




**ProjectPro**

# *Critical Path 2.0*

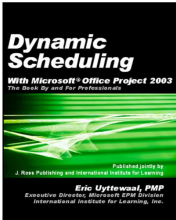
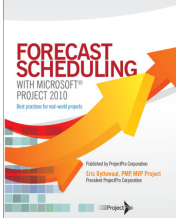
*The Next Edition of the Critical Path Theory  
Software Specification for Critical Path 2.0  
Compliance*

**Eric Uyttewaal, PMP**  
**ProjectPro Corp.**  
**www.ProjectProCorp.com**

## *Presenter Intro: Eric Uyttewaal, PMP*




- ❖ President ProjectPro Corp.
- ❖ Specializes in Microsoft Project and Project Server
- ❖ BS, Engineering;  
MS Business Administration
- ❖ Author "Forecast Scheduling with Project 2010" and "Dynamic Scheduling with Microsoft Office Project 2003"
- ❖ Formerly: Executive Director at IIL as developer and manager of the Orange, Blue, Black Belt certification curriculum



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## Consulting by ProjectPro: Specialties

1. Project Server 2007/2010 Implementations
2. Scheduling of Programs  
(with many links between subprojects)
3. Schedule improvement and raising scheduling maturity

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## ProjectPro Course Offering 2007/2010

### Microsoft Project:

Fundamentals  
2 days  
Project Managers

Forecast Scheduling  
2 days  
Project Managers

Forecasting Programs  
2 days  
Program Managers

### Microsoft Project and Project Server (PS) Courses:

Managing Tasks in PWA  
0.5 day  
Team Members

Managing Projects  
3 days  
Project Managers

Managing Programs  
2 days  
Program Managers

Managing Resources  
2 days  
Resource Managers

Managing Portfolios  
2 days  
Portfolio Managers

Monitoring Projects, Programs, Portfolios  
0.5 – 1 day  
Executives

Deploying PS  
2-5 days  
Deploy. Team

Configuring PS  
2 days  
Project Office

Administering PS  
2 days  
Administrators

### *Members of the Working Group*

Robyn Antill	Sai Prasad
Michelle Colodzin	Wayne Robinson
Brian Evans	John Krahula
Timothy Mather	Gary Hartnett
Fernando Nunes de Oliveira	Vladimir Liberzon
Raul Römer	Jack Dahlgren
Murali Puthiyarambath	Charles Follin
John Stiles	Eric Uyttewaal
Ali Vessali	

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### *Objectives of the Working Group*

- Improve Critical Path Theory
  - Address problems experienced in practice
- Develop Critical Path 2.0 Theory
  - No “best practices”
- Elevate entire field of scheduling software
- Publish paper at PMI-SCOP (PMI-COS) conference in May 2011

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## *Planned Outputs*

- Standard for Critical Path 2.0 / CPM 2.0
- A specification document for the scheduling software industry with the minimum requirements to be Critical Path 2.0 compliant

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## *Critical Path 1.0*

Critical Path 1.0 (CPM 1.0) was first defined by:

- **Kelley**, James. *Critical Path Planning and Scheduling: Mathematical Basis*. Operations Research, Vol. 9, No. 3, May-June, 1961
- *Critical-Path Planning and Scheduling*, **Kelley**, James E. Jr., and **Walker**, Morgan R., Proceeding of the Eastern Joint Computer Conference, Boston. December 1-3, 1959, pp. 160-173. 10.

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### *Critical Path 1.0 Definition*

Generally, but not always, the sequence of schedule activities that determines the duration of the project. It is the longest path through the project.

