



CPM-200: Principles of Schedule Management

Lesson C: Schedule Analysis Techniques

Instructor

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PMI-College of Performance Management faculty





Lesson Objectives

The student will understand:

- 1. What is meant by Schedule Analysis.**
- 2. What insight Schedule Analysis can provide the project team.**
- 3. Why Schedule Analysis is performed.**
- 4. What are some of the basic techniques for performing Schedule Analysis**



This Lesson Will Provide Insight Into:

- ❑ **Critical Path:** schedule driver or long pole
 - ❑ **Accuracy:** correct schedule inputs (activities, durations)
 - ❑ **Integration:** properly defined interrelationships
 - ❑ **Realism:** an achievable schedule
 - ❑ **Performance:** timely, efficient accomplishment of work
 - ❑ **Variances:** significance of differences from baseline
 - ❑ **Trends:** direction of the schedule
 - ❑ **Forecasting:** predicting future schedule performance
 - ❑ **What-If:** impact of potential problems and changes
 - ❑ **Risk:** likelihood of overrunning the schedule
 - ❑ **Resources:** sufficient availability of staff, facilities, etc.
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Schedule Accuracy: *is the schedule data correct?*

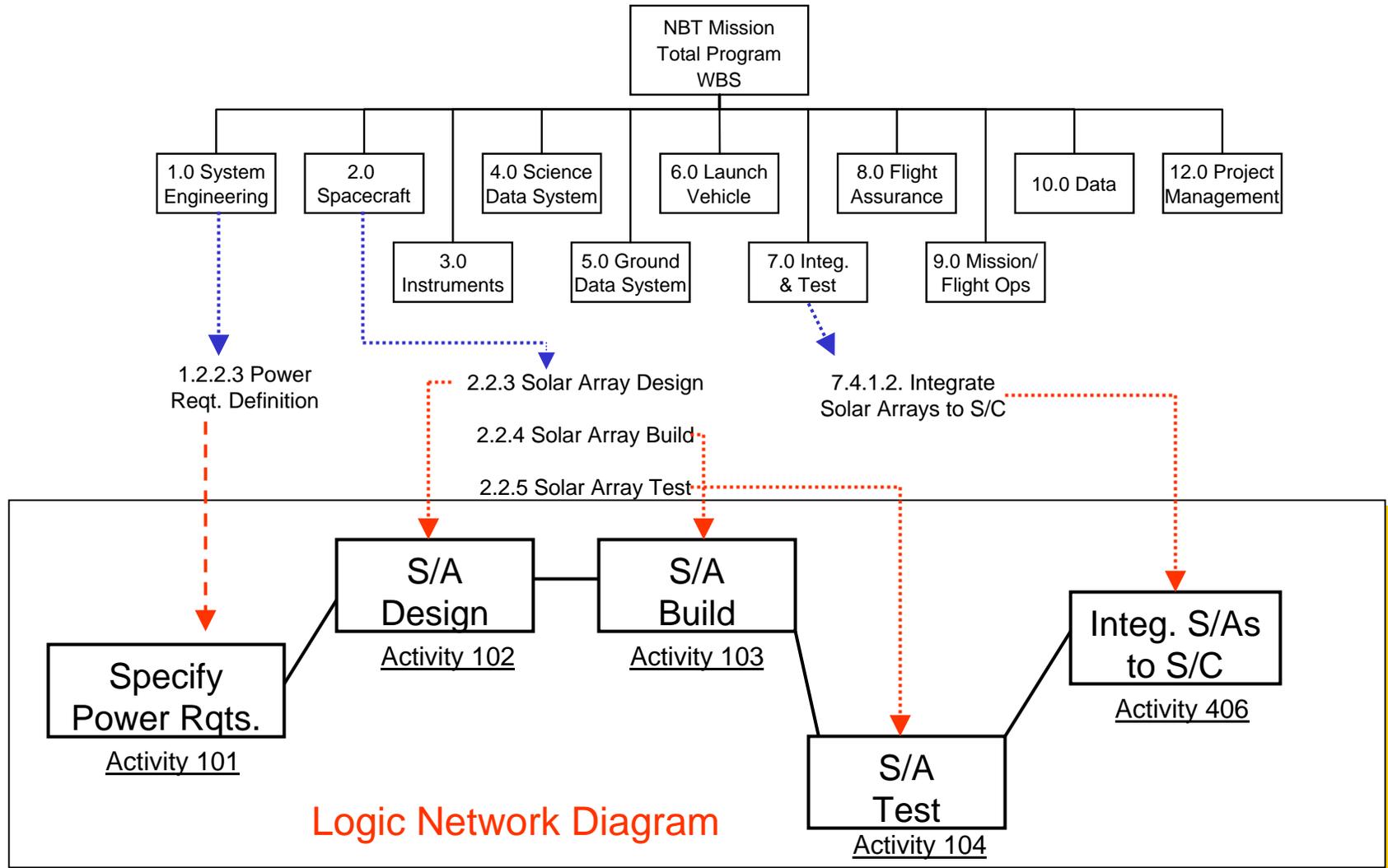
Schedule Accuracy- The primary data used to develop the schedule should be correct and based on reality

