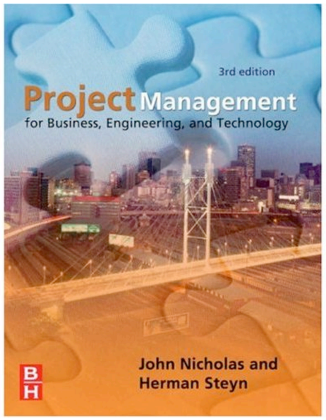
Critical Chain Project Management

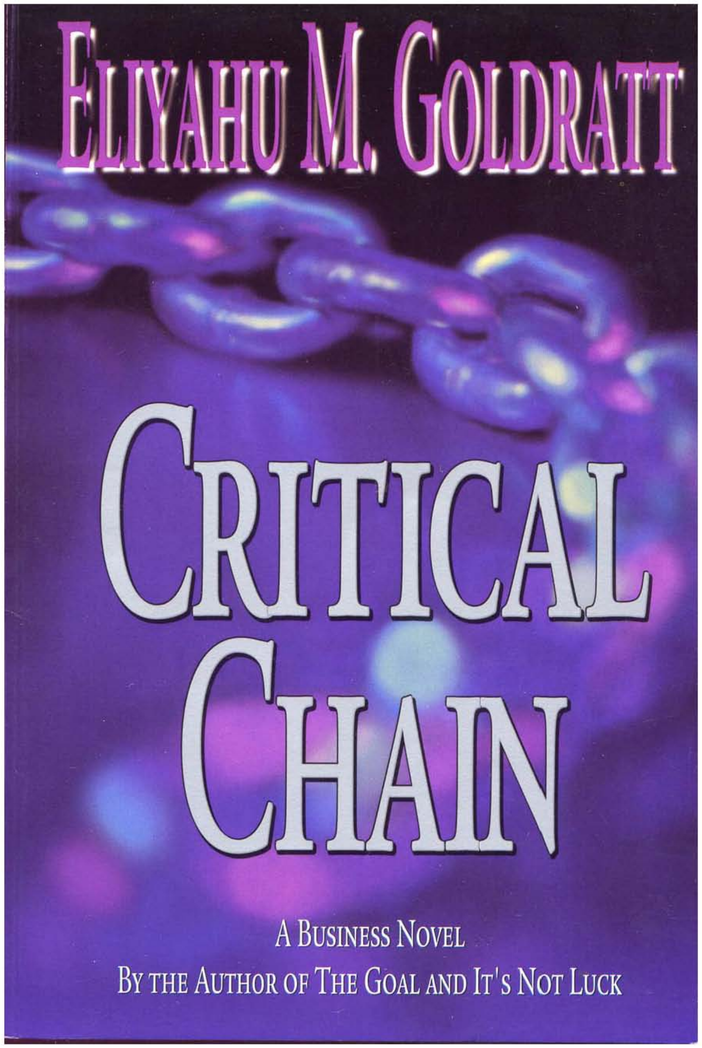
CCPM

Source: http://www.myplick.com/view/eWOSwlru3mm/Critical-Chain-Project-Management-CCPM

Some inserts also from:



Origin


Eliyahu M. Goldratt
Critical Chain
A Business Novel
By the Author of The Goal and It's Not Luck

Builds on Previous Concepts

- Relatively vogue topic
- Builds on
  - PERT, Critical Paths, CPM
  - Gantt Charts
  - etc.
- Additional gains for Multi-Project Management
- Some tool support
  - Some integration with, e.g. Microsoft Project
  - Some stand-alone tools

Claimed Examples of Improvement

PHNSY-FMB Improvements

METRIC	BEFORE CCPM	AFTER CCPM	IMPROVEMENT
ON-TIME (Scheduled Availabilities)	40% (8 of 20)	93% (25 of 27)	⇑ 133%
Average Cost per Job (incl. overtime)	$6,113	$4,700	⇓ 23%
Man-Days	3,741	2,202	⇓ 41%
Job Completion Rate (same time period)	180 (93%)	220 (99%)	⇑ 22%
Overtime	28.75%	12.5%	⇓ 57%
Customer Backlog	110	83	⇓ 25%

Rev. 4: 2/27/04

Critical Chain Project Management

- Appreciate that conventional PM has delivery problems
- Some are in the areas of estimating and scheduling
- Understand how CCPM addresses these weaknesses
- Understand the CCPM techniques

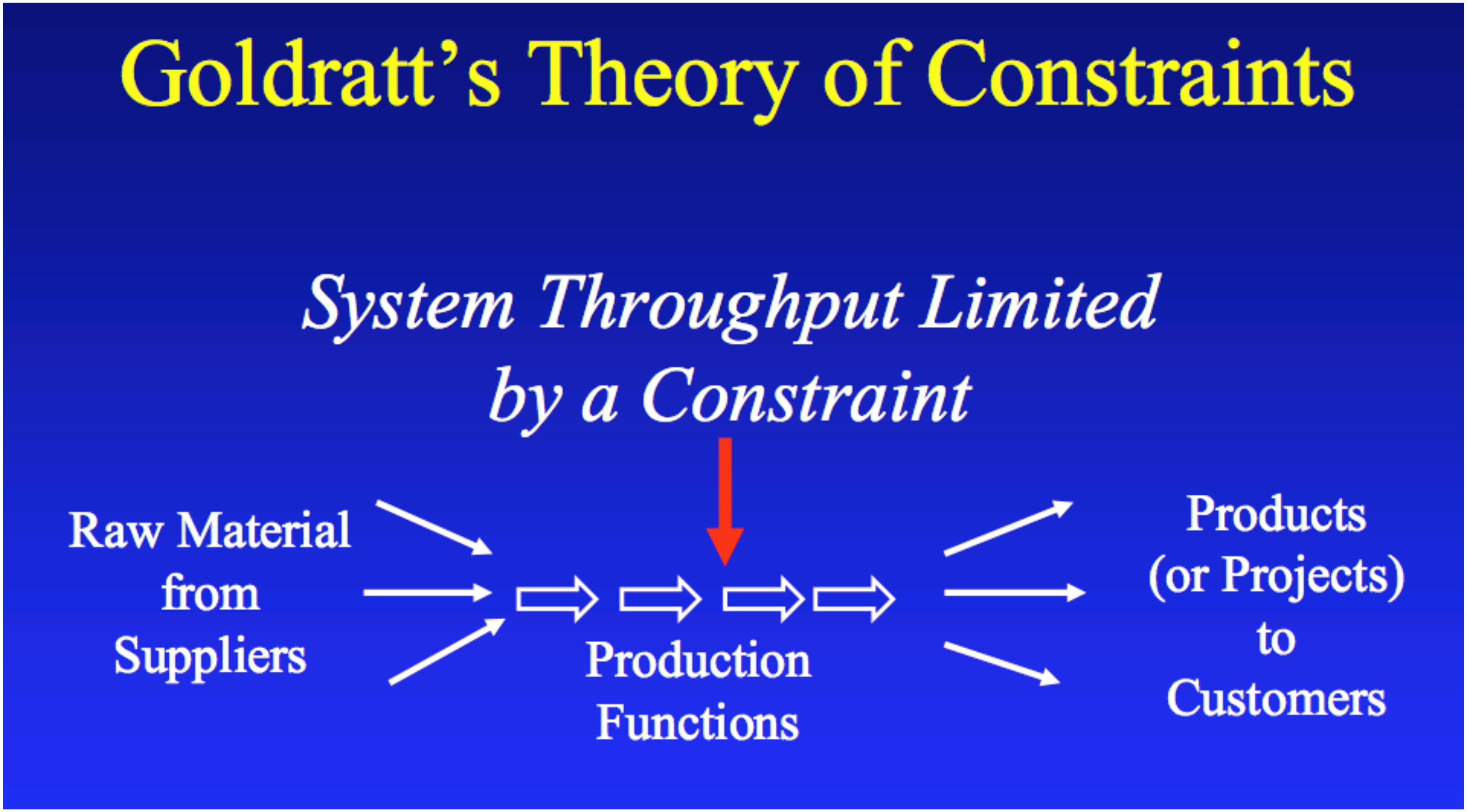
“Theory of Constraints”

The critical chain method is a Theory of Constraints (TOC) application to projects