*Source: PMBOK (4<sup>th</sup> Edition)*

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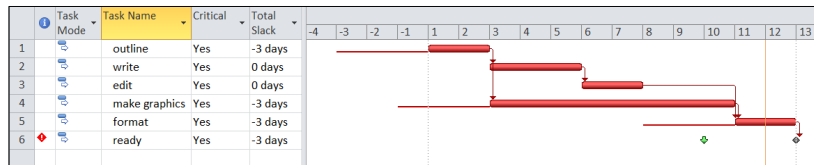
### *Assumptions of Critical Path 1.0*

1. Activity estimates are normally distributed  
PERT or Monte Carlo Simulation
2. There is no merge-bias or path-convergence  
Monte Carlo Simulation
3. You have unlimited resources available  
Critical Chain, Resource Critical Path and Simulation

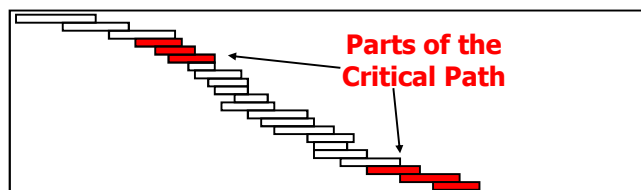
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**“Activity is Critical when Total Float  $\leq 0$ ” leads to:**

- Software displays too many critical tasks:



- Software displays too few critical tasks:



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**Scheduling Software Displays Too Few Critical Tasks when:**

- Incomplete network logic
- Constraint Dates
- Elapsed Durations and Elapsed Lags
- Resource Calendar: Unavailability of Resources
- Task Calendars
- External Predecessors
- Workload Leveling

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## *DEMO Incomplete Critical Path*

- Use: **DEMO Perfect Critical Path.mpp**

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## *How Leveling Affects the Critical Path 1.0*

**Write X**

**Harry 3 D**

**Write Y**

**Harry 2 D**

Optimistic  
Forecasts

↓ **leveling**

**Write X**

**Harry 3 D**

**Write Y**

**Harry 2 D**

Incomplete  
Critical Path

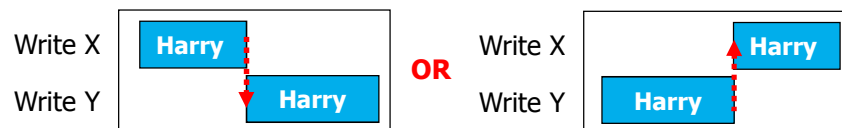
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## Resource Dependencies Differ from Logical Dependencies

A **logical dependency** imposes the sequence:



A **resource dependency** does not impose sequence. The relationship is that both tasks share the same resource.



Source: *Forecast Scheduling with Microsoft Project 2010*

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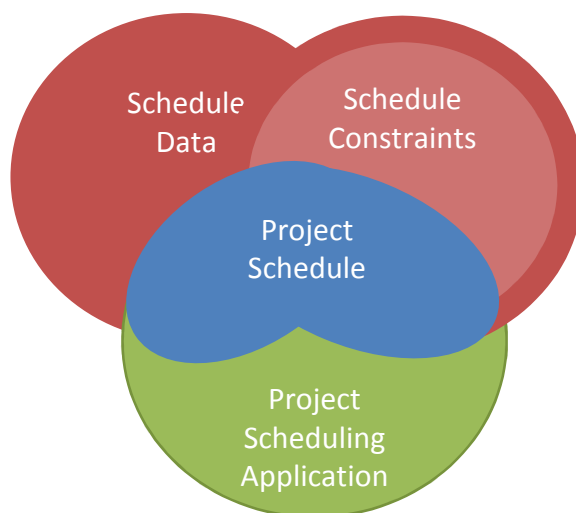
## Summary: Issues with Critical Path 1.0

- Weak definition: it contains literally "*Generally, but not always...*". PMBOK 4<sup>th</sup> edition
- Critical Path 1.0 assumptions are no longer tenable
- Critical Path 1.0 cannot handle date, calendar and resource constraints. Problems:
  - Incomplete Critical Paths
  - No Resource-Critical Paths

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## *Introduction of Terminology for Critical Path 2.0*



## **Project Schedule Data**

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>➤ WBS</li><li>➤ Estimates</li><li>➤ Dependencies</li><li>➤ Resources: Materials, Machines, Labor, Facilities, Land, Three-Dimensional Space</li><li>➤ Priorities: Project, Deliverable/Activity, Resource</li><li>➤ Constraints (see next column)</li></ul> | <p>Constraints:</p> <ul style="list-style-type: none"><li>➤ Logical constraints</li><li>➤ Resource availability constraints</li><li>➤ Date constraints</li><li>➤ Calendar constraints: Project, Resource, Activity, Lag/Lead</li><li>➤ Financial constraints</li><li>➤ Physical constraints</li><li>➤ Organization policy constraints</li><li>➤ Regulatory or Legal constraints</li><li>➤ Ecological constraints</li><li>➤ Political constraints</li></ul> |
|---|--|

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### *Constraints: Definition*

Constraints are a special type of project schedule data that the scheduler **needs to take into account** in order to produce a **realistic and feasible schedule**.