- ❑ Activities capture the entire work scope
- ❑ Durations are realistic and feasible, not “success-oriented” or “fat”
- ❑ Assumptions and constraints are legitimate

Analysis Approach:

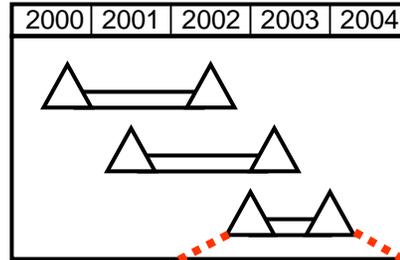
- ❑ Verification of activity traceability to project data (e.g. WBS, SOW)
- ❑ Comparison of current durations to baseline, prior period, “actuals” from similar projects or previous builds, BOEs, supplier lead times, etc.
- ❑ Verification of schedule assumptions with external agreements such as Memorandums Of Understanding, Letters Of Agreement, contracts & subcontracts, GFE lists, etc.

Horizontal Schedule Integration: *is the logic right?*

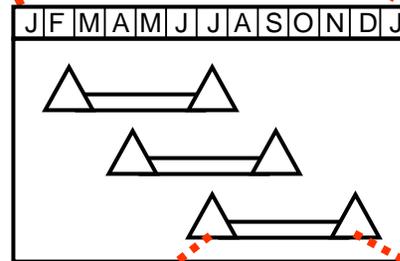


Vertical Schedule Integration: *is alignment correct?*

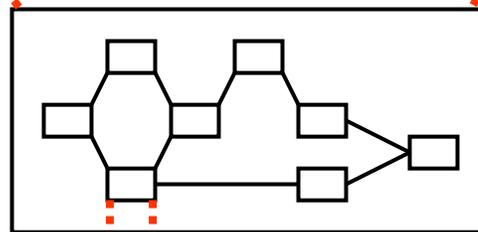
**Master
Schedule**



**Intermediate /
Summary
Schedule**



**Detail
Schedule**



Cost Account / Work Package Schedules

Schedule Performance: *Ratio Analysis Example*

ASTRO Project Software Module Code & Checkout Completion: As of 5/31/02

	2001			2002										
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
CUM Baseline	1	2	3	6	11	22	32	40	50	59	62	65	67	70
CUM Actual	1	3	7	7	8	15	24	30						

TO DATE

30 modules ÷ 8 months = 3.75 (actual rate)

40 modules ÷ 8 months = 5 (baseline rate)

