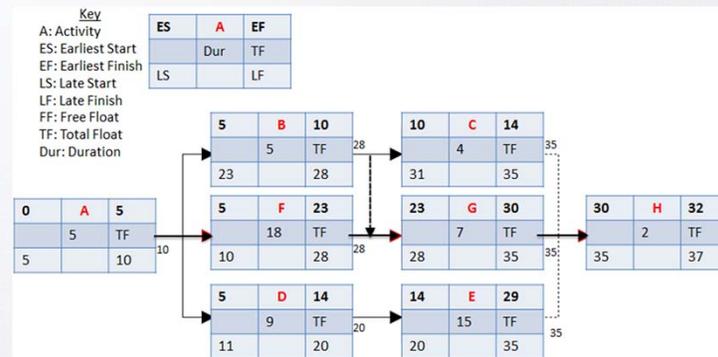
Backward Pass - The calculation of late dates of activities in a project. The backward pass begins with the latest early finish date of the last activity, or the imposed project finish date if one exists, and works backward to the first activity in the project. The late start and finish dates of each activity calculate based on durations, constraints, and relationships.

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

#### Calculation/ Backward Pass :

Step 3: Consider all successors to fill in each LS & LF



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### Relationship Concepts And Properties

#### Methods for Calculating CPM Network Properties

##### Calculation/ Backward Pass :

Step 3: Consider all successors to fill in each LS & LF

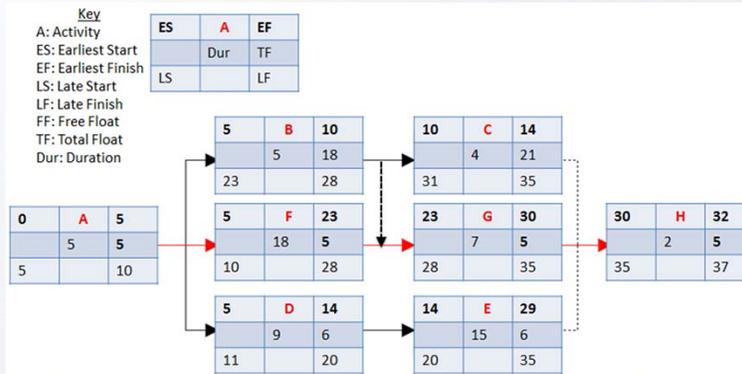
1. A late finish, or desired completion time, must be assumed. For the example we'll assume 35 days.
2. Place the value of the latest finish date in the LF box of the last activity, then fill in the latest start date.
3. Once all successors have been marked in the LF and LS positions, mark an activities LF position with the smallest number marked in the LS of those successors.
4. The LS for each activity is LF minus its activity duration.

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

Calculation/ Total Float:

Step 4: Calculate Total Float (TF) as  $TF=LS-ES$



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Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

Calculation/ Total Float:

Step 4: Calculate Total Float (TF) as  $TF=LS-ES$

## Relationship Concepts And Properties

### Methods for Calculating CPM Network Properties

#### Calculation/ Critical Path:

Step 5: The critical path includes the activities in which the float equals LS-ES from the starting activity.

0	A	5	5	F	23	G	30	H	32
5	5	5	18	5	7	5	2	5	
5		10	10		28	28	35	35	37



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### Relationship Concepts And Properties

#### Methods for Calculating CPM Network Properties

##### Calculation/ Critical Path:

Step 5: The critical path includes the activities in which the float equals LS-ES from the starting activity. In this case, 5. Therefore, the critical path includes activities A, F, G, & H.

## General Concepts and Fundamentals - Recap

- What we've covered so far...
  - General Concepts and Fundamentals
    - Work Breakdown Structure (WBS)
    - Activity Details
    - Relationship Concepts And Properties
  - The "logic"
- Why?
  - We've established an understanding of the structure, details and relationships/properties that drive the Critical Path Method.



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Recap of what we've covered so far...

General Concepts and Fundamentals  
Work Breakdown Structure (WBS)  
Activity Details  
Relationship Concepts And Properties  
The "logic"

Why?

We've established an understanding of the structure, details and relationships/properties that drive the Critical Path Method

## CPM Schedule Components

- What should we expect from the contractor?
  - Structure (WBS)
  - Details (tables and reports)
  - Logic (tables and reports)
    - Relationships
    - Assumptions
  - Network diagram (Gantt Chart)



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What should we expect to receive from the contractor?

- Deliverables
  - Structure
  - Details about activities
  - Logic
    - Relationships
    - Assumptions
  - Network diagram (Gantt Chart)

## CPM Schedule Components

- Deliverables include:
  - The electronic schedule file (.xer, .xml, .xls format), and
  - Hard copies (Printed or PDF) of:
    - Logic Diagrams/bar charts ( 11" x 17" format)
    - Tables or Tabular Sorts of Activity Details
    - Narrative Report
    - Optional or available through Regional Power-User:
      - The Schedule Log (SchedLog)
      - Relationship Report Table including: Predecessor ID, Successor ID, Relationship Type, Predecessor Activity Name, Successor Activity Name, and Lag.



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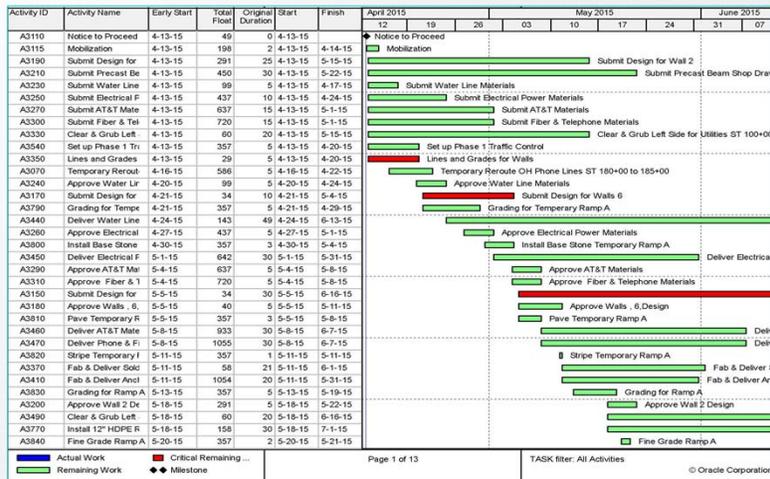
### CPM Schedule Components

The deliverables expected from the Contractor include the electronic schedule file (.xer, .xml, .xls format), and hard copies (Printed or PDF) of:

