

Critical Path Planning & the Theory of Constraints

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Agenda

- Brief background of CPP & TOC
- Outline how each process works
- Compare and contrast the 2 methods
- The presentation will be available at <http://www.asqhudsonmohawk.org/>

Vocabulary

- Critical Path Planning
- A Critical Path is the longest duration path (sequence) through a network of tasks (work plan).
- Critical Tasks (activities) are tasks (activities) on the critical path.

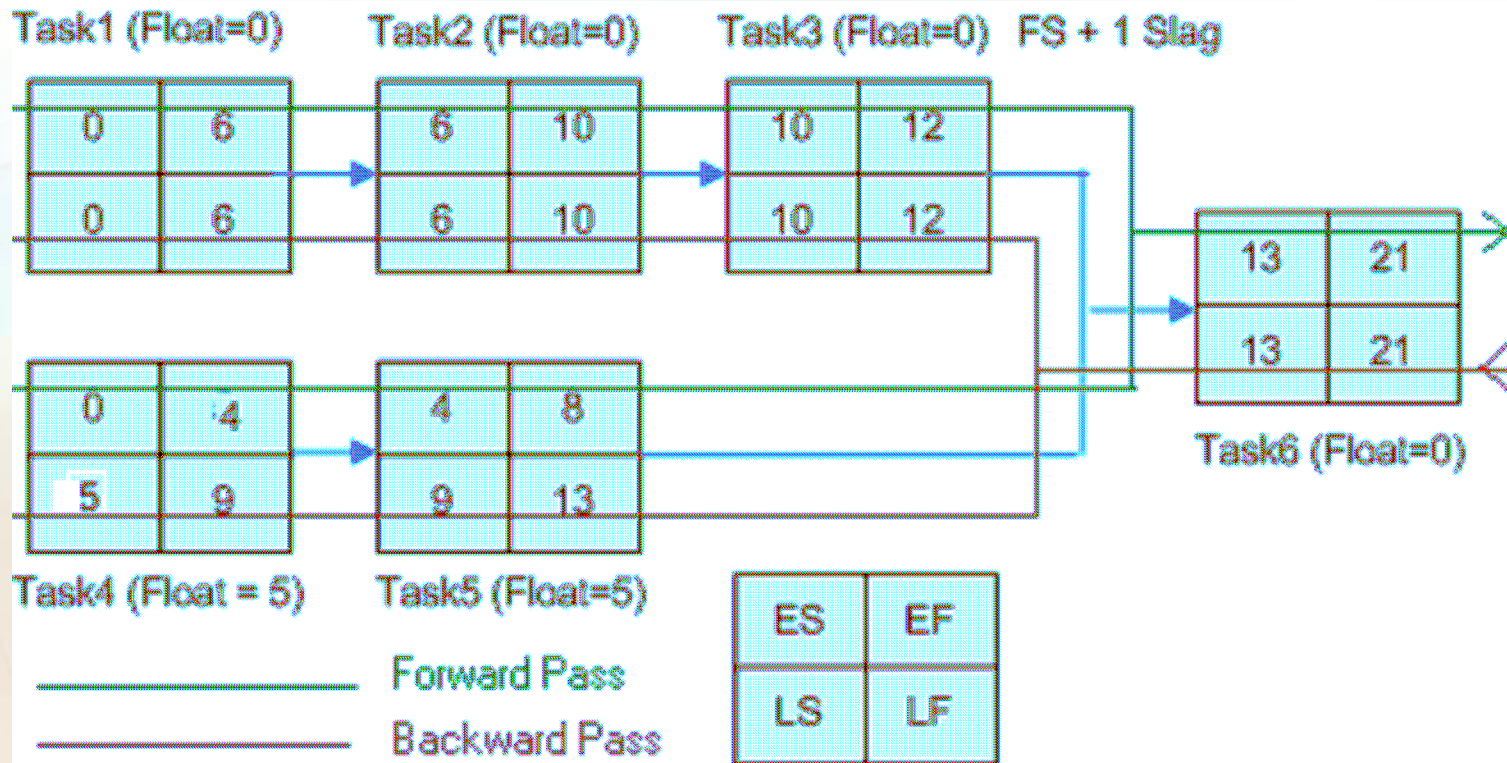
Scheduled Tasks

- Early Start (ES)
- Early Finish (EF)
- Late Start (LS)
- Late Finish (LF)

Basic Technique

- Early Start and Early Finish dates are calculated by Forward Pass
- Late Start and Late Finish Give are calculated by Backward Pass
- Float time is amount of time a task can slip without delaying the project.
- $\text{Float} = \text{LS} - \text{ES}$ or $\text{LF} - \text{EF}$