$3.75 \div 5 = 75\%$ efficiency-to-date

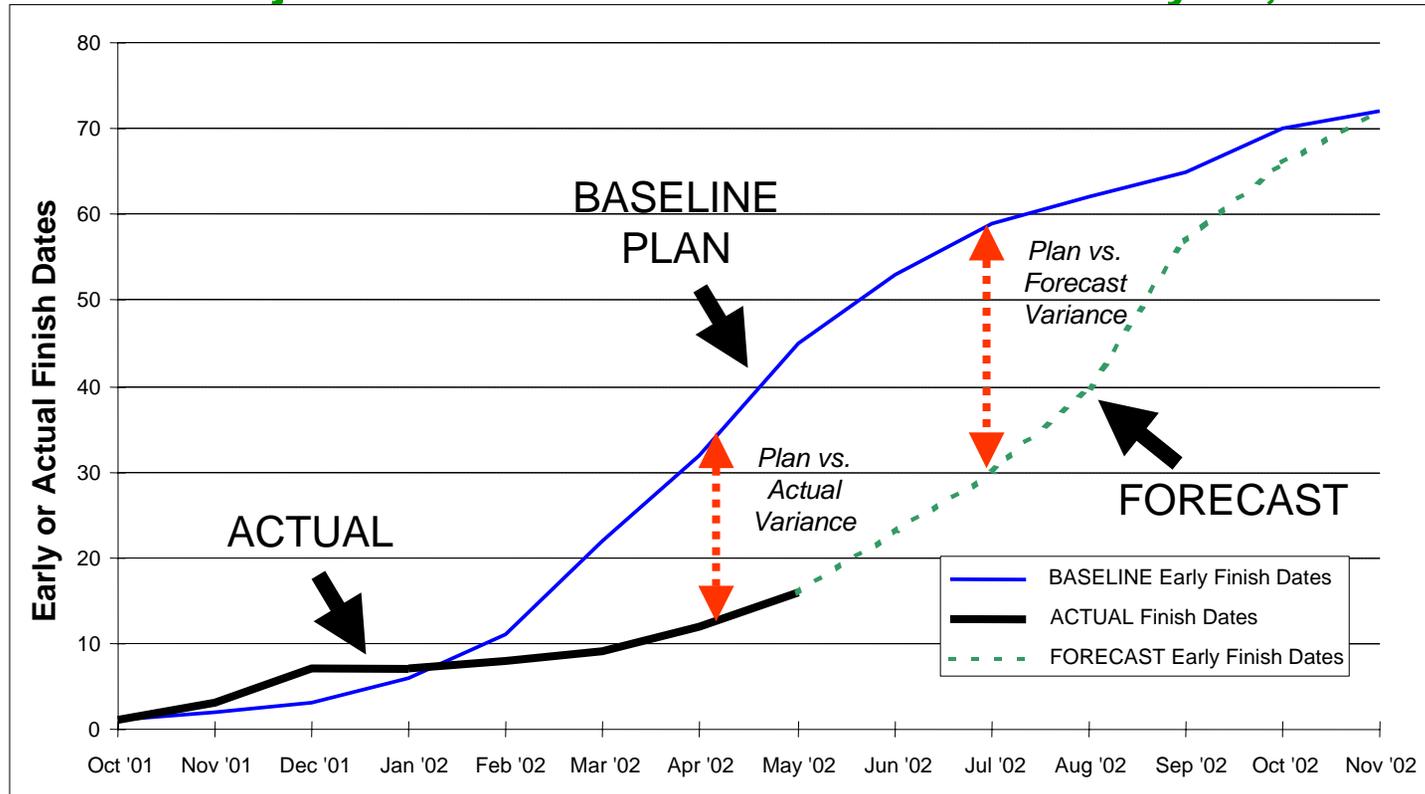


To date, schedule efficiency is 75% - the ASTRO software development team is accomplishing, on average, 3/4 of what it planned to do.

Schedule Variances:

are differences from the baseline significant?

NBT Project Schedule Performance - as of May 30, 2002



	Oct '01	Nov '01	Dec '01	Jan '02	Feb '02	Mar '02	Apr '02	May '02	Jun '02	Jul '02	Aug '02	Sep '02	Oct '02	Nov '02
CUM Baseline	1	2	3	6	11	22	32	45	53	59	62	65	70	72
CUM Actual	1	3	7	7	8	9	12	16						
CUM Forecast									23	30	40	57	66	72

Example Variance Analysis Report

WBS: 1.1.2 C&DH Subsystem

1.1.2.2 RTT “B” Assembly

MILESTONE: CDH6022 RTT “B” Ready for Observatory Integration & Test

BASELINE: 5/28/02

FORECAST: 6/7/02

CAUSE & CORRECTIVE ACTION:

- Memory anomaly during final test caused a 10 day slip in delivery to I&T, putting the RTT B on the critical path at -5 days total slack.
- A 2nd shift will be added to finish testing.
- I&T Manager can modify I&T work flow to accommodate this delay if necessary.