Source: *Proceedings of Critical Path 2.0 working group*, Mar. 2011

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### *Critical Path 2.0 Definition*

The Critical Path 2.0 is the **subset** of activities that **determines and explains the entire duration** of the schedule when **all schedule data** that are entered into the scheduling application are **taken into account**.

There can be more than one Critical Path that run in parallel in a schedule.

Source: *Proceedings of Critical Path 2.0 working group*, Mar. 2011

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## Term “Subset”

- Path
  - The word is in the term to define
  - Implies logical links (resource dependencies?)
- Chain
  - Implies logical links
- Series
  - Implies logical links
- Subset:
  - Reveals added value of the theory: focus!

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## Term “Longest Path”

Longest Path = *the string of **directly related** activities that comprise the longest path from the data date to the last activity in the schedule* (Source: Ron Winter)

- Deals effectively with most constraints mentioned except with resource constraints
- Does not deal well with a situation where a few, short activities start from a start-no-earlier-than constraint that finish later than any other path

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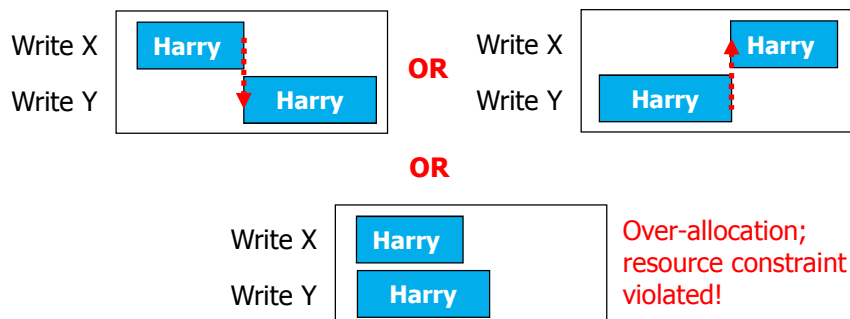
## Term “Total Float”

- Critical Path 1.0 (PMBOK 4<sup>th</sup> edition):  
*The total amount of time a schedule activity may be delayed from its early start date without delaying the project finish date, or violating **a schedule constraint**.*
- Critical Path 2.0:  
*The total amount of time a schedule activity may be delayed from its early start date without delaying the project finish date, or violating **any schedule constraint (including resource constraints) based on the current schedule**.*

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## “...based on the current schedule”

A necessary stipulation when calculating the Critical Path 2.0 in resource-constrained schedules:



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## The Differences between Critical Path 1.0 and Critical Path 2.0

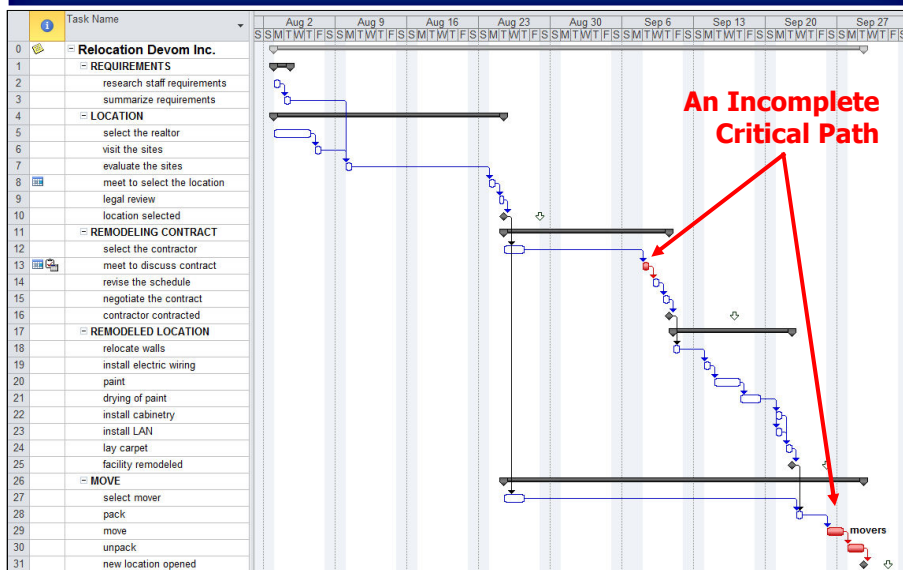
- Critical Path 2.0 applies in resource-constrained schedules
- Critical Path 2.0 standard requires that (at least) the next four schedule constraints should be taken into account: logical, resource, date and calendar constraints
- Critical Path 2.0 always produces a complete Critical Path when these constraints are used in schedules
- You can end up with a different Critical Path under Critical Path Method 2.0 than you would under Critical Path Method 1.0.