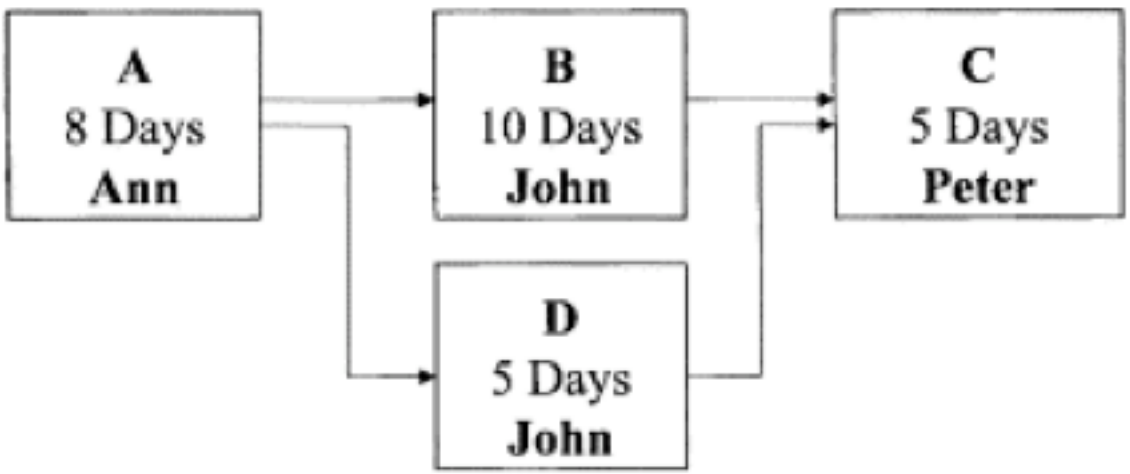
Project duration is considered as the constraint:

- The objective of a project is to deliver something that would generate income (or provide some other benefit)
- The project itself costs money
- The sooner the income (or other benefit) can materialize, the better

TOC in a Picture



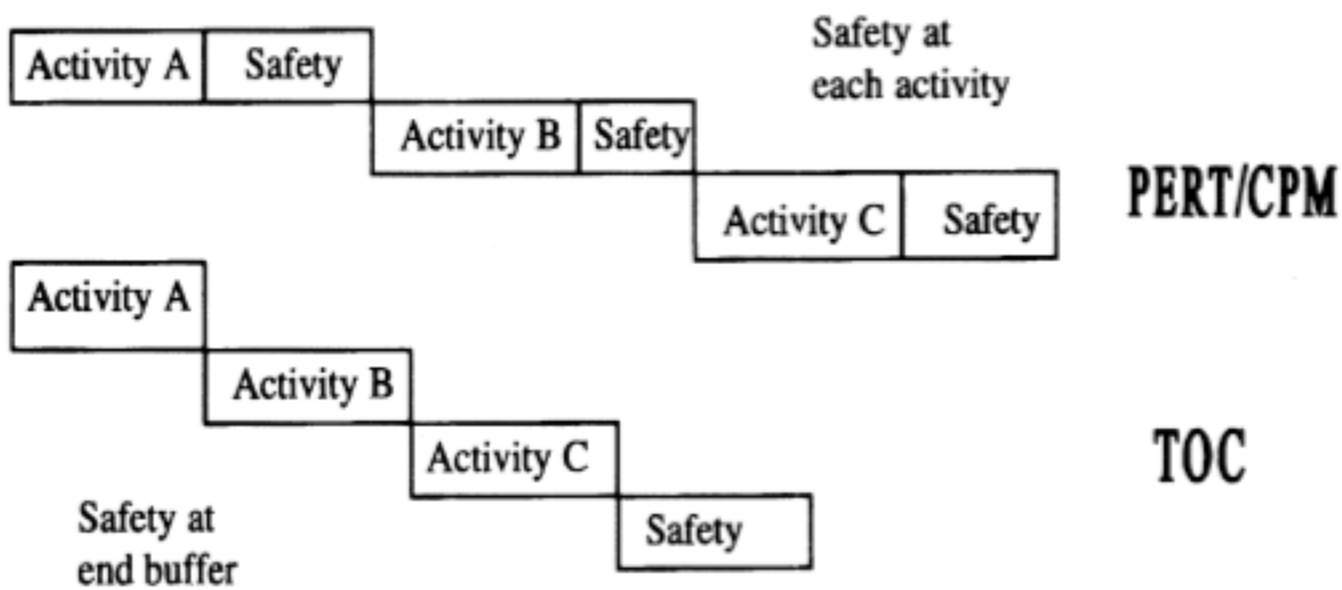
Critical Chain vs. Critical Path



Critical Path: A B C (23 Days)

Critical Chain: A B D C or A D B C (28 Days)

CPM (PERT) vs. CCPM (TOC)



How we manage uncertainty in projects?

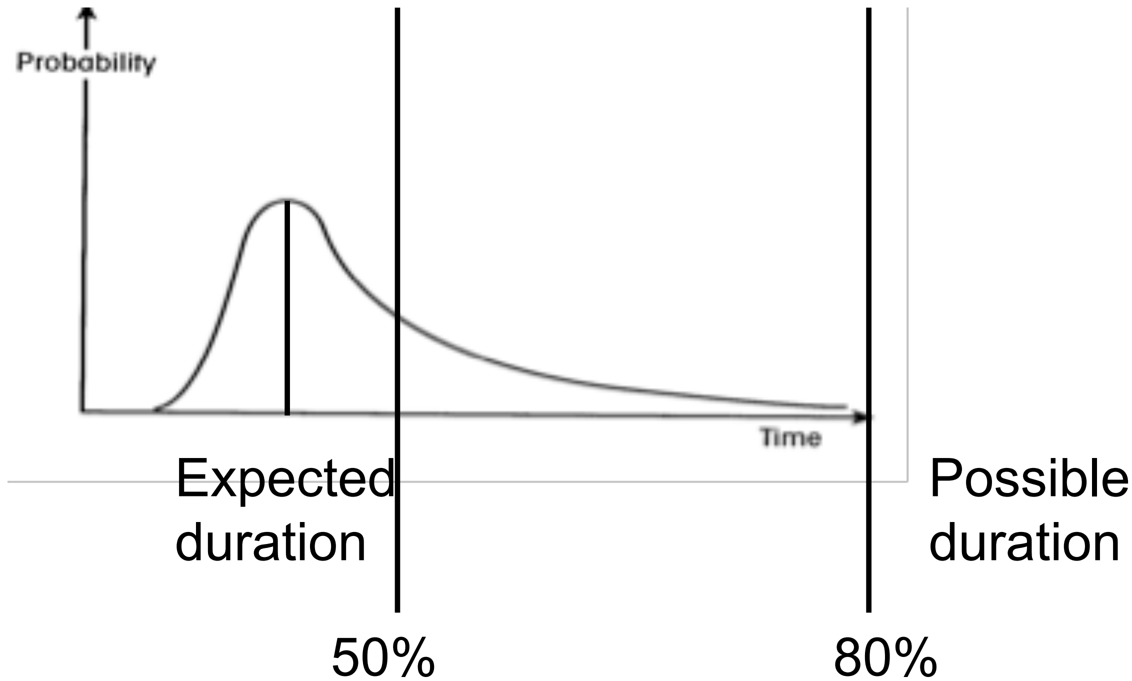
- finish the project late
- reduce scope or specifications
- all task owners pad estimates
- the actual duration expands to fill the time allotted.

“Parkinson’s Law”

Reasons for not Finishing Early

- **No incentive for early finish**
- **Keep on improving the work:**
  - Enjoy the work
  - Reduce risk of poor deliverable
- **Often leads to adding unnecessary “bells & whistles”**
- **Argued for long duration - reporting early finish could jeopardise credibility**

Student Syndrome and estimating

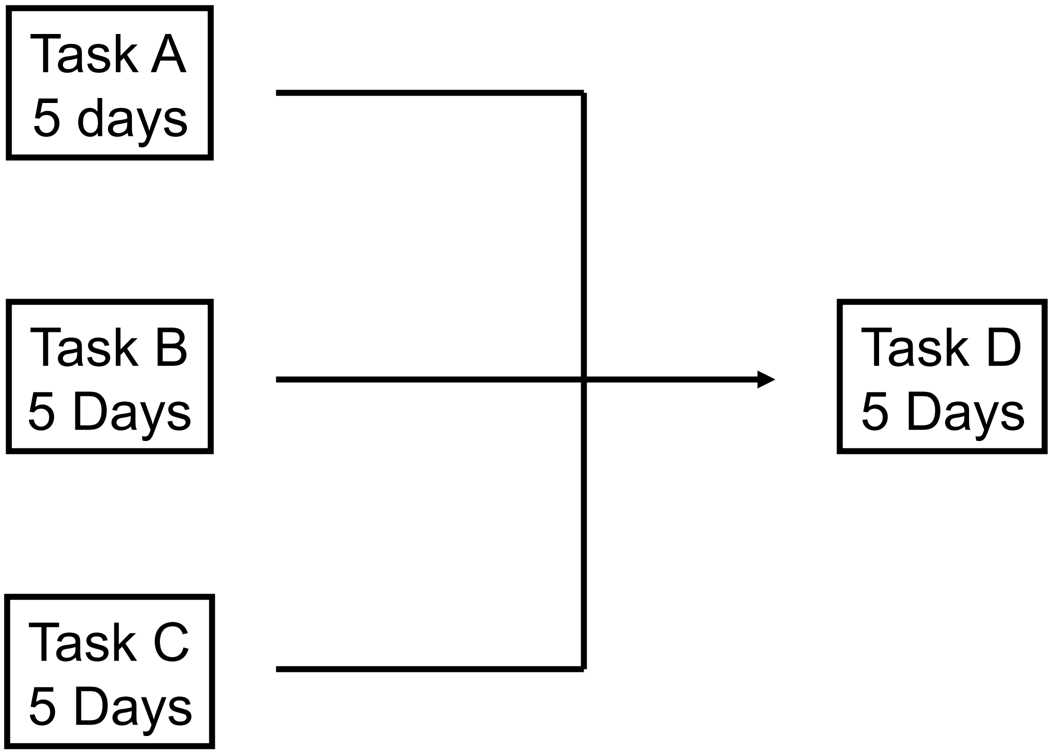


What happens to safety time when we hit problems?