Schedule Trends:

is the schedule's direction favorable or unfavorable?

Schedule Trend(s):

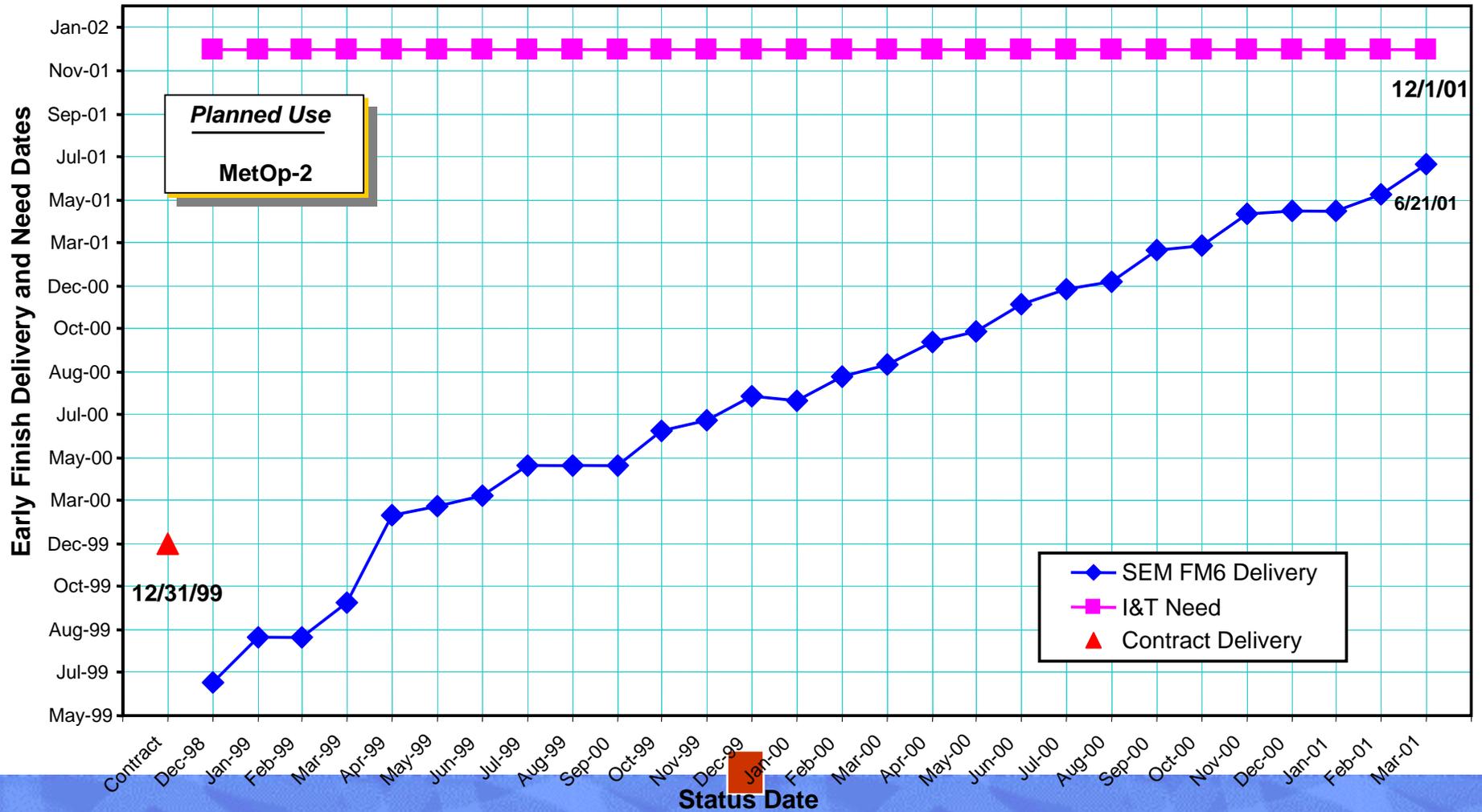
- ❑ Indicate the schedule's future direction based on historical results
- ❑ Provide a means to indicate the extent to which actual and predicted performance are diverging from the baseline schedule