Critical Path 2.0 compliant scheduling software must:  
be able to deal with logical, resource, date and calendar constraints, and  
produce a complete Critical Path when those constraints are used

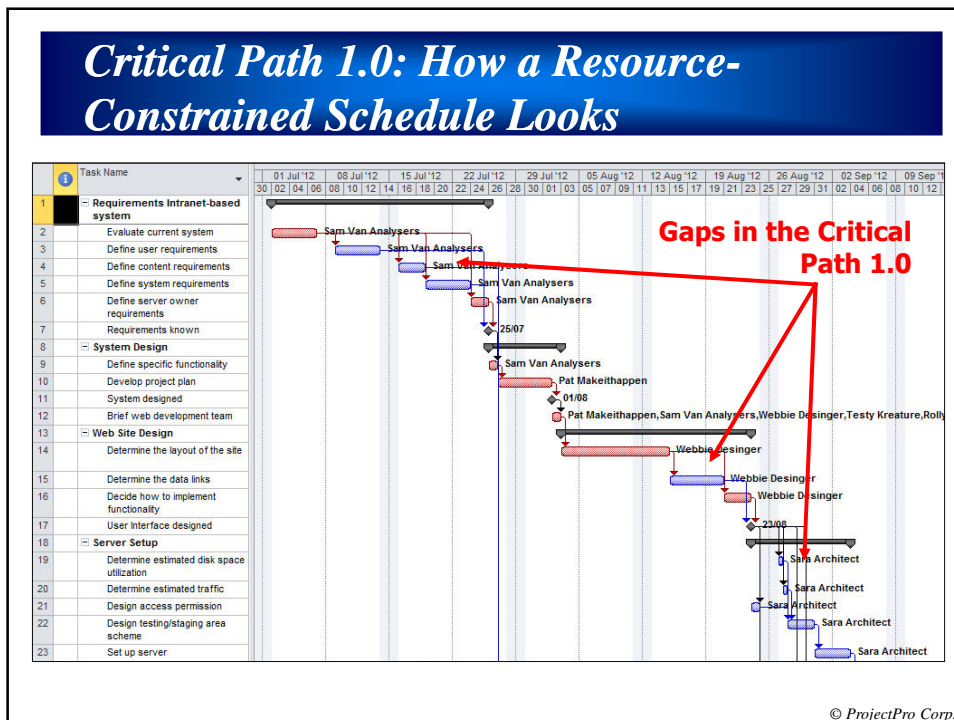