Consequences of the *Student Syndrome*

- The safety is wasted before we start.
- Our stakeholders think we underestimate tasks.
- We never complete tasks on time.
- The problem gets worse when we work on several tasks simultaneously.

Other delays - parallel paths



If Task A actually takes 12 days, but B & C take 5 days, what happens to task D?

In parallel activities, the biggest delays are passed to the next step.

BUT early finishes in B and C are not passed on.

Multitasking = Bad?

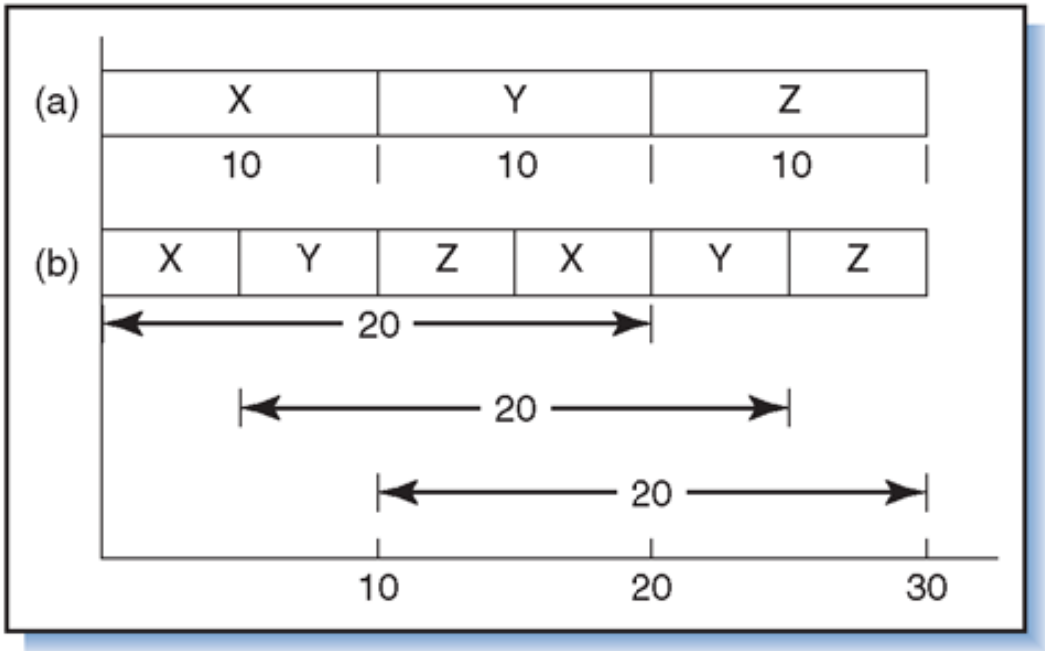
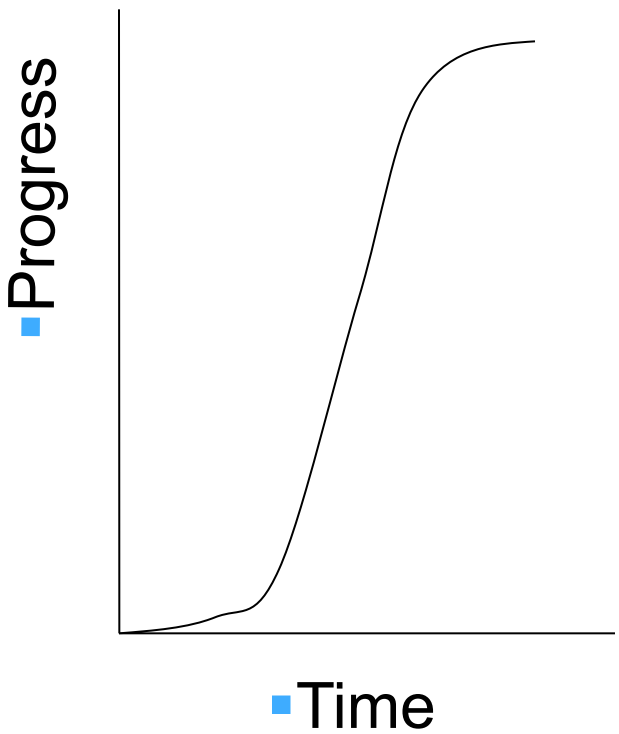


Figure 7-21
Effect of multitasking on elapsed and completion times.

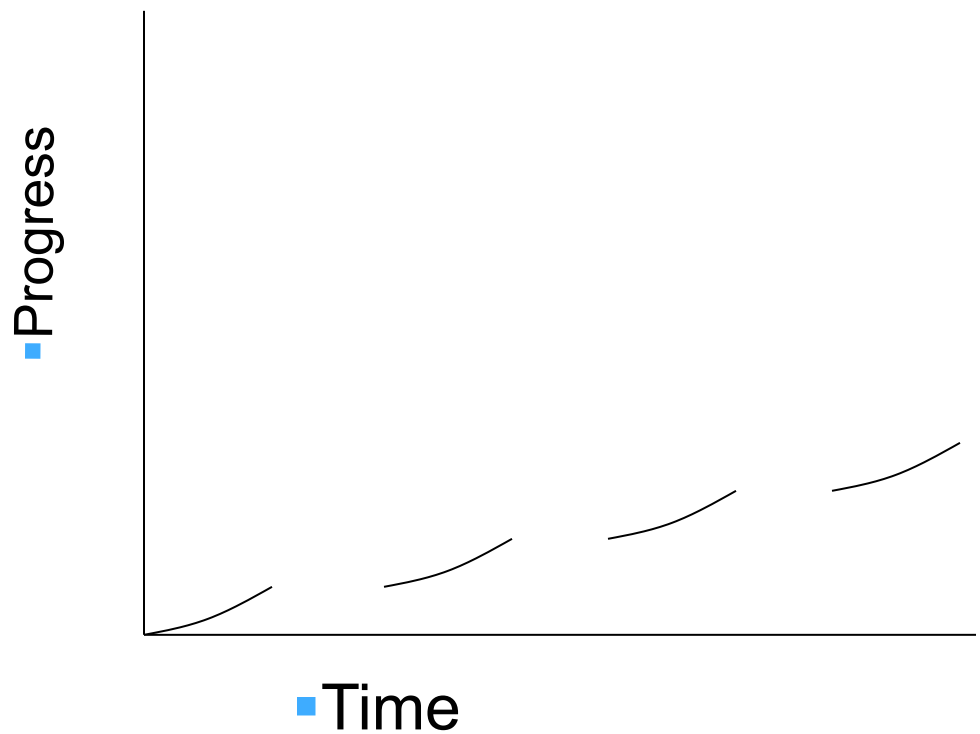
This figure does not show time lost due to context switching.

Multi-Tasking wastes reserves

- Without multi-tasking



- With multi-tasking



Parkinson's Law (one of)

- Parkinson's Law:
  "Work expands to fill the time available."