Forward and Backward Pass



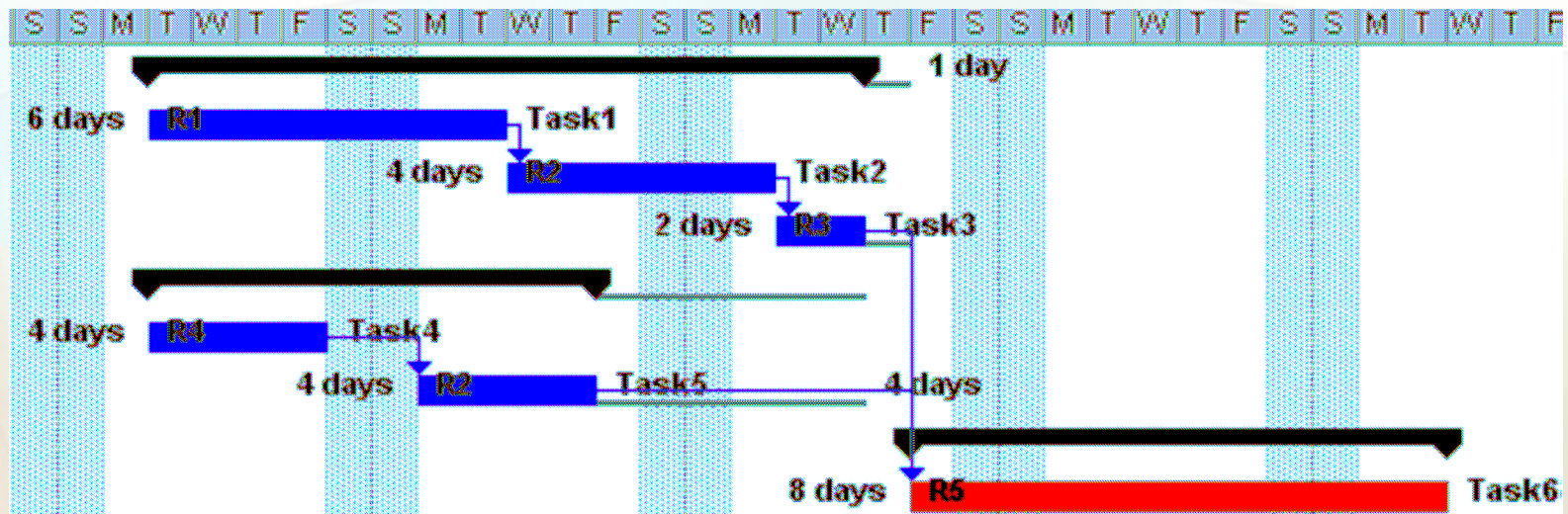
Critical Path

| Task | Successor | Duration | Resource | Lag |
|-------|-----------|----------|----------|------|
| Task1 | Task2 | 6 | R1 | 0 |
| Task2 | Task3 | 4 | R2 | 0 |
| Task3 | Task6 | 2 | R3 | FS+1 |
| Task4 | Task5 | 4 | R4 | 0 |
| Task5 | Task6 | 4 | R2 | 0 |
| Task6 | - | 8 | R5 | 0 |

FS = Finish to Start

- **Critical Path = Task1+Task2+Task3+ Lag+ Task6 = 5+4+2+1+8 = 21 Days.**

Gantt Chart



CPM Strengths

- Project Planning and control.
- Time-cost trade-offs.
- Cost-benefit analysis.
- Contingency planning.
- Reducing risk

Limitations of CPM

- CPM assumes low uncertainty in schedule dates.
- Does not consider resource dependencies.
- Less efficient use of buffer time.
- Less focus on non critical tasks that can cause risk.
- Based on only deterministic task duration.
- Critical Path can change during execution

Theory of Constraints

- Eliyahu M. Goldratt originated the TOC in his book, "The Goal: A Process of Ongoing Improvement."
- A system can never be better than its weakest part.
- Improvement depends upon the identification of that constraint and its mitigation.

CCPM Strengths

- PMBOK: Planning and control processes.
- TOC (Theory of Constraints): Remove bottleneck to resolve constraints.
- Lean: Eliminate waste.
- Six Sigma: Reduce Variations.