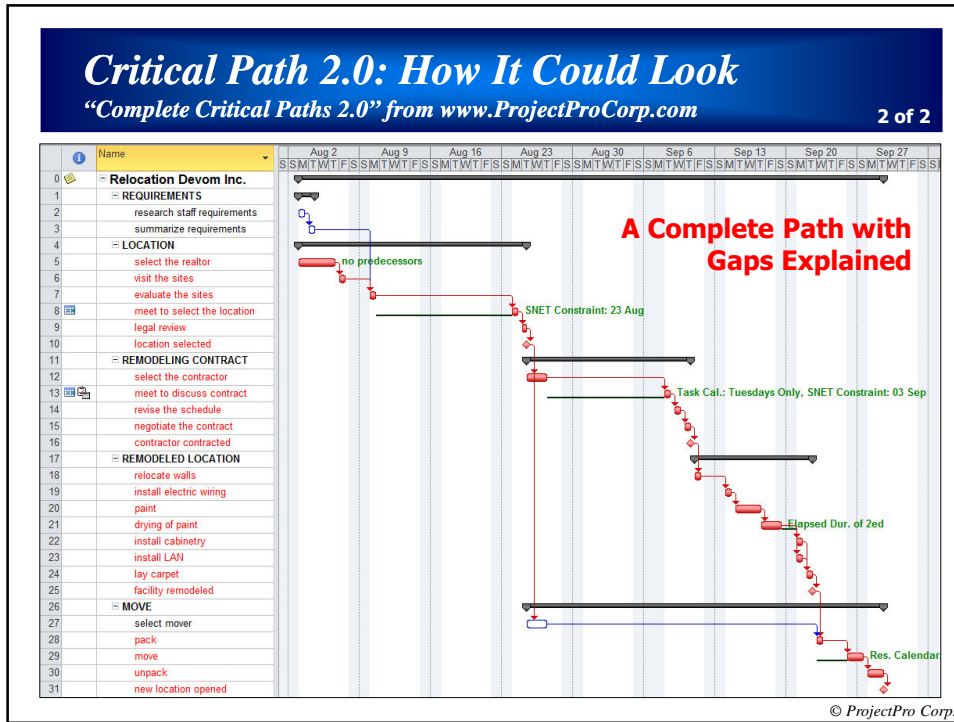
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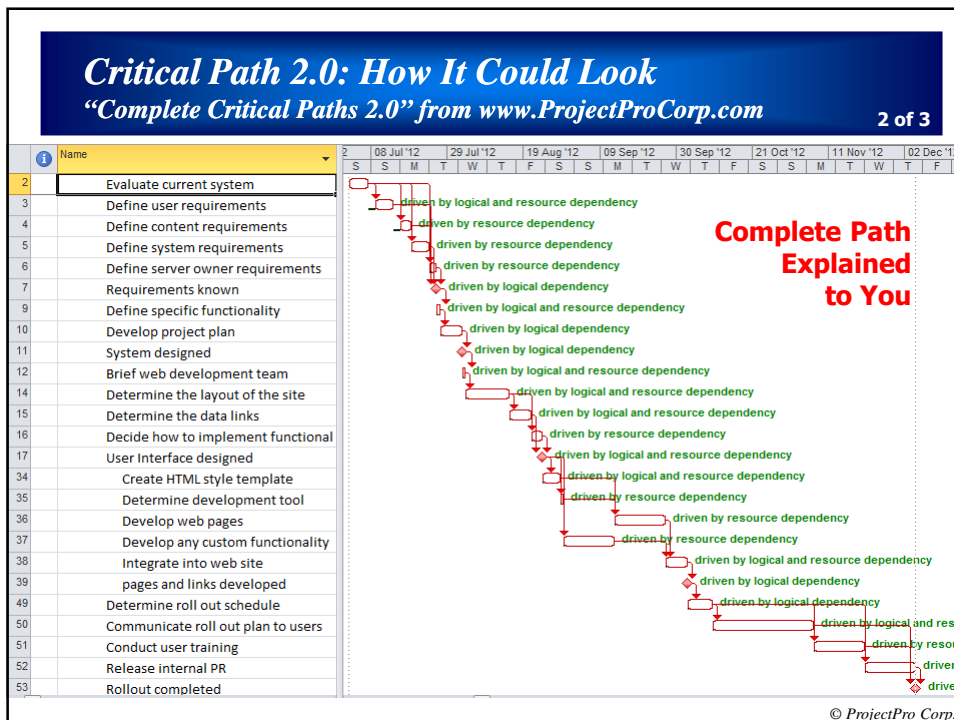
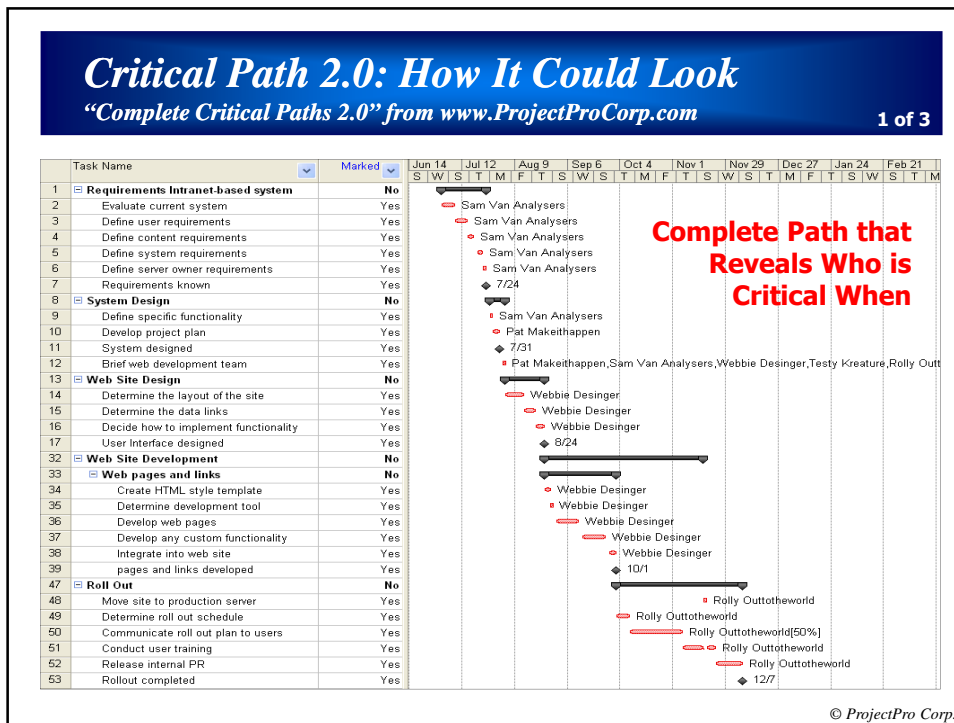
## Critical Path 1.0: How a Date- and Calendar-Constrained Schedule Looks