- Because the person negotiated to get the time, he/she could be embarrassed if it is now done in much less time. This could lead to loss of credibility and invite pressure

Summary of Ways to Waste Schedule Safety

- student syndrome
- multi-tasking
- passing on of previous delays
- Parkinson’s law

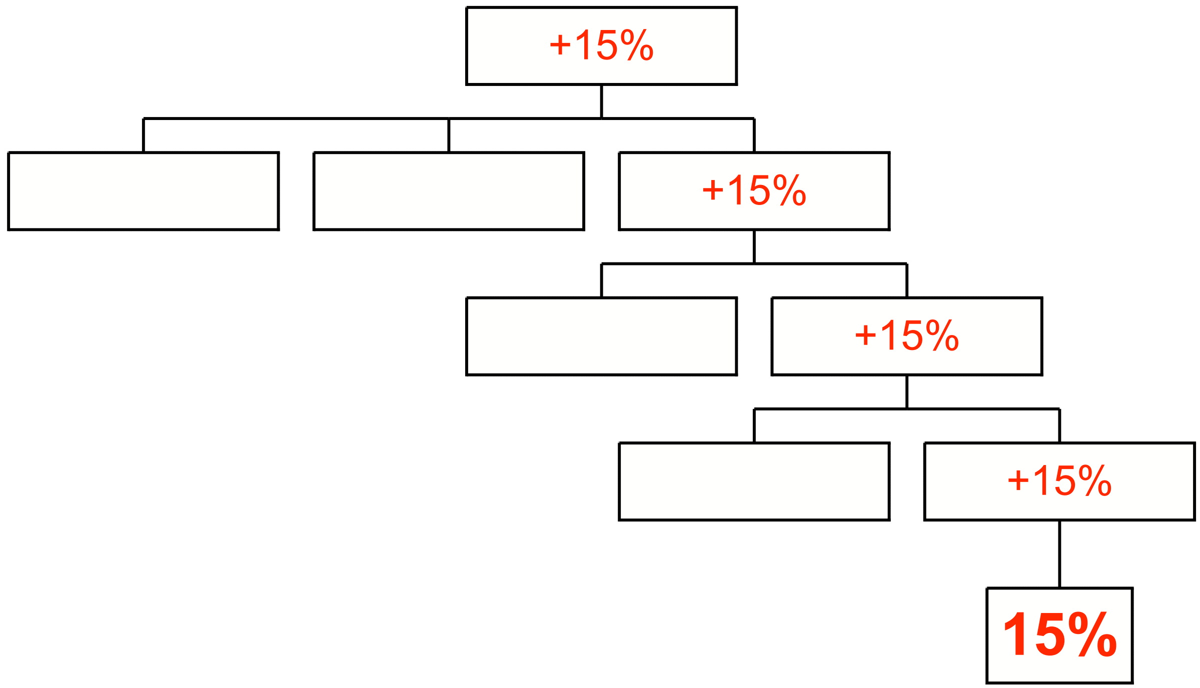
Principle of Aggregation

- The basis of, for example, the insurance industry
- Sometimes correctly applied in project cost management
- Since 1997 increasingly being applied to project scheduling (as a result of the “Critical Chain” methodology)

Using Principle of Aggregation

- There are substantial reserves in project schedules
- Reserves should be provided at project level only
- Even if reserves are only built in at the lowest level, the *principle of aggregation* offers potential for significant reduction of the reserves

Problem with Contingency Reserves at more than one WBS level



- How much reserve in total?
- Analogous to compound interest.
- $1.15^5 = 2.01$
- The reserve is doubled by level 5.

Mathematics of Aggregation for Risk Management

- Risk ≈ Standard Deviation σ of Task Time
- When several tasks are aggregated,
  the *variance* (= σ^2) is the *sum* of the variances of the individual tasks:

  $$\sigma_{agg}^2 = \sigma_1^2 + \sigma_2^2 + \ldots + \sigma_n^2$$

- Therefore, the **risk** of the aggregated tasks is the ***square root*** of the sum of squares of the individual risks. For example, if all tasks have the same σ_i, then

  $$\sigma_{agg} = n^{1/2}\sigma_1 \qquad \text{(vs. n x risk)}$$

The CCPM Approach

- Determine the critical chain
  (longest chain of dependent events, ***including resource limitations***).

- Take away 1/3 or 1/2 of the task duration from all tasks
  (or use the low end of interval estimates).

- Put it in a buffer and manage it separately.

- Use the *roadrunner* (or relay-race) *approach* to start the job immediately and finish it ASAP.

- Let a person finish one job before starting another.

Aggregating Reserves

- **Contingency reserves at project level is referred to as a "*project buffer*"**

- **Two reasons why a project buffer can be smaller than the sum of individual reserves:**
  - The principle of aggregation
  - When a schedule indicates less time, less time is wasted (students' syndrome is minimized)

Aggregating Reserves

Only the **project manager** makes commitments on due dates (and project cost) – everybody else only makes realistic estimates without reserves.

This normally requires a change in project culture – the only difficult aspect of critical chain management.

Buffer Awareness

Should people responsible for activities be aware of the project buffer?

Yes, if not, they will tend to build in contingency reserves at activity level as well

They must trust the project manager to “bail them out” in the event of an unforeseen event

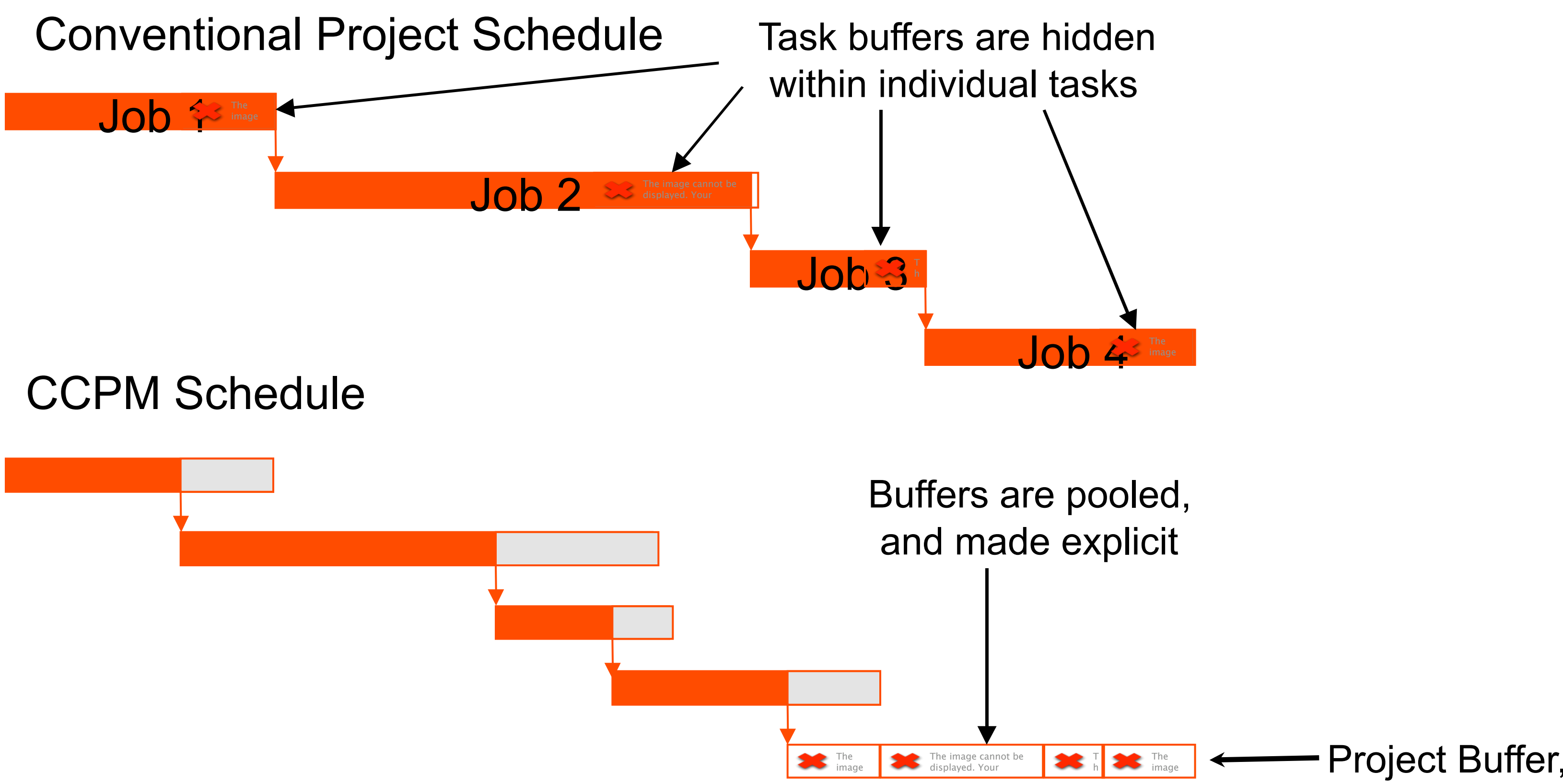
Culture Change

- To convince people to give estimates without significant reserve built in, everybody in the organization must understand that the durations on the schedule are **merely estimates**.