CCPM is based on

- Resource constrained situations.
- Optimum use of Buffer (time added to prevent slippage of schedule)

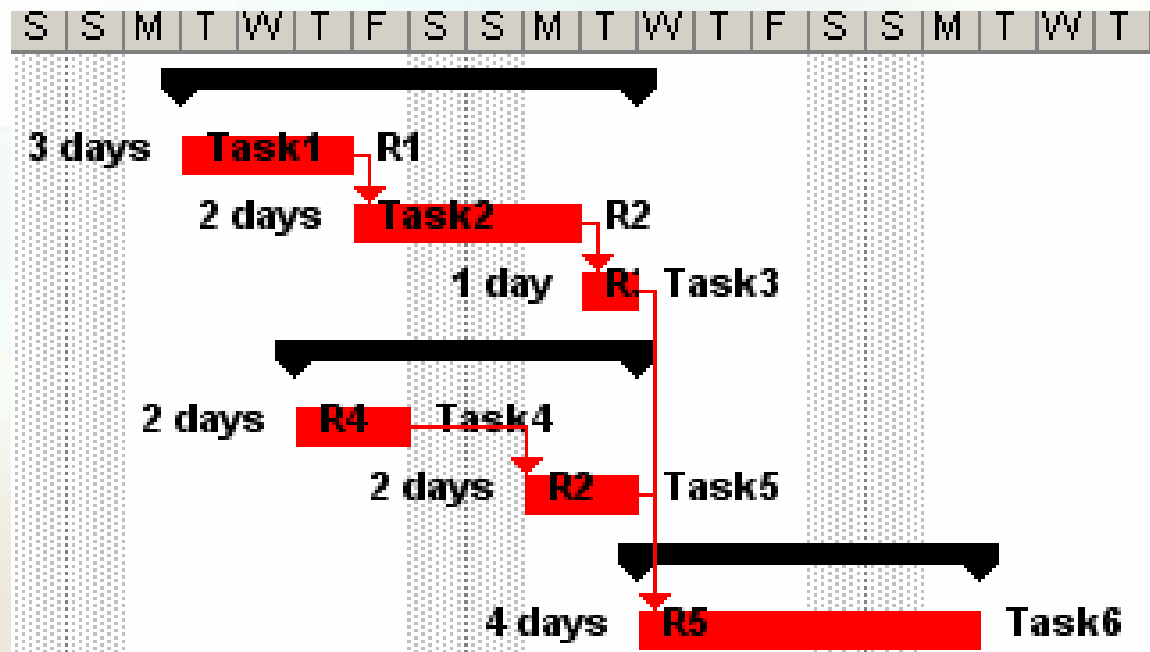
The 3 Buffers

- Project Buffers (PB): Amount of buffer time at the end of the project.
- Feeding Buffers (FB): Amount of buffer time at the end of a sequence of tasks.
- Resource Buffers (RB): It is an alert that is used to indicate that resource is needed to perform a task. This alert can be set few days before a resource is actually needed.

CCPM Application

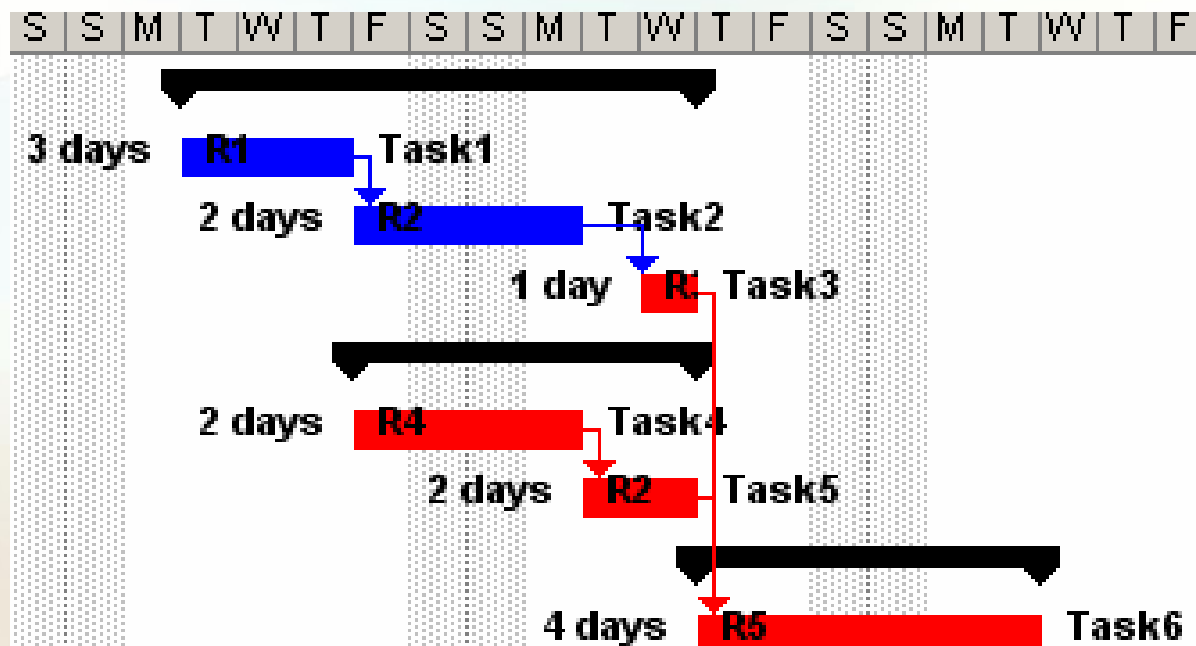
- Remove safety time and reduce tasks durations by 50%.
- Create schedule on Late Finish dates and Remove resource constraints and identify critical chain.
- Add Project Buffer of 50% of the tasks duration and add Feeder buffer to non critical chain.