- *Logic Diagrams/bar charts ( 11" x 17")*
- *Tables or Tabular Sorts of Activity Details*
- *Narrative Report*
- *Optional or available through Regional Power-User:*
  - *The Schedule Log (SchedLog)*
  - *Relationship Report Table including: Predecessor ID, Successor ID, Relationship Type, Predecessor Activity Name, Successor Activity Name, and Lag.*

# CPM Schedule Components

Logic Diagrams/bar charts (without relationship lines)



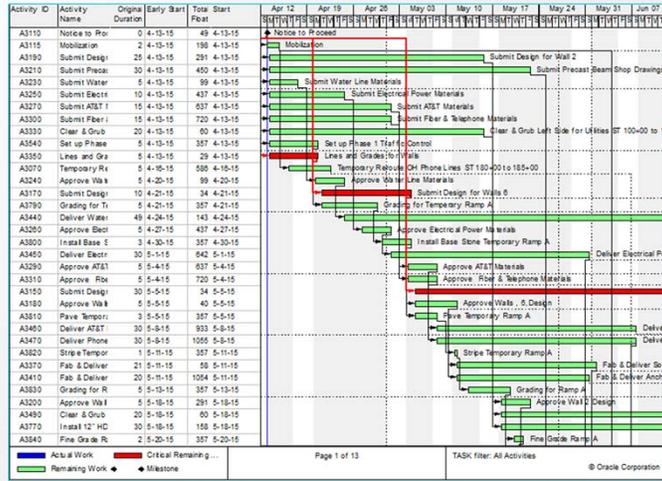
61

## CPM Schedule Components Logic Diagrams/bar charts (without relationship lines)

Also known as "Gantt Chart". The activity details can be customized and the information can be sorted in various ways.

# CPM Schedule Components

Logic Diagrams/bar charts (with relationship lines)



## CPM Schedule Components Logic Diagrams/bar charts (with relationship lines)

Also known as "Gantt Chart". The activity details can be customized and the information can be sorted in various ways.

# CPM Schedule Components

## Tables or Tabular Sorts of Activity Details

SR-01 Classic Schedule Report - Sort by ES, TF

Activity ID	Activity Name	Original Duration	Remaining Duration	Units % Complete	Start	Finish	Late Start	Late Finish	Total Float
A1000	SETUP PROJECT TRAILER	3	0	100%	11-0-09A	11-0-09A	2-15-11	2-15-11	
A1000	SUBMITTAL APPROVAL	140	0	100%	8-20-09A	1-6-10A	4-19-10	4-19-10	
M800	EROSION PREP MEETING	1	0	100%	2-17-10A	2-17-10A	4-19-10	4-19-10	
A1030	NTP	0	0	100%	8-20-09A		4-19-10		
A1070	DRAFT / SUBMIT SAFETY PLAN	141	0	100%	8-20-09A	2-23-10A	4-19-10	4-19-10	
A1000	CONTRACT AWARD	0	0	100%	8-3-09A		4-19-10		
A1010	SAFETY PLAN APPROVAL	0	0	100%	2-23-10A		4-19-10		
A1090	FABRICATE ORDERS	10	0	100%	11-12-09A	12-4-09A	8-14-10	8-14-10	
A1110	FABRICATE BEARING PADS	50	0	100%	12-18-09A	3-2-10A	8-10-10	8-10-10	
A1100	SANDBLAST AND PAINT ORDERS	22	10	0%	3-8-10A	3-29-10	8-14-10	8-24-10	148
A1090	SECURITY CLEARANCE	272	80	0%	8-20-09A	5-18-10	12-17-10	2-15-11	272
C1000	FORMWORK, REINFORCING, JOINTS, & CIP PREP MEETING	1	1	0%	3-22-10	3-22-10	5-10-10	5-11-10	38
P1010	DRILLED SHAFT, PILING, & ROCK ANCHOR PREP MEETING	1	1	0%	3-22-10	3-22-10	5-10-10	5-11-10	38
M1000	SITE EROSION CONTROL	3	9	0%	3-18-10A	4-2-10	3-29-10	4-13-10	5
X0001	MOBILIZATION	20	10	0%	3-1-10A	4-6-10	5-11-10	5-28-10	30
A1080	FURNISH AND DELIVER PILES	5	5	0%	3-23-10	3-29-10	7-6-10	7-15-10	78
P1030	P1 EXPLORATION BELOW SHAFT	15	0	100%	3-8-10A	3-19-10A	5-11-10	5-11-10	
P1050	P2 FOUNDATION EXPLORATION	15	0	100%	3-8-10A	3-19-10A	5-13-10	5-13-10	
N1010	P1 FOOTING EXCAVATION & PRIP	4	4	0%	4-6-10	4-9-10	4-13-10	4-20-10	5
N1050	P2 FOOTING EXCAVATION & PRIP	4	4	0%	4-13-10	4-16-10	5-19-10	5-24-10	22
V1000	ELECTRICAL & FENCING PREP MEETING	1	1	0%	4-19-10	4-19-10	6-15-10	6-15-10	41
K1010	EARTHWORK & RIP RAPPREMEETING	1	1	0%	4-19-10	4-19-10	6-15-10	6-15-10	41
1050	P2 PLACE FOOTING REBAR	2	2	0%	4-20-10	4-21-10	5-26-10	5-26-10	22
B1120	ROADWAY CLEARING	5	5	0%	4-20-10	4-27-10	6-16-10	6-22-10	34
N1000	FOUNDATION PREP PREPARATORY MEETING	1	1	0%	4-21-10*	4-21-10	4-19-10	4-20-10	-1
O1020	P1 CONSTRUCT TEMP SHORING	7	7	0%	4-22-10	5-4-10	4-20-10	4-30-10	-1
O1040	P2 FORM AND POUR FOOTING	4	4	0%	4-22-10	4-28-10	5-26-10	6-1-10	22
B1000	DEMO & CLEARING PREP MEETING	1	1	0%	4-27-10*	4-27-10	2-8-11	2-10-11	208



### CPM Schedule Components Tables or Tabular Sorts of Activity Details

Tables can also be customized and sorted depending on the needs.