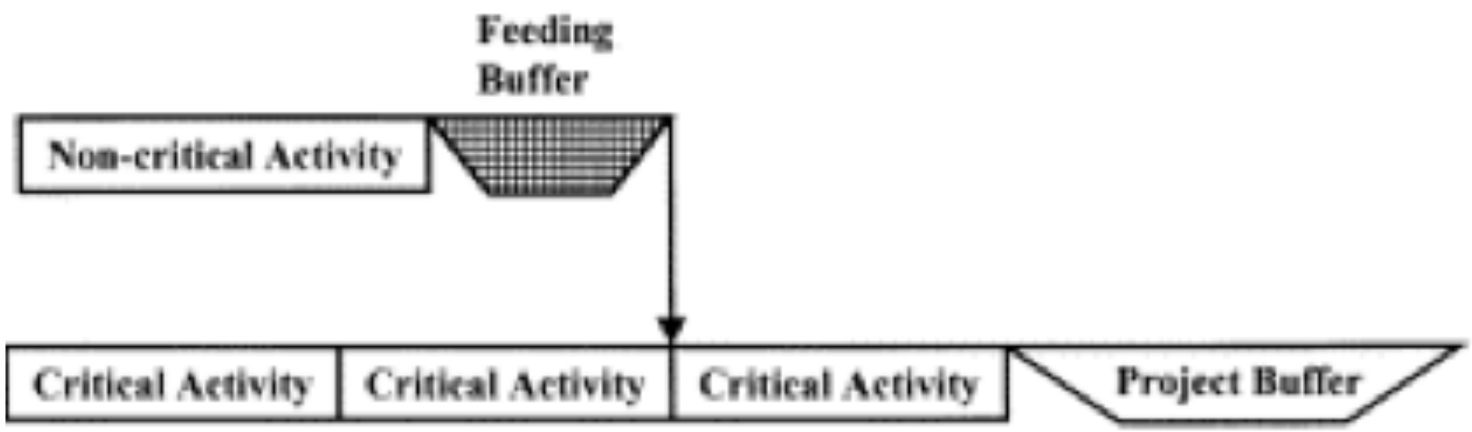
- This means that only the project manager makes a commitment on due date.

- **There are no due dates (deadlines) on activities**.