1. Remove safety time and reduce tasks durations by 50%



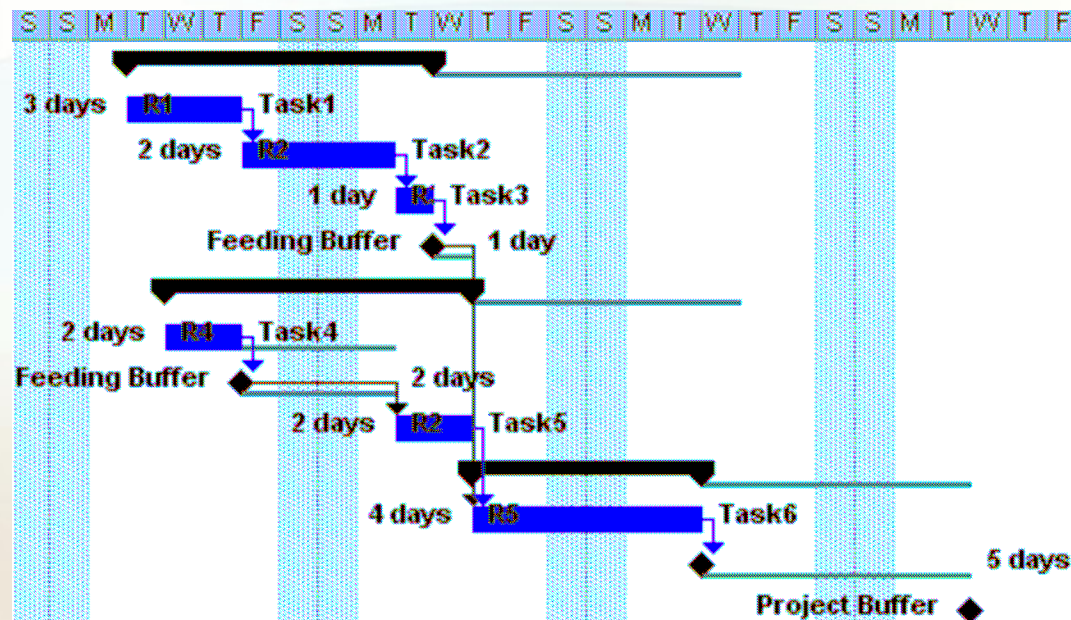
Project Duration = Task1+Task2+Task3+ Task6 =
3+2+1+4 = 10 Days.

2. Create schedule on Late Finish dates and remove resource constraints and identify critical chain.



Project Duration = Task1+Task2+Task5+ Task6 =
3+2+2+4 = 11 Days.

3. Add Project Buffer of 50% of the tasks duration and add Feeder buffer to non critical chain.



$$\text{Project Duration} = \text{Task1} + \text{Task2} + \text{Task5} + \text{Task6} + \text{PB} = 3 + 2 + 2 + 4 + 5 = 16 \text{ Days.}$$

Comparison of CPM and CCPM

- According to the results of our example, project duration by CPM is 21 days and the project duration for the same amount of work by using CCPM is 16 Days.
- Using TOC based CCPM:
 - Project Duration can be reduced by 25-40%.
 - Resources can be utilized effectively.
 - Project is fully focused on both critical and non critical tasks

Additional Information

- The Project Management Body of Knowledge (PMBOK) www.pmi.org
- [What is the Theory of Constraints?](#)
- [The Theory of Constraints and its Thinking Processes](#)
- [The Theory of Constraints Project Management](#)
- “The Goal: A Process of Ongoing Improvement” & “The Critical Chain” by Dr. Eliyahu M Goldratt