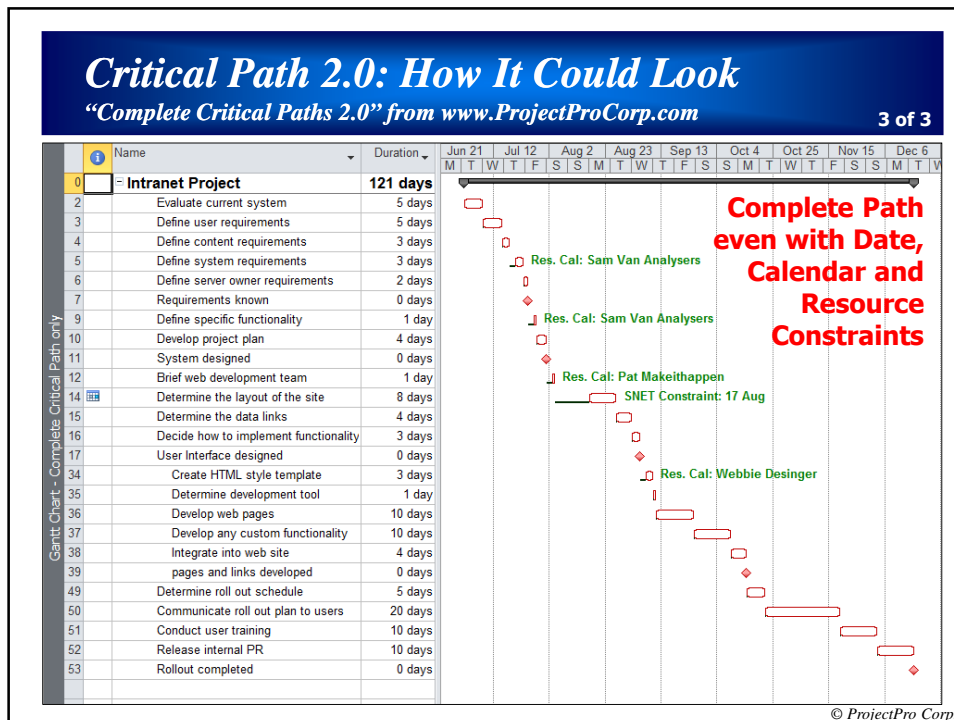
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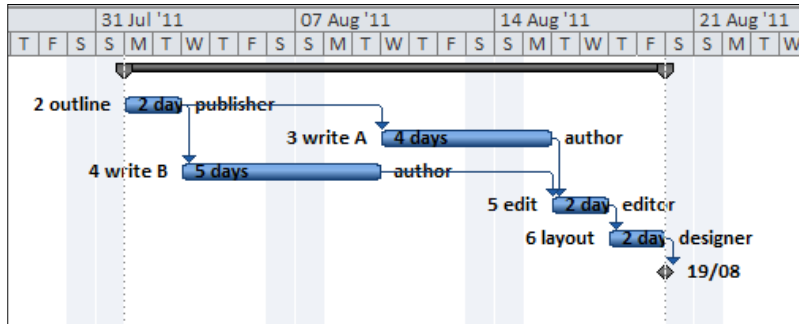
### How to Find the Critical Path 2.0 in Resource-Constrained Schedules? 1 of 2