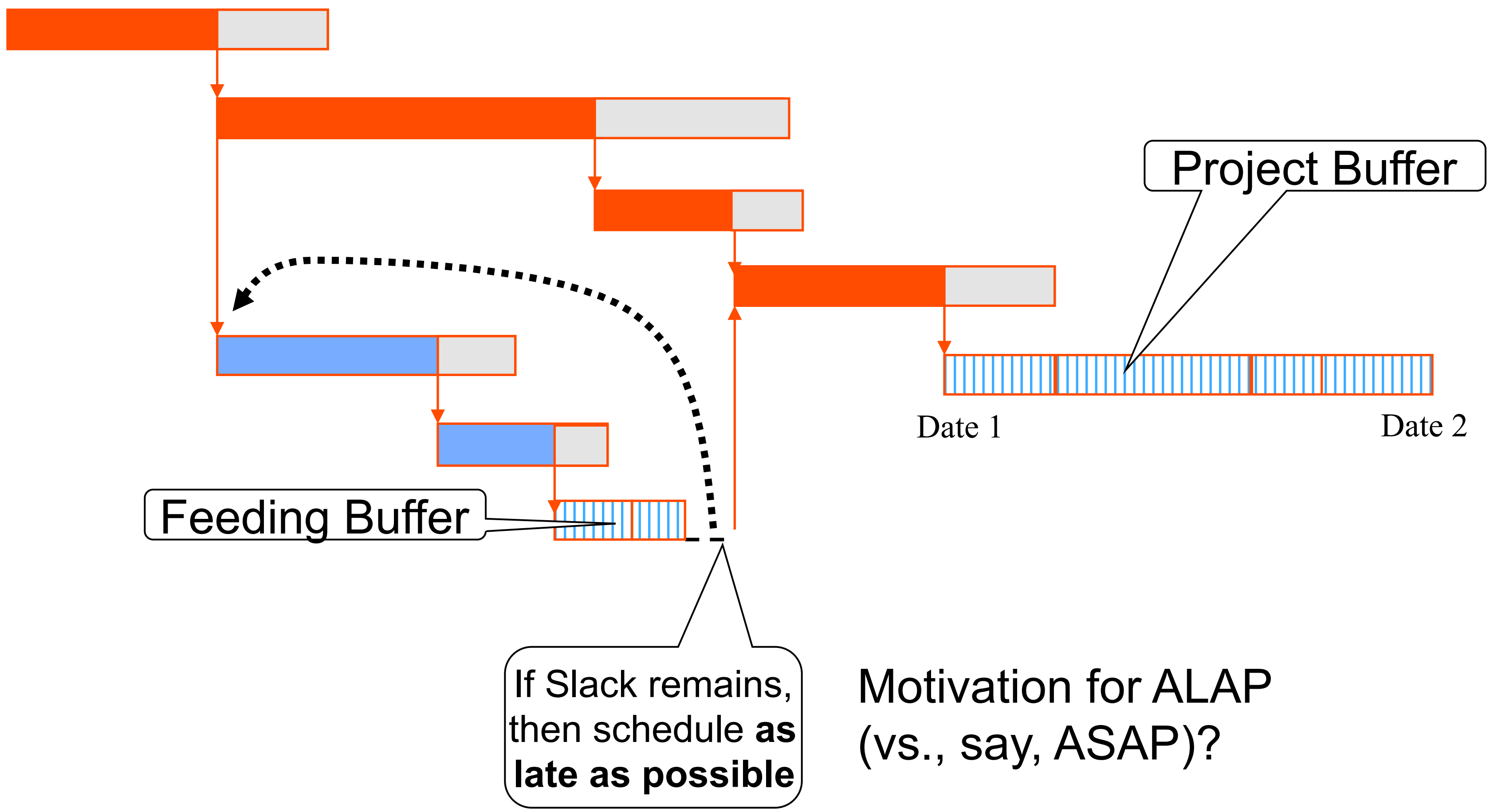
Time Buffers Shown Explicitly



“Feeding Buffer” “protects” critical chain from delays in non-critical tasks

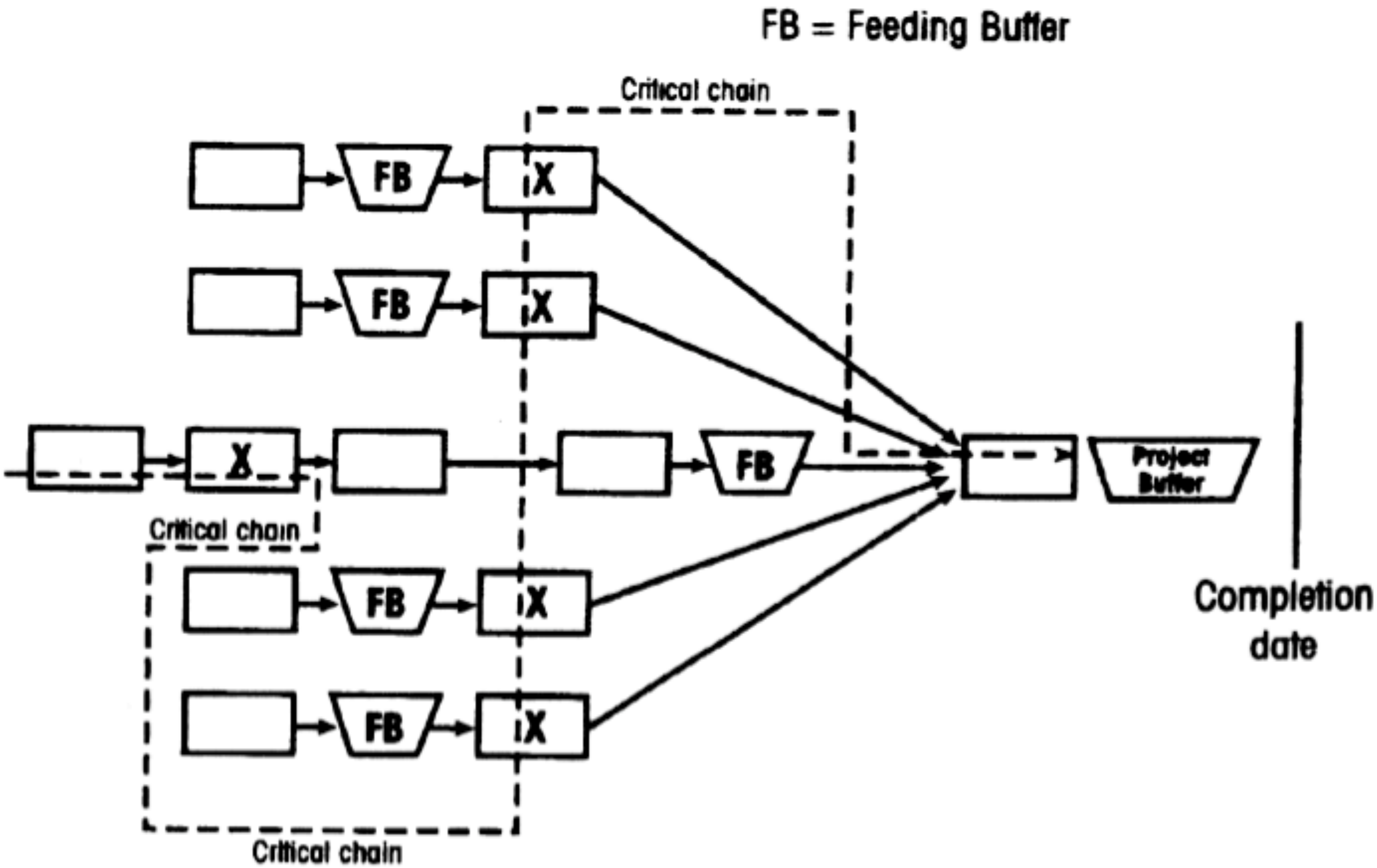


Feeding Buffers - the buffer principle, but on *non-critical* paths

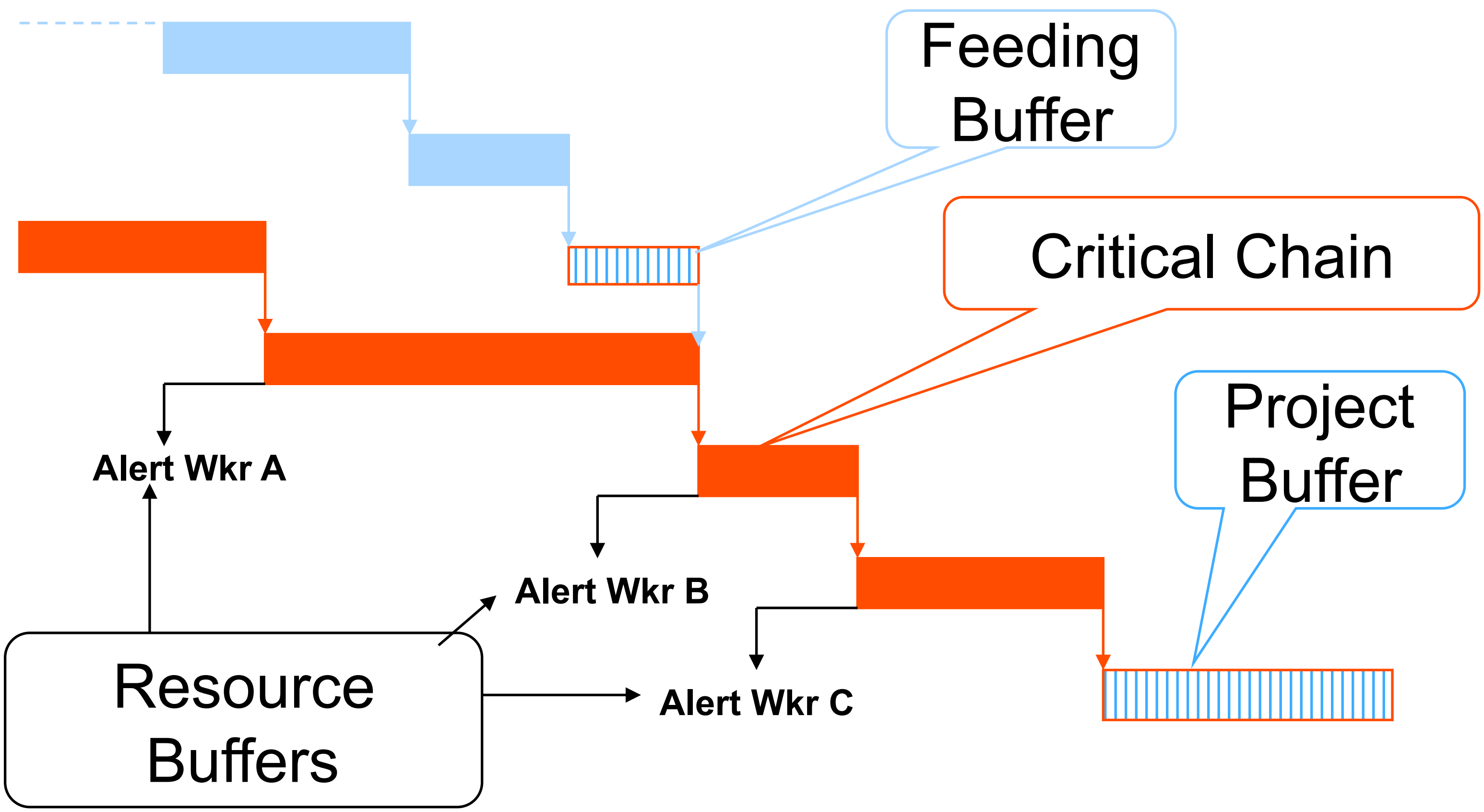


Motivation for ALAP (vs., say, ASAP)?

Visualizing CC in PERT Chart



Resource Buffers = “Wake up” calls



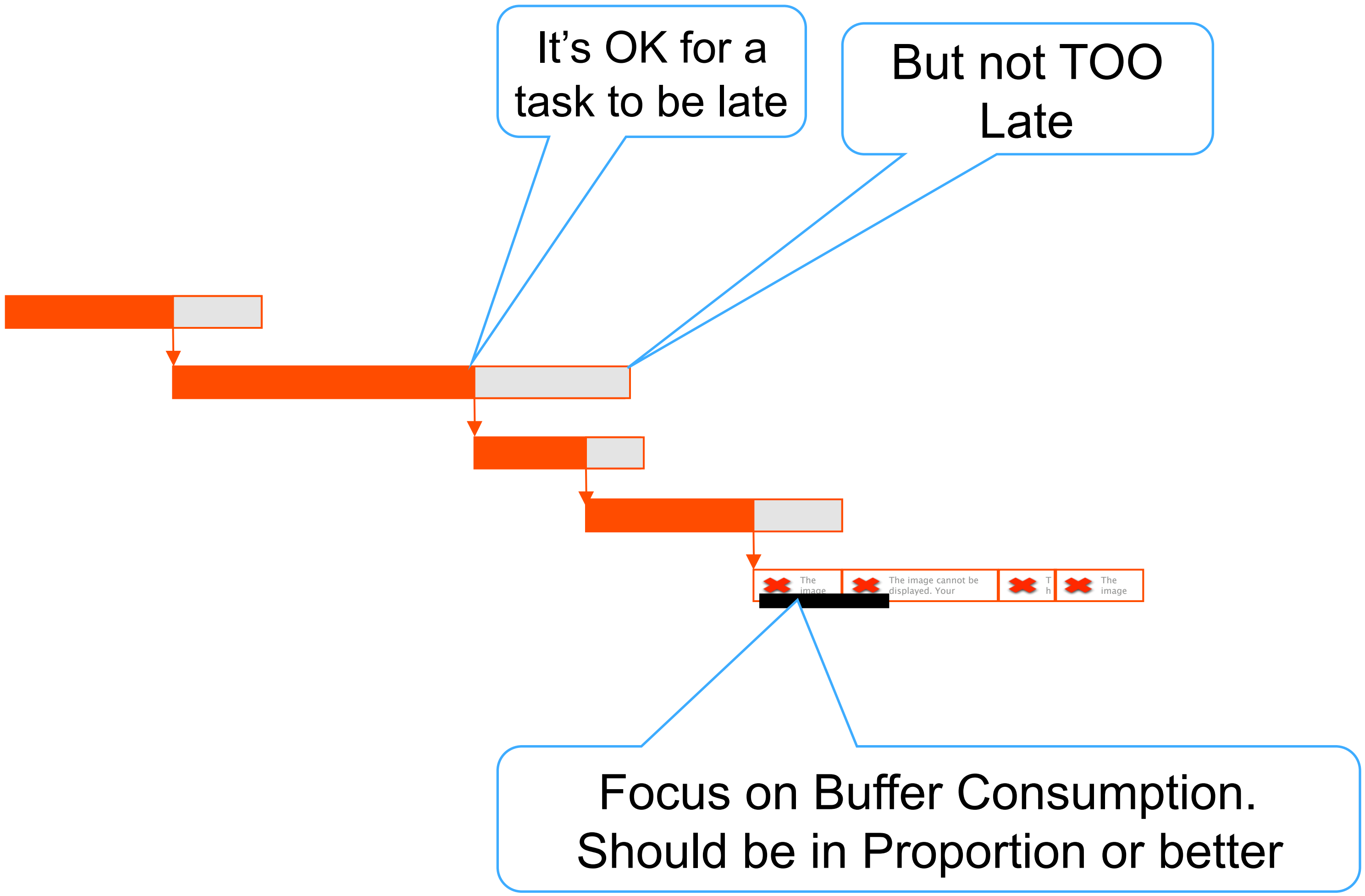
Adds neither Time nor Cost to the Project

Summary of Buffers

Table 7-5 Summary of buffer types for a single project.