## CPM Schedule Components

### Narrative Report

#### Float Calculation Method

- *The method used to calculate Total Float for this project in Primavera (P6 Professional) is "Start Float = Late Start – Early Start" (see Schedule > Schedule Options > Compute Total Float as)*

#### Approach to Sequencing the Work

- Activities in the schedule are grouped by structure that they pertain to. The various structures are broken out by roadway, box culverts, box bridges, bridge, ramps, retaining walls, tie-ins, and utilities. The construction for activities in each structure are shown in each phase that they are built in, all according to the traffic control plans.
- Utilities, including those not part of this contract, are being taken into consideration as each structure is scheduled in the various phases (i.e. 30" gas line relocation at Box 10; Water line at I-65 Overpass Bridge).
- Removal of Structures is scheduled based on time constraints related to land availability (i.e. beginning of project at Tract #2).
- *All activities (overlapping) with Start-Start and Finish-Finish relationships have been re-sequenced to only use Finish-Start relationships with no lag times.*

#### Critical Path

- The critical path is being controlled by work through the following work areas/phases:
  - Grading
    - Ramp A & B – I-65N to SR109 (Ph 1A)
    - Ramp C & D – SR109 to I-65N (Ph 1A)
    - Ramp E & F – Inside Loop I-65
    - Ramp G & H – SR109 to I-65 S Loop Outside (Ph 1A)
    - Frontage Road (Ph 1A)
    - Lake Springs to Fred White (Ph 1A)
    - SR 109 Tie-in (Ph 1B)



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### CPM Schedule Components Narrative Report

The written Narrative shall describe the Contractor's complete overall work plan and sequence in which the Work will be accomplished. The schedule narrative adds and supports understanding of the basis and assumptions in the schedule. The Narrative shall be prepared in accordance with **Section 108.03-(C)(2)(d)** of the Specifications.

## CPM Schedule Components

### Schedule Log

```

Scheduling/Leveling Report - 9-14-15 - PM.exe
=====
Default Project.....Training
Projects:
  Training.....Supervisor Training
Scheduling/Leveling Settings:
-----
General
-----
Scheduling .....Yes
Leveling .....No
Ignore relationships to and from other projects .....No
Make open-ended activities critical .....No
Use Expected Finish dates .....Yes
Schedule automatically when a change affects dates .....No
Level resources during scheduling .....No
Recalculate assignment costs after scheduling .....No
When scheduling progressed activities use .....Retained Logic
Calculate start-to-start lag from .....Early Start
Define critical activities as Total Float less than or equal to .0
Compute Total Float As .....Finish Float
Calculate float based on finish date of .....Each project
Calendar for scheduling Relationship Lag .....Predecessor Activity calendar
-----
Advanced
-----
Calculate multiple float paths.....No
-----
Statistics:
-----
# Projects.....1
# Activities.....8
# NOT Started.....8
# In Progress.....0
# Completed.....0
# Relationships.....11
# Activities with constraint.....0
    
```



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CPM Schedule Components  
**Schedule Log**

Also known as the “Scheduling/Leveling Report”. This report is produced after the schedule is calculated. It contains valuable information on:

- Scheduling/Leveling Settings,
- Statistics,
- Errors, Warnings,
- Scheduling/Leveling Results,
- and Exceptions.

# CPM Schedule Components

## Relationship Report Table

pred_task_id	task_id	pred_type	PREDTASK_status_c	TASK_status_code	predtask_task_name	task_task_name	lag_hr_cnt
Predecessor	Successor	Relationship	(*)Predecessor Activity Status	(*)Successor Activity Status	(*)Predecessor Activity Name	(*)Successor Activity Name	Lag(d)
A1000	A1010	FS	Not Started	Not Started	BR 1R Construct Bent 1 Cofferdam & Seal	BR 1R Construct Bent 1 Columns	0
A1000	A1005	FS	Not Started	Not Started	BR 1R Construct Bent 1 Cofferdam & Seal	BR 1R Construct Bent 1 Footings	0
A1000	A1025	FS	Not Started	Not Started	BR 1R Construct Bent 1 Cofferdam & Seal	BR 1R Construct Bent 2 Cofferdam & Seal	0
A1005	A1010	FS	Not Started	Not Started	BR 1R Construct Bent 1 Footings	BR 1R Construct Bent 1 Columns	0
A1010	A1020	FS	Not Started	Not Started	BR 1R Construct Bent 1 Columns	BR 1R Construct Bent 1 Cap	0
A1020	A1030	FS	Not Started	Not Started	BR 1R Construct Bent 1 Cap	BR 1R Construct Bent 2 Footings	0
A1020	A1055	FS	Not Started	Not Started	BR 1R Construct Bent 1 Cap	BR 1R Core Drill and Install Abutment 1 Pile	0
A1025	A1030	FS	Not Started	Not Started	BR 1R Construct Bent 2 Cofferdam & Seal	BR 1R Construct Bent 2 Footings	0
A1030	A1050	FS	Not Started	Not Started	BR 1R Construct Bent 2 Footings	BR 1R Construct Bent 2 Columns	0
A1050	A1060	FS	Not Started	Not Started	BR 1R Construct Bent 2 Columns	BR 1R Construct Bent 2 Cap	0
A1050	A1070	FS	Not Started	Not Started	BR 1R Construct Bent 2 Cap	BR 1R Construct Abutment 1 Grade Beam	0
A1060	A1077	FS	Not Started	Not Started	BR 1R Construct Bent 2 Cap	BR 1R Core Drill and Install Abutment 2 Pile	0
A1065	A1070	FS	Not Started	Not Started	BR 1R Core Drill and Install Abutment 1 Pile	BR 1R Construct Abutment 1 Grade Beam	0
A1065	A1077	FS	Not Started	Not Started	BR 1R Core Drill and Install Abutment 1 Pile	BR 1R Construct Abutment 2 Pile	0
A1070	A1075	FS	Not Started	Not Started	BR 1R Construct Abutment 1 Grade Beam	BR 1R Construct Abutment 1 Backwall	0
A1075	A1110	FS	Not Started	Not Started	BR 1R Construct Abutment 1 Backwall	BR 1R Set Precast Beams	0
A1075	A1090	FS	Not Started	Not Started	BR 1R Construct Abutment 1 Backwall	BR 1R Construct Abutment 2 Grade Beam	0
A1077	A1080	FS	Not Started	Not Started	BR 1R Core Drill and Install Abutment 2 Pile	BR 1R Construct Abutment 2 Grade Beam	0
A1080	A1100	FS	Not Started	Not Started	BR 1R Construct Abutment 2 Grade Beam	BR 1R Construct Abutment 2 Backwall	0
A1100	A1110	FS	Not Started	Not Started	BR 1R Construct Abutment 2 Backwall	BR 1R Set Precast Beams	0
A1100	A1170	FS	Not Started	Not Started	BR 1R Construct Abutment 2 Backwall	BR 2R Construct Bent 1 Foundation Prep & Fc	0
A1110	A1120	FS	Not Started	Not Started	BR 1R Set Precast Beams	BR 1R Form Deck	0
A1120	A1130	FS	Not Started	Not Started	BR 1R Form Deck	BR 1R Install Deck Rebar	0
A1130	A1140	FS	Not Started	Not Started	BR 1R Install Deck Rebar	BR 1R Place and Finish Deck	0
A1140	A1150	FS	Not Started	Not Started	BR 1R Place and Finish Deck	BR 1R Construct Bridge End Slabs	0
A1150	A1160	FS	Not Started	Not Started	BR 1R Construct Bridge End Slabs	BR 1R Slipform Parapet Rails	0
A1160	A1485	FS	Not Started	Not Started	BR 1R Slipform Parapet Rails	Demo Existing Bridge TL	0
A1170	A1180	FS	Not Started	Not Started	BR 2R Construct Bent 1 Foundation Prep & Fc	BR 2R Construct Bent 1 Columns	0
A1180	A1190	FS	Not Started	Not Started	BR 2R Construct Bent 1 Columns	BR 2R Construct Bent 1 Cap	0
A1190	A1200	FS	Not Started	Not Started	BR 2R Construct Bent 1 Cap	BR 2R Construct Bent 2 Foundation Prep & Fc	0
A1190	A1225	FS	Not Started	Not Started	BR 2R Construct Bent 1 Cap	BR 2R Core Drill and Install Abutment 1 Pile	0
A1200	A1210	FS	Not Started	Not Started	BR 2R Construct Bent 2 Foundation Prep & Fc	BR 2R Construct Bent 2 Columns	0
A1210	A1220	FS	Not Started	Not Started	BR 2R Construct Bent 2 Columns	BR 2R Construct Bent 2 Cap	0
A1220	A1230	FS	Not Started	Not Started	BR 2R Construct Bent 2 Cap	BR 2R Construct Abutment 1 Grade Beam	0
A1220	A1225	FS	Not Started	Not Started	BR 2R Construct Bent 2 Cap	BR 2R Core Drill and Install Abutment 1 Pile	0
A1220	A1245	FS	Not Started	Not Started	BR 2R Construct Bent 2 Cap	BR 2R Core Drill and Install Abutment 2 Pile	0
A1225	A1230	FS	Not Started	Not Started	BR 2R Core Drill and Install Abutment 1 Pile	BR 2R Construct Abutment 1 Grade Beam	0
A1225	A1245	FS	Not Started	Not Started	BR 2R Core Drill and Install Abutment 1 Pile	BR 2R Core Drill and Install Abutment 2 Pile	0
A1230	A1240	FS	Not Started	Not Started	BR 2R Construct Abutment 1 Grade Beam	BR 2R Construct Abutment 1 Backwall	0
A1240	A1270	FS	Not Started	Not Started	BR 2R Construct Abutment 1 Backwall	BR 2R Set Precast Beams	0
A1240	A1250	FS	Not Started	Not Started	BR 2R Construct Abutment 1 Backwall	BR 2R Construct Abutment 2 Grade Beam	0