1. List all activities and enter all **effort** estimates
2. Determine all relationships including type of dependency (FS, SS, FF and SF) and lags (or leads)
3. **Enter all resources and their resource calendars**
4. **Assign resources to the activities and allocate the effort**
5. **Determine the duration of each activity**
6. Enter all other constraints: date and calendar constraints
7. **Level the workloads of all resources completely.**
8. Determine all possible paths of the logical dependencies **and resource dependencies**
9. Determine the duration of each path through the network taking all logical dependencies, **resource dependencies** and all other constraints into account.
10. Identify the longest path(s) of all possible paths that explain the entire project duration; this is Critical Path 2.0.

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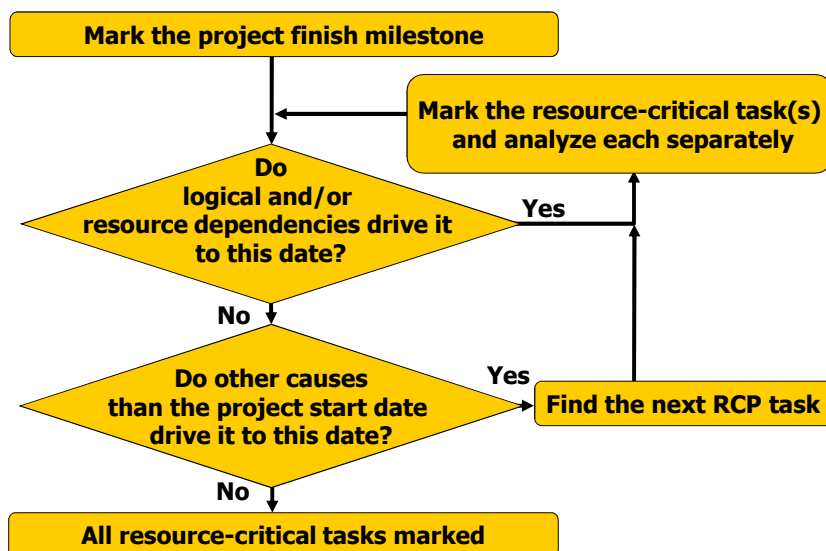
## How to Find the Critical Path 2.0 - Example



Paths	Duration
path 2, 3, 5, 6	$2+4+2+2=10$
path 2, 4, 5, 6	$2+5+2+2=11$
path 2, 4, 3, 5, 6	$2+5+4+2+2=15$

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## How to Find the Critical Path 2.0 in Resource-Constrained Schedules? 2 of 2




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## *Software Specification for Critical Path 2.0 Compliant Software*

1. Is able to capture logical, resource, date and calendar constraints
2. Will alert the user to incomplete network logic
3. Will alert the user to over-allocations
4. Is able to level the workloads in the schedule
5. Is able to produce a complete Critical Path that explains the entire project duration when those constraints are used

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## *Thank You for Attending !*

- Discuss with professional schedulers online:  
**LinkedIn group** "Forecast Scheduling" 
- To receive a PDF-file of the Critical Path 2.0 paper,  
email: EricU@ProjectProCorp.com