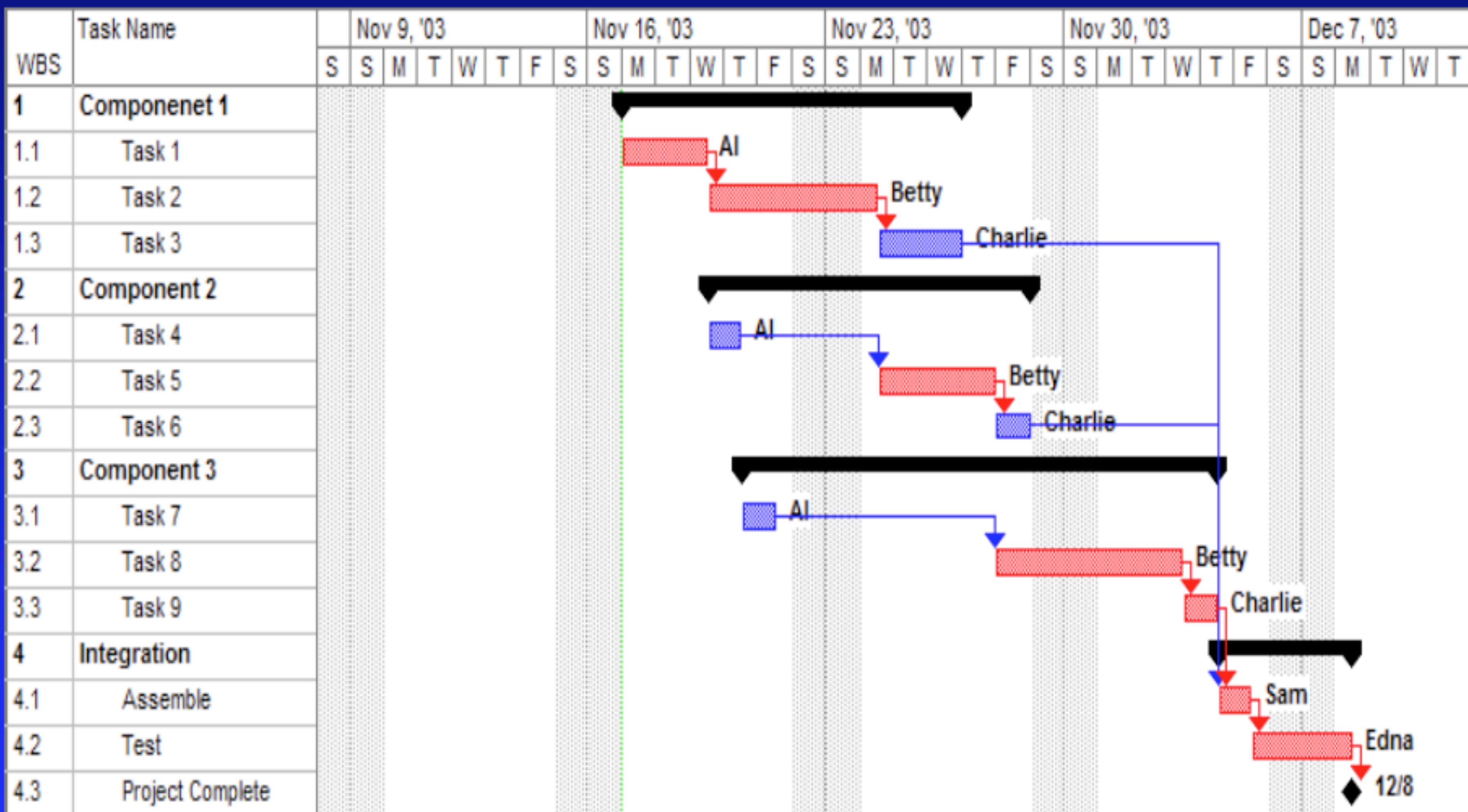
Buffer Type	Function of the Buffer
Project buffer	Comprised of aggregated contingency reserves taken from activities on the critical chain; provides a contingency reserve between the earliest completion date possible and the committed date.
Milestone buffer	Similar to a project buffer but used when a project phase or milestone has a fixed due date.
Feeding buffer	Comprised of aggregated contingencies taken from noncritical paths; stabilizes the critical chain by preventing noncritical activities from delaying critical activities.
Resource buffer	An early warning or "count down" to the start of a critical activity that ensures that resources are ready to do work on the critical chain as soon as all preceding activities have been completed.

CCPM Project Execution

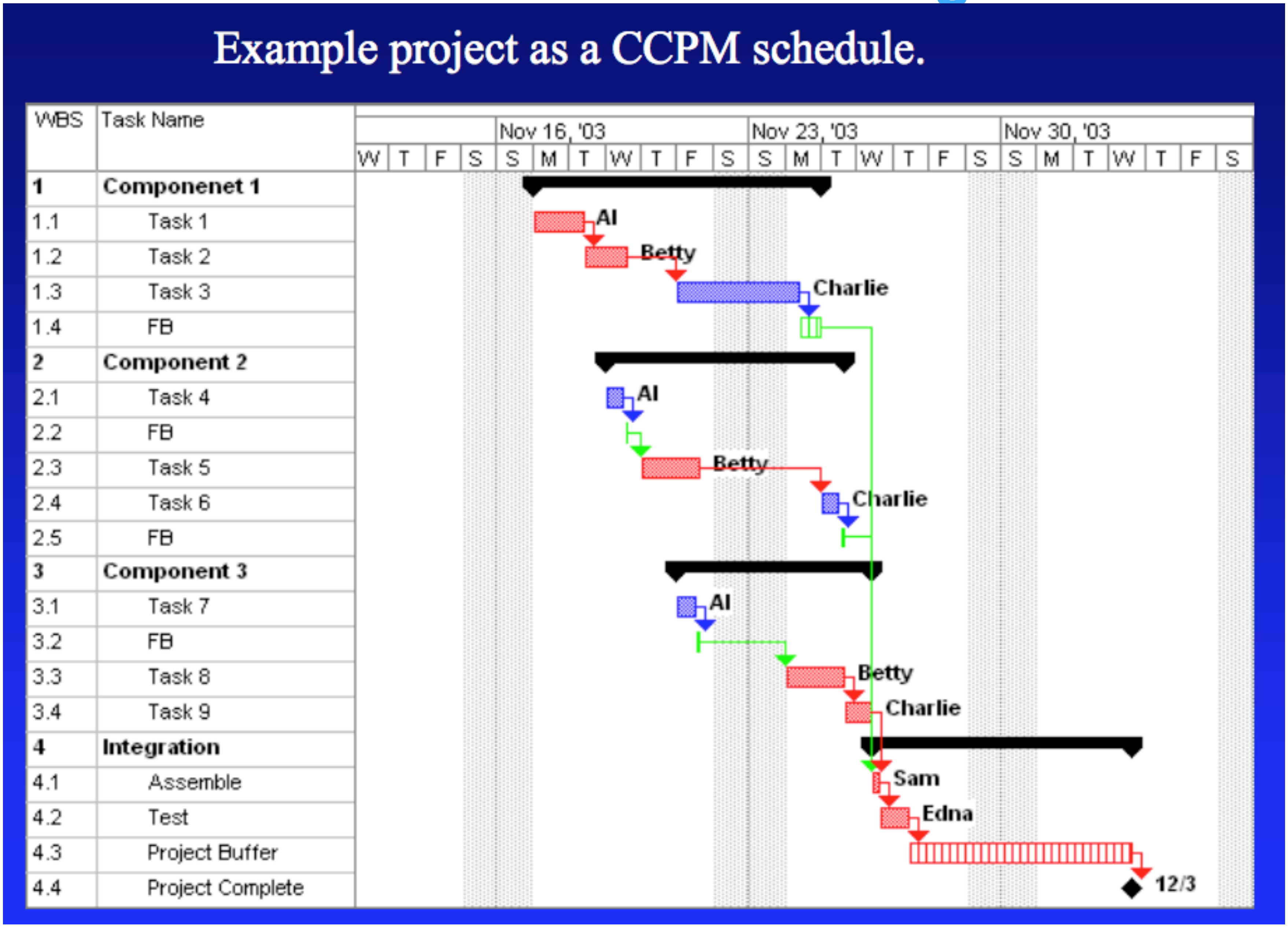


Before “Critical Chain” Management

Critical Chain Identified: The longest path through the project…after resource leveling.