### CPM Schedule Components Relationship Report Table

Since two activities are required to form a relationship, the relationship information is not available on the tables of activity details. Relationship information, such as the relationship type or lag, between a predecessor and successor must be gathered in a relationship report or table.

Note: The use of leads or lags must be approved by the **District Supervisor**.

## TDOT Documents and Procedures

- TDOT Specification
- Checklists
- Circular Letter
  - Receiving and Storing Schedule Files
  - Conducting the Baseline CPM Schedule Review
  - Schedule Updates
  - Schedule Revisions
  - Communication with the Contractor
  - Time Impacts and Delays
  - Primavera Power-Users



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### TDOT Documents and Procedures

- TDOT Specification
- Checklists
- Circular Letter
  - Receiving and Storing Schedule Files
  - Conducting the Baseline CPM Schedule Review
  - Schedule Updates
  - Schedule Revisions
  - Communication with the Contractor
  - Time Impacts and Delays
  - Primavera Power-Users

## TDOT Specification

- Section:
  - 108.03 Prosecution of Construction
- Role:
  - Serves as the basis for Acceptance/Rejection.
  - All other documents and procedures are based on the Specification.



108.03

The Contractor is responsible for scheduling, sequencing, and prosecuting the Work to comply with Contract requirements. The cost of preparing and updating the schedule is incidental to all Contract items.

Conduct periodic job site meetings with the Engineer monthly or as required by the complexity of the Project to assess progress. Update the schedule on a monthly basis to reflect actual progress and to document approved Contract Change Orders. Include the actual start and finish of each activity, percentage complete, the remaining duration of activities started and ongoing, and a summary of schedule changes. Submit the schedule updates to the Engineer for review within 48 hours after the job site meeting.

**C. Project Durations Greater Than 24 Months or When Required By Contract**

Develop a Critical Path Method (CPM) schedule using computerized scheduling software.

**1. Baseline CPM Schedule.** Within fifteen (15) calendar days after the Notice to Proceed, submit a draft baseline CPM schedule to the Engineer and hold a meeting to review. Define and sequence activities so as to accurately describe the Project and to meet Contract requirements, the scope of work, phasing, accommodations for traffic, and interim, milestone, and project completion dates. Use working days to create the schedule, beginning with the date of the Notice to Proceed. Ensure that the CPM schedule identifies and includes the following:

- a. Planned start and completion dates for each activity;
- b. Alphanumeric coding structure and activity identification system;
- c. Duration of each activity (stated in work days, and with activities of more than one update period or thirty (30) work days in duration broken into two or more activities distinguished by location or some other feature);
- d. Finish-to-start relationships among activities, without leads or lags, unless otherwise approved by the Engineer.

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### TDOT Documents and Procedures

#### **TDOT Specification**

Section:

108.03 Prosecution of Construction

Role:

Serves as the basis for Approval/Disapproval.

All other documents and procedures are based on the Specification.

## Checklists

- Role:
  - Designed to check the requirements of the Specification in an easy to follow format.
  - One checklist for reviewing the Baseline Schedule.
  - One checklist for reviewing Schedule Updates.

		Meets Specification	
		Yes	No
<b>Tabular sorts of activities by</b>			
Early start?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Predecessors?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Successors?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work area by early start?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Total float?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Meets Specification</b>			
Bar Chart?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40-day look-ahead bar charts by early start?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Meets Specification</b>			
<b>Narrative Report</b>		<b>Yes</b>	<b>No</b>
The approach to sequencing the work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The critical or longest path?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Potential conflicts that may affect the schedule and how they might be mitigated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Workdays per week?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Holidays?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of shifts per day?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of hours per shift?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equipment cost?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How the schedule accommodates adverse weather days for each month?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>CPM Schedule Identifies, Includes, or Uses</b>			
		<b>Yes</b>	<b>No</b>
Working days to create schedule?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planned start and completion dates for each activity?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Alphanumeric coding structure and activity identification systems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Duration of each activity (listed in work days, and with activities of more than one calendar period or thirty (30) work days in duration broken into two or more activities distinguished by location or some other feature)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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### TDOT Documents and Procedures

#### Checklists

Role:

- Designed to check the requirements of the Specification in an easy to follow format.
- One checklist for reviewing the Baseline Schedule.
- One checklist for reviewing Schedule Updates.