After “Critical Chain” Management



CCPM Summary, Part 1

1. Reduce activity duration estimates by 50%. Activity durations are normal estimates, which we know to be high probability and contain excessive safety time. We estimate the 50% probability by cutting these in half. (The protection that is cut from individual tasks is aggregated and strategically inserted as buffers in the project.
2. Eliminate resource contentions by leveling the project plan. The Critical Chain can then be identified as the longest chain of path and resource dependencies after resolving resource contentions.
3. Insert a Project Buffer at the end of the project to aggregate Critical Chain contingency time (initially 50% of the critical chain path length)
4. Protect the Critical Chain from resource unavailability by Resource buffers. Resource buffers are correctly placed to ensure the arrival of Critical Chain resources.

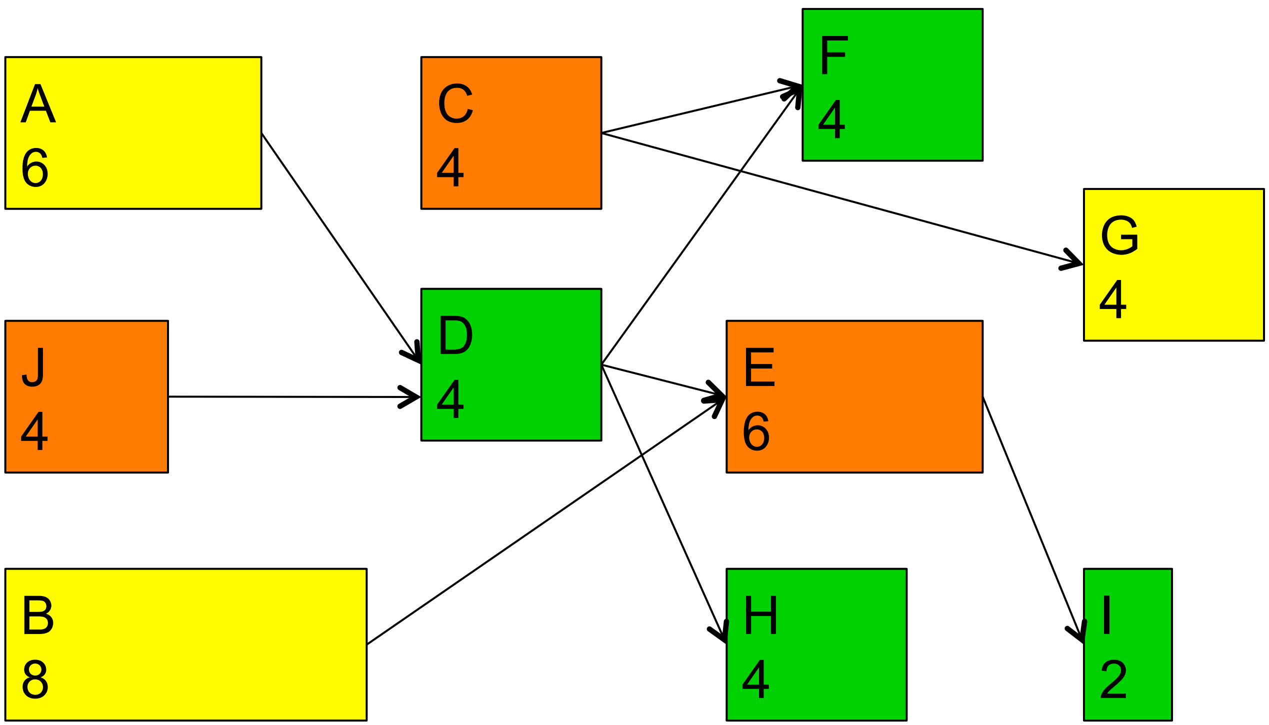
CCPM Summary, Part 2

5. Size and place Feeding Buffers on all paths that feed the Critical Chain. Feeding buffers protect the Critical Chain from accumulation of negative variations, e.g. excessive or lost time, on the feeding chains. This subordinates the other project paths to the Critical Chain.
6. Start gating tasks as late as possible. Gating tasks are tasks that have no predecessor. This helps prevent multitasking.
7. Ensure that resources deliver relay-race performance. Resources should work as quickly as possible on their activities, and pass their work on as they complete.
8. Provide resources with activity durations and estimated start times, not milestones. This encourages resources to pass on their work when done.
9. Use buffer management to control the plan. Buffers provide information to the project manager, for example, when to plan for recovery and when to take recovery action.

Exercise

Colors indicate common resource requirement.
Numbers give time estimates.
Arrows represent precedence.

Develop a Critical Chain plan, assuming it is reasonable to halve the time estimates.

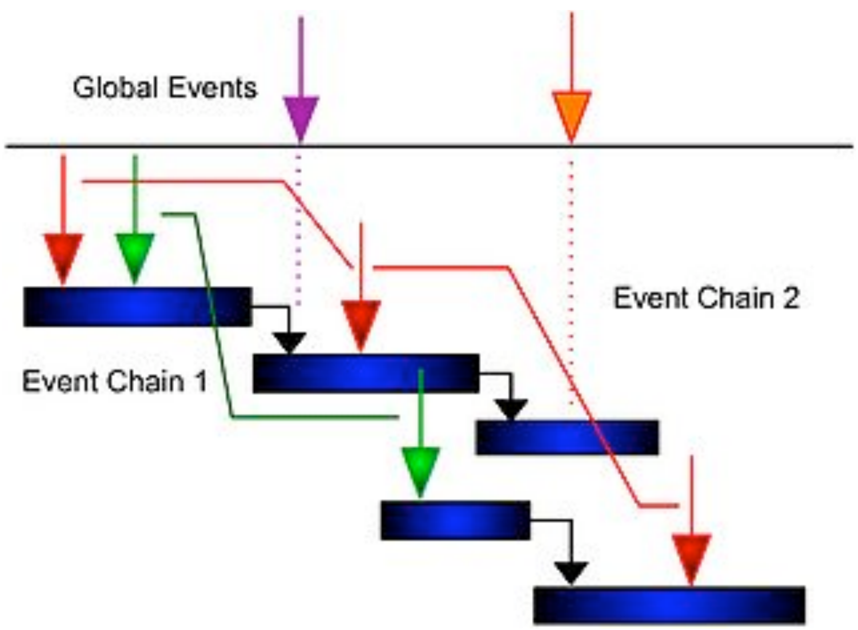


Interlude

ANNE L. RETENTIVE
ANNE, I'M GOING TO TASK YOU WITH A DELIVERABLE.
www.dilbert.com
scottadams@aol.com
GAAA!! TASK IS NOT A VERB!! MY WORLD IS FALLING APART!
© 2001 United Feature Syndicate, Inc.
TOMORROW I'LL ASK HER TO TIMELINE HER PROJECT.

What's the NBT (Next Big Thing)?

Event-Chain Methodology?
Activities are affected by events, which cause other events. Events often pose risks to the completion of the activity.



EC Step 1

- Create a project schedule model using **best-case scenario estimates** of duration, cost, and other parameters. In other words, project managers should use estimates that they are comfortable with, which in many cases will be optimistic.

EC Step 2

- **Define a list of events and event chains** with their probabilities and impacts on activities, resources, lags, and calendars. This list of events can be represented in the form of a **risk breakdown structure**. These events should be identified separately (separate time, separate meeting, different experts, different planning department) from the schedule model.

EC Step 3

- Perform a quantitative analysis using **Monte Carlo simulations**. The results of Monte Carlo analysis are statistical distributions of the main project parameters (cost, duration, and finish time), as well as similar parameters associated with particular activities. Based on such statistical distributions, it is possible to determine the chance the project or activity will be completed on a certain date and within a certain cost. The results of Monte Carlo analysis can be expressed on a **project schedule as percentiles of start and finish times for activities**.

EC Step 4

- Perform a **sensitivity analysis** as part of the quantitative analysis. Sensitivity analysis helps **identify the crucial activities and critical events and event chains**. Crucial activities and critical events and event chains have the most affect on the main project parameters.

- Reality checks may be used to validate whether the probability of the events are defined properly.

EC Step 5

- **Repeat the analysis on a regular basis** during the course of a project based on actual project data and include the actual occurrence of certain risks. The probability and impact of risks can be reassessed based on actual project performance measurement. It helps to provide up to date forecasts of project duration, cost, or other parameters.