## Circular Letter

**Section:** 108.03 Prosecution of Construction

**Number:** 108.03 (C)

**Subject:** Critical path method (CPM) Schedules

**Role:** Provide general guidance and supporting information for checklists and Specification.



Circular Letter 108.03(C) Critical path method (CPM) Schedules

**Circular Letter**  
**Section:** 108.03 Prosecution of Construction  
**Number:** 108.03 (C)  
**Subject:** Critical Path Method (CPM) Schedules

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TDOT Documents and Procedures  
**Circular Letter**

**Section:** 108.03 Prosecution of Construction

**Number:** 108.03 (C)

**Subject:** Critical path method (CPM) Schedules

**Role:** Provide general guidance and supporting information for checklists and Specification.

## Circular Letter

### Receiving and Storing Schedule Files

- Once received, schedule files should be stored under the contract folder.
  - CMS/File Management Drive (a.k.a. Unit Drive).
  - Within the contract's folder, create a folder titled "CPM Schedules".
    - Example: \Unit ##### - CITY CVA###\CPM Schedules
  - Save all schedule files and narratives in this folder.



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TDOT Documents and Procedures

Circular Letter

### Receiving and Storing Schedule Files

Once a schedule and related materials are received by the contractor, these files shall be stored under the respective contract folder on the CMS/File Management Drive (a.k.a. Unit Drive).

Within the contract's folder, create a folder titled "CPM Schedules".

Example: \Unit ##### - CITY C\A###\CPM Schedules

Save all schedule files and narratives in this folder.

## Circular Letter

### Conducting the Baseline CPM Schedule Review

- Meeting held with Contractor within 15 days after NTP to review baseline CPM schedule.
- Use **Form 108.03(C)(1) Baseline CPM Schedule Review Checklist** to assist in determining whether the baseline schedule meets the requirements of 108.03. of the Specifications.

108.03(C)(1)  
Baseline CPM Schedule Checklist

Project Information  
Contract ID: \_\_\_\_\_

Reviewer  
Name: \_\_\_\_\_  
Title: \_\_\_\_\_  
Date: \_\_\_\_\_

**General**

	Yes	No	Meets Specification
Draft baseline CPM schedule submitted to the Engineer within fifteen (15) calendar days after the Notice to Proceed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meeting held to review?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussion at the Construction Conference?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Schedule begins with the date of the Notice to Proceed (date date=NTP date)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Schedule ends on or before Contract Completion Date?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Float is defined as the amount of time between the date when an activity can start (early start), and the date when an activity must start (late start)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Submission Requirements**

	Yes	No	Meets Specification
One hard copy of the schedule received (Printed or PDF)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
One electronic copy of the schedule received? <small>Acceptable file types: .pdf, .xls, .xls</small>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Logic Diagram**

	Yes	No	Meets Specification
In color?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Displaying no more than 50 activities on each 11 x 17 inch sheet?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Each sheet including title, match data for diagram continuation, and a key?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Page 1 of 3



### TDOT Documents and Procedures

#### Circular Letter

#### Conducting the Baseline CPM Schedule Review

Within fifteen (15) calendar days after the Notice to Proceed, the contractor shall arrange a meeting to review and submit a draft baseline CPM schedule. The purpose of the meeting is to discuss the Contractor’s plan to execute the work by the completion date set forth in the Proposal. This meeting also allows discussion of potential conflicts that may affect the schedule and how they might be mitigated.

**FORM 108.03(C)(1) BASELINE CPM SCHEDULE REVIEW CHECKLIST** assist in determining whether the baseline schedule meets the requirements of **108.03**.

## Circular Letter

Conducting the Baseline CPM Schedule Review

- ***Form 108.03(C)(1) Baseline CPM Schedule Review Checklist***



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TDOT Documents and Procedures

Circular Letter

**Conducting the Baseline CPM Schedule Review**

SEE **FORM 108.03(C)(1) BASELINE CPM SCHEDULE REVIEW CHECKLIST**

## Circular Letter

### Schedule Updates

- The CPM schedule will be updated on a monthly basis to determine the current status of the project.
- As the schedule is updated, it is critically important to ensure that the schedule accurately reflects how the work is being performed.



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TDOT Documents and Procedures  
Circular Letter  
**Schedule Updates**

The CPM schedule will be updated on a monthly basis to determine the current status of the project. As the schedule is updated, it is critically important to ensure that the schedule accurately reflects how the work is being performed.

## Circular Letter

### Schedule Updates

- IMPORTANT: TO VERIFY THAT THE SCHEDULE UPDATES ARE CORRECT, IT IS NECESSARY FOR FIELD STAFF TO COLLECT AS-BUILT INFORMATION THROUGH A VARIETY OF SOURCES.
- SOURCES INCLUDE, BUT ARE NOT LIMITED TO:
  - DAILY WORK REPORTS (DWRS),
  - MEETING MINUTES, AND
  - PROGRESS PHOTOGRAPHS/VIDEOS.
- **(NOTE: IT IS RECOMMENDED TO DOCUMENT THE ACTUAL FINISH DATES FOR COMPLETED ACTIVITIES IN THE DAILY WORK REPORTS (DWRS)).**



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TDOT Documents and Procedures  
Circular Letter  
**Schedule Updates**

**IMPORTANT: TO VERIFY THAT THE SCHEDULE UPDATES ARE CORRECT, IT IS NECESSARY FOR FIELD STAFF TO COLLECT AS-BUILT INFORMATION THROUGH A VARIETY OF SOURCES. SOURCES INCLUDE, BUT ARE NOT LIMITED TO: DAILY WORK REPORTS (DWRS), MEETING MINUTES, AND PROGRESS PHOTOGRAPHS/VIDEOS.**

**(NOTE: IT IS RECOMMENDED TO DOCUMENT THE ACTUAL FINISH DATES FOR COMPLETED ACTIVITIES IN THE DAILY WORK REPORTS (DWRS)).**

# Circular Letter

## Schedule Updates

- Use **FORM 108.03(C)(3) CPM SCHEDULE UPDATE CHECKLIST** to analyze the current progress, ensure compliance with **Section 108.03** of the Specifications, and determine potential needs for a schedule revision.

108.03(C)(3)  
CPM Schedule Update Checklist

Project Information  
Contract ID: \_\_\_\_\_ Division: \_\_\_\_\_  
Name: \_\_\_\_\_  
Title: \_\_\_\_\_  
Date: \_\_\_\_\_

Schedule Update Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

General

One hard copy of the schedule update received (PDF)?	<input type="checkbox"/>	<input type="checkbox"/>	<b>Meets Specification</b>
One electronic copy of the schedule update received?	<input type="checkbox"/>	<input type="checkbox"/>	<b>Yes</b> <b>No</b>
Applicable for open, semi, and sub	<input type="checkbox"/>	<input type="checkbox"/>	
Table including actual start and finish dates of each activity or remaining duration of activities started but not yet completed (activity status required)?	<input type="checkbox"/>	<input type="checkbox"/>	
Updated critical or longest path? Does it make sense?	<input type="checkbox"/>	<input type="checkbox"/>	

Submission Requirements

Logic Diagram	<input type="checkbox"/>	<input type="checkbox"/>	<b>Meets Specification</b>
In color?	<input type="checkbox"/>	<input type="checkbox"/>	<b>Yes</b> <b>No</b>
Depicting no more than 50 activities on each page (11 x 17 inch format)?	<input type="checkbox"/>	<input type="checkbox"/>	
Each sheet including title, match data for diagram continuation, and a key?	<input type="checkbox"/>	<input type="checkbox"/>	

Bar Chart

60-day look-ahead bar charts (bottom) by early start?	<input type="checkbox"/>	<input type="checkbox"/>	<b>Meets Specification</b>
Tabular sorts of activities by...	<input type="checkbox"/>	<input type="checkbox"/>	<b>Yes</b> <b>No</b>
Total float?	<input type="checkbox"/>	<input type="checkbox"/>	
Early start?	<input type="checkbox"/>	<input type="checkbox"/>	

Narrative Report

Progress during the month?	<input type="checkbox"/>	<input type="checkbox"/>	<b>Meets Specification</b>
	<input type="checkbox"/>	<input type="checkbox"/>	<b>Yes</b> <b>No</b>



TDOT Documents and Procedures  
Circular Letter  
**Schedule Updates**

Use **FORM 108.03(C)(3) CPM SCHEDULE UPDATE CHECKLIST** to analyze the current progress, ensure compliance with **Section 108.03** of the Specifications, and determine potential needs for a schedule revision.

## Circular Letter

### Schedule Updates

- **FORM 108.03(C)(3) CPM SCHEDULE UPDATE CHECKLIST**



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TDOT Documents and Procedures  
Circular Letter  
**Schedule Updates**

See **FORM 108.03(C)(3) CPM SCHEDULE UPDATE CHECKLIST**

## Circular Letter

### Schedule Revisions

- Revisions required when:
  - Schedule has been significantly impacted by a change in the Work or condition, or
  - Contractor has deviated significantly from his baseline plan or schedule.
- The Contractor may offer a revised schedule, or the District Supervisor may request one.
- Circumstances are addressed in:
  - Form 108.03(C)(3) CPM Schedule Update Checklist and in
  - Section 108.03(D) of the Specifications.



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### TDOT Documents and Procedures

#### Circular Letter

#### Schedule Revisions

A revision of the baseline CPM schedule is required when the schedule has been significantly impacted by a change in the Work or condition or the Contractor has deviated significantly from his baseline plan or schedule.

The Contractor may offer a revised schedule, or the **District Supervisor** may request one. Circumstances that may lead to requesting a revised schedule are addressed in **FORM 108.03(C)(3) CPM SCHEDULE UPDATE CHECKLIST** and in **Section 108.03(D)** of the Specifications.

If the Contractor cannot justify unsatisfactory progress, administrative actions can be made in accordance with **Section 108.03(D)** of the Specifications.

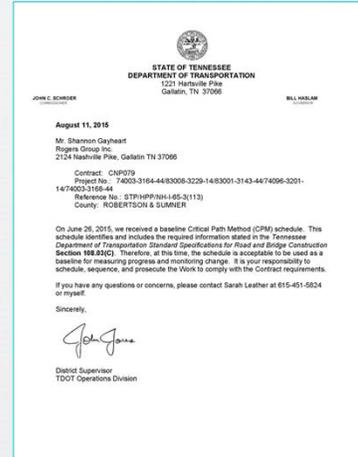
## Circular Letter

### Communication with the Contractor

Upon review of the CPM schedule and related materials, the District Supervisor will either:

- Provide review comments,
- Request additional information,
- Accept the CPM schedule, or
- Reject the CPM schedule

Template Letters are available on the Construction Division's Website.



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### TDOT Documents and Procedures

#### Circular Letter

#### Communication with the Contractor

Upon review of the CPM schedule and related materials, the **District Supervisor** will either:

- ***Provide review comments,***
- ***Request additional information,***
- ***Accept the CPM schedule, or***
- ***Reject the CPM schedule***

#### *Providing review comments*

General review comments may be provided verbally, or in writing. No formal letter is required.

#### Template Letters

*Template Letters are available on the Construction Division's Website.*

## Circular Letter

### Time Impacts and Delays

- Delays are unavoidable, and may be justified if caused by...
  - Conditions beyond the Contractors control, and
  - The Contractor is without fault.
  
- Contractor shall submit a written request for a time extension.
  - Must show the impact of the delay on the critical path via
    - Including a **Time Impact Analysis** and
    - supporting documentation



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### TDOT Documents and Procedures

#### Circular Letter

#### Time Impacts and Delays

Delays on construction projects are unavoidable. If the contractor has been delayed because of conditions beyond their control and they are without fault, then a time extension may be justified.

The Contractor shall notify the **District Supervisor** in accordance with **Section 104.03** of the Specifications and submit a written request for a time extension. The written request shall include a Time Impact Analysis and supporting documentation showing the impact of the delay on the critical path.

## Circular Letter

### Time Impacts and Delays

- District Supervisor may extend the contract time or completion date only if...
  - An excusable delay,
  - Affects the critical path
    - Of the work as shown on the accepted progress schedule.
  
- Section 108.07 of the Specification



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TDOT Documents and Procedures  
Circular Letter  
**Time Impacts and Delays**

In accordance with **Section 108.07** of the Specifications, the **District Supervisor** may extend the contract time or completion date only if an excusable delay affects the critical path of the work as shown on the accepted progress schedule.

## Circular Letter

### Time Impacts Analysis (TIA)

- A 'forward-looking' schedule analysis technique
  - Adds a modeled delay to an accepted CPM schedule
  - Determines possible impact of that delay to project completion
- TIA provides a reasonable assessment of a delay when applied appropriately.
  - The TIA must be calculated quickly,
  - while the project is on-going, and is
  - Works best with a single change or delay event.



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TDOT Documents and Procedures

Circular Letter

### Time Impacts Analysis (TIA)

Time Impact Analysis (TIA) is a 'forward-looking,' prospective schedule analysis technique that adds a modeled delay to an accepted CPM schedule to determine the possible impact of that delay to project completion. A TIA is performed to evaluate the most likely results of an unplanned event.

The TIA provides a reasonable assessment of a delay when applied appropriately. The TIA must be calculated quickly, while the project is on-going, and is best when modeling the effects of a single change or delay event.

## Circular Letter

### Time Impacts Analysis (TIA)

- TIA relies on CPM calculations to show the differences between two schedules:
  - 1. A schedule that does not include a delay, and**
  - 2. A schedule that does include an activity modeling the delay event.**
- Difference in completion dates is considered to be the impact of the delay (time).



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TDOT Documents and Procedures

Circular Letter

### Time Impacts Analysis (TIA)

TIA relies on the CPM calculations to show the differences between two schedules:

***A schedule that does not include a delay, and***

***A schedule that does include an activity modeling the delay event.***

The difference in project completion dates is considered to be the impact of the delay for time duration considerations.

## Circular Letter

### Time Impacts Analysis (TIA)

Two assumptions make TIA possible.

1. The most recent schedule update, just before the delay, accurately displays the status a sequence of work on the project at the time of delay.
  - Thus, timely acceptance of schedule updates is critical.
2. Actual delay will not change the remaining work plan.
  - Work both prior to and following the delay remain unchanged, or 'frozen'.

When these assumptions are met, TIA is simple and effective.



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### TDOT Documents and Procedures

#### Circular Letter

#### Time Impacts Analysis (TIA)

There are two assumptions that make TIA possible. The first assumption is that the most recent schedule update, just before the delay, accurately displays the status a sequence of work on the project at the time of delay. Therefore, timely acceptance of schedule updates is critical to the TIA success. The second assumption is that actual delay will not change the remaining work plan. Essentially, the work both prior to and following the delay remain unchanged, or 'frozen'.

When TIA is appropriate and all assumptions are met, it is a simple and effective method for modeling the effects of a delay.

## Circular Letter

### Time Impacts Analysis (TIA)

- Contractor is responsible for performing the TIA (Section 108.07 of the Specifications).

### Steps of TIA - Overview

1. Create activity/s to represent delay.
2. Insert into most recent update, but w/ zero duration.
3. Run network calculations. Dates should remain unchanged.
4. Input Approved durations into delay activity/s.
5. Recalculate CPM.
6. Determine total time impact, and then remove any delays already awarded.



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Circular Letter

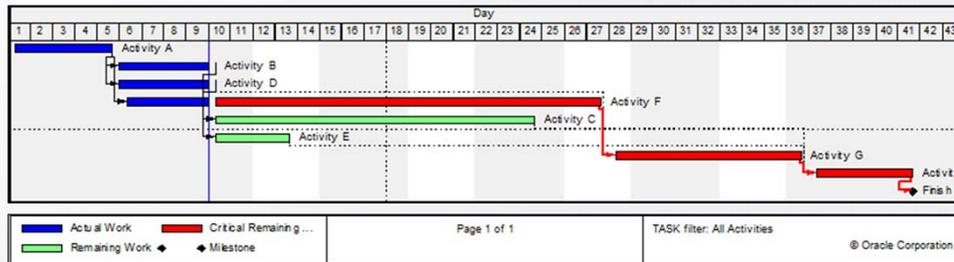
**Time Impacts Analysis (TIA)**

**Steps of TIA**

According to **Section 108.07** of the Specifications, the Contractor is responsible for performing the TIA. These are the steps they are expected to perform:

1. Create activity/s to represent delay.
2. Insert into most recent update, but w/ zero duration.
3. Run network calculations. Dates should remain unchanged.
4. Input Approved durations into delay activity/s.
5. Recalculate CPM.
6. Determine total time impact, and then remove any delays already awarded.

## TIA Example



- Activity C was delayed 14 days.
- The most recent schedule update had a data date of Day-10, so progress through Day-9 is shown as performed.

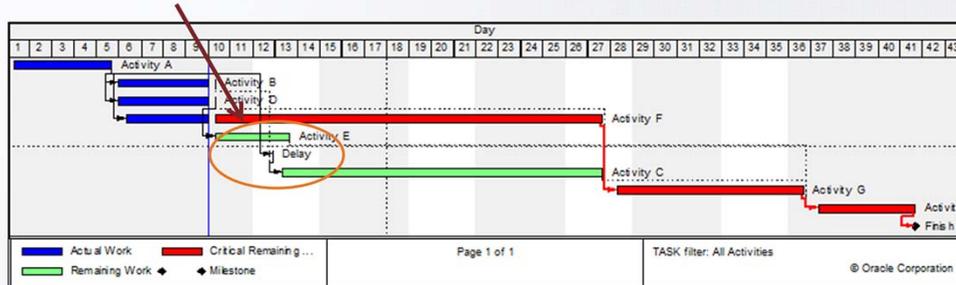


TIA Example

Activity C was delayed 14 days.

The most recent schedule update had a data date of Day-10, so progress through Day-9 is shown as performed.

## TIA Example



- Delay inserted with zero duration.
- Network calculations ran.
- Finish Milestone remains on day 42.

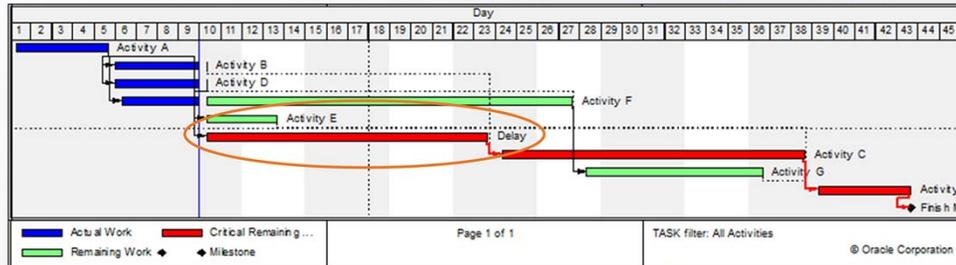


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### TIA Example

1. Create delay activity to represent delay.
2. Insert into most recent update, but w/ zero duration.
3. Run network calculations. Dates should remain unchanged.

## TIA Example



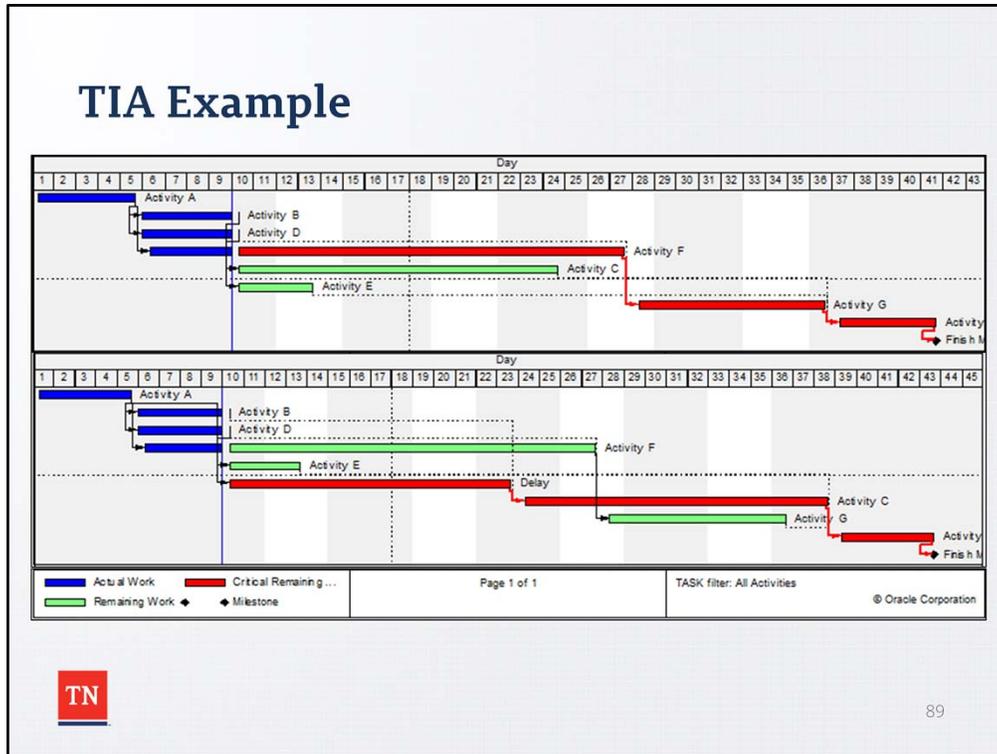
- Delay duration of 14 days entered
- Network calculations ran.
- Finish Milestone is moved to Day 44 (2 days).



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### TIA Example

1. Input Approved durations into delay activity/s (14 days)
2. Recalculate CPM.
3. Determine total time impact, and then remove any delays already awarded.



TIA Example

In summary, the 14-day delay to Activity C resulted in an overall delay to the completion of 2 days. Additionally, the Critical Path changed from Activities A-F-G-H to Activities A-B-C-H.

Both schedules are compared to prove the impact of the delay.

## Circular Letter

### Time Impacts Analysis (TIA)

- Support is very important when processing a time extension using TIA!!
  
- At a minimum, the deliverable of a TIA should include:
  - ***A written request for a time extension.***
  - ***Two schedules with supporting documents (narrative, tables, reports):***
    - 1. The most recent schedule update, just prior to the delay.***
    - 2. A schedule that includes an activity modeling the delay event.***



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**Time Impacts Analysis (TIA)**

The support is very important when processing a time extension using TIA. At a minimum, the deliverable of a TIA should include:

- ***A written request for a time extension.***
- ***Two schedules with supporting documents (narrative, tables, reports):***
  - 1. The most recent schedule update, just prior to the delay.***
  - 2. A schedule that includes an activity modeling the delay event.***

## Circular Letter

### Support: Primavera Power-Users

- Primavera Power-Users: Personnel with access to Primavera software, and advanced knowledge in CPM schedules.
  - At Headquarters and in each region
- Power-Users are available as a resource
  - Provide assistance as needed
  - (such as running reports, or checking TIAs).

To identify each Power-User and their contact information, visit the Construction Division Website, under Construction Division Resources, and select CPM Schedules.



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### TDOT Documents and Procedures

#### Circular Letter

#### Support: Primavera Power-Users

Primavera Professional is the leading project management software used in the Construction Industry for scheduling. Within the Construction Division, both at Headquarters and regionally, there are Power-Users who have access to Primavera software, and advanced knowledge in CPM schedules. These Power-Users are available as a resource to provide assistance (such as running reports, or checking the TIA) as needed. To identify each Power-User and their contact information, visit the Construction Division Website, under Construction Division Resources, and select CPM Schedules.

## Duties/Authorities of the Engineer

- *The Contractor is responsible for scheduling, sequencing, and prosecuting the Work to comply with the Contract requirements.*
- The Engineer cannot:
  - Assume responsibility for the contractor's methods
  - Unreasonably interfere with the conduct of the work
  - Dictate the contractor's procedures.
- Authorities of the Engineer include:
  - Approval of the contractor's general program of field procedures.
  - Approval of construction equipment the contractor proposes to use.
  - If work begins to lag behind schedule, the engineer may reasonably instruct the contractor to speed up its activities.



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### Duties/Authorities of the Engineer

The Contractor is responsible for scheduling, sequencing, and prosecuting the Work to comply with the Contract requirements.

The Engineer has direct responsibility to oversee the progress of the work, and exercise the right of job inspection and approval of materials. While the Engineer is given considerable authority, they cannot:

- Assume responsibility for the contractor's methods
- Unreasonably interfere with the conduct of the work
- Dictate the contractor's procedures.

This does not imply, however, that the engineer is without responsibility for keeping the project on-schedule. In this regard, the authorities of the Engineer include:

- Approval of the contractor's general program of field procedures.
- Approval of construction equipment the contractor proposes to use.
- If work begins to lag behind schedule, the engineer may reasonably instruct the contractor to speed up its activities.

## Sources

- Harris, Paul E. (2014, December 17). "Planning and Control Using Oracle Primavera P6 Versions 8.1 to 8.4 Professional Client & Optional Client".
- Lindeburg PE, Michael R. (2011). "Civil Engineering Reference Manual for the PE Exam". Twelfth Edition.
- Oracle Primavera P6 Professional Help
- Virginia Department of Transportation. (Draft Release 3: 10-5-12). VDOT Post-award Scheduling Guide: Guidelines for Establishing & Maintaining Schedule Control on Projects During the Construction Phase.