Analysis Approach:

- ❑ **Performance trends:** track actual completion of activities and milestones over time to determine if progress is being made
- ❑ **Slack trends:** track slack depletion over time to assess if sufficient spare time is available or if resources should be reallocated
- ❑ **Reserve trends:** track reserve consumption over time to determine if it is still sufficient
- ❑ **Delivery trends:** track projected delivery dates over time to extent of delays or slippages

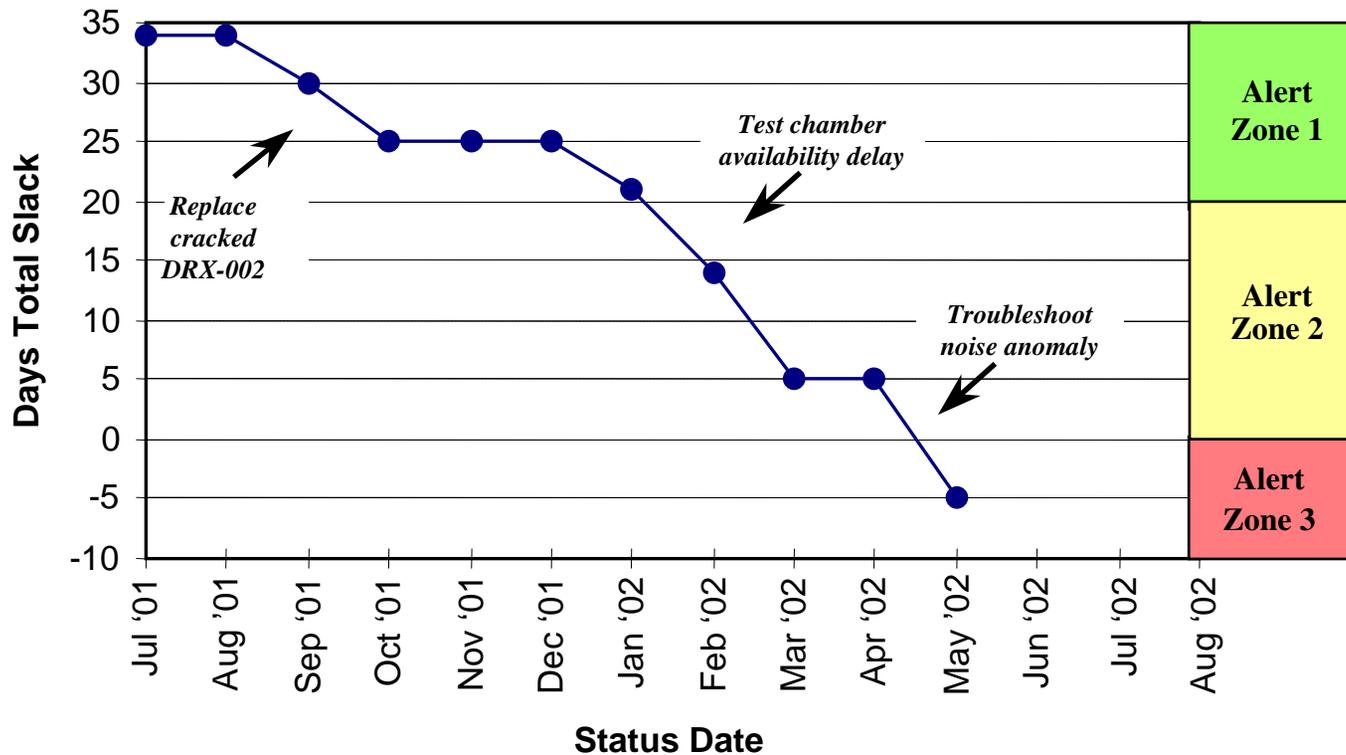
Delivery Date Trend vs. Need Date Trend

SEM FM6 Instrument Delivery vs. I&T Need



Example Slack Trend With Risk Thresholds

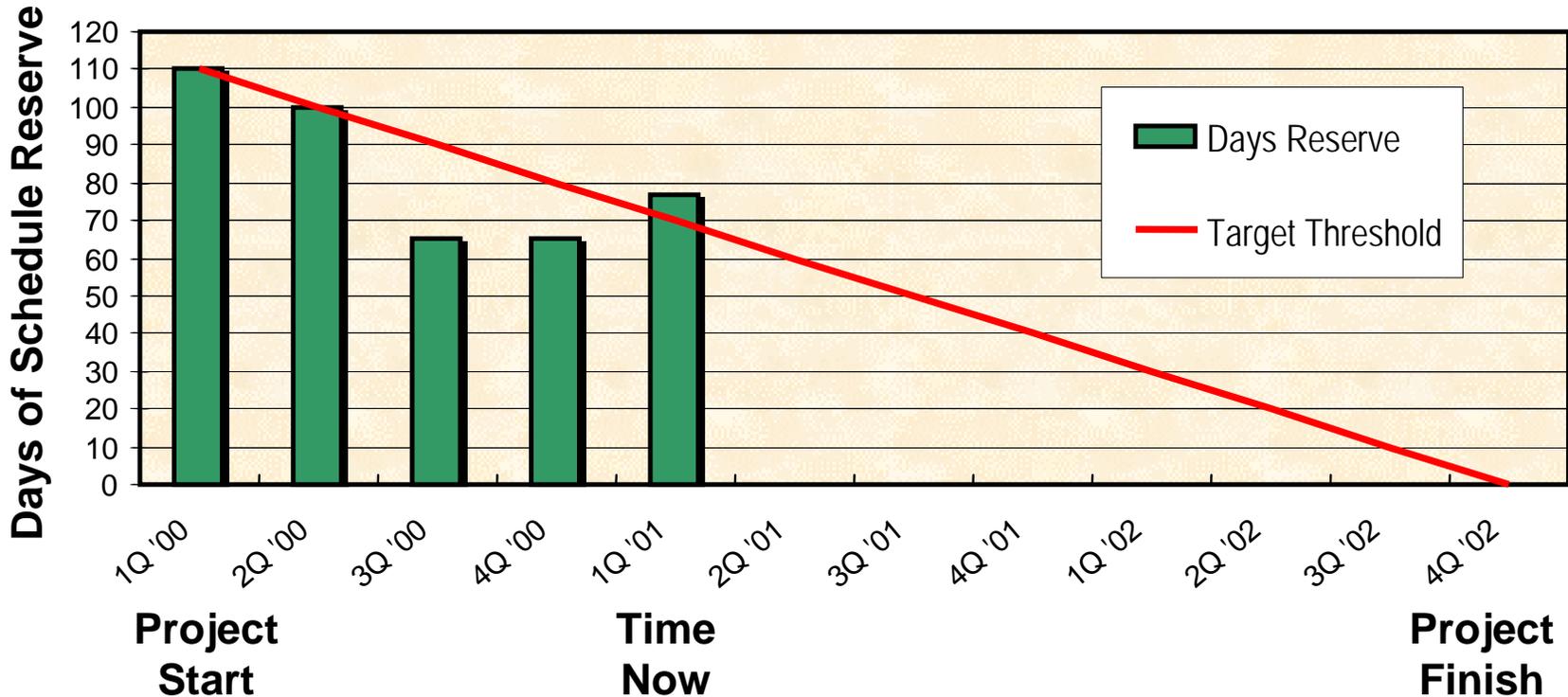
WBS 1.1.2.2 RTT B Assembly Risk Indicator



Example Schedule Reserve Trend

NBT Project Schedule Reserve Consumption Trend

As of: March 31, 2001



Risk-Based Schedule Reserve Determination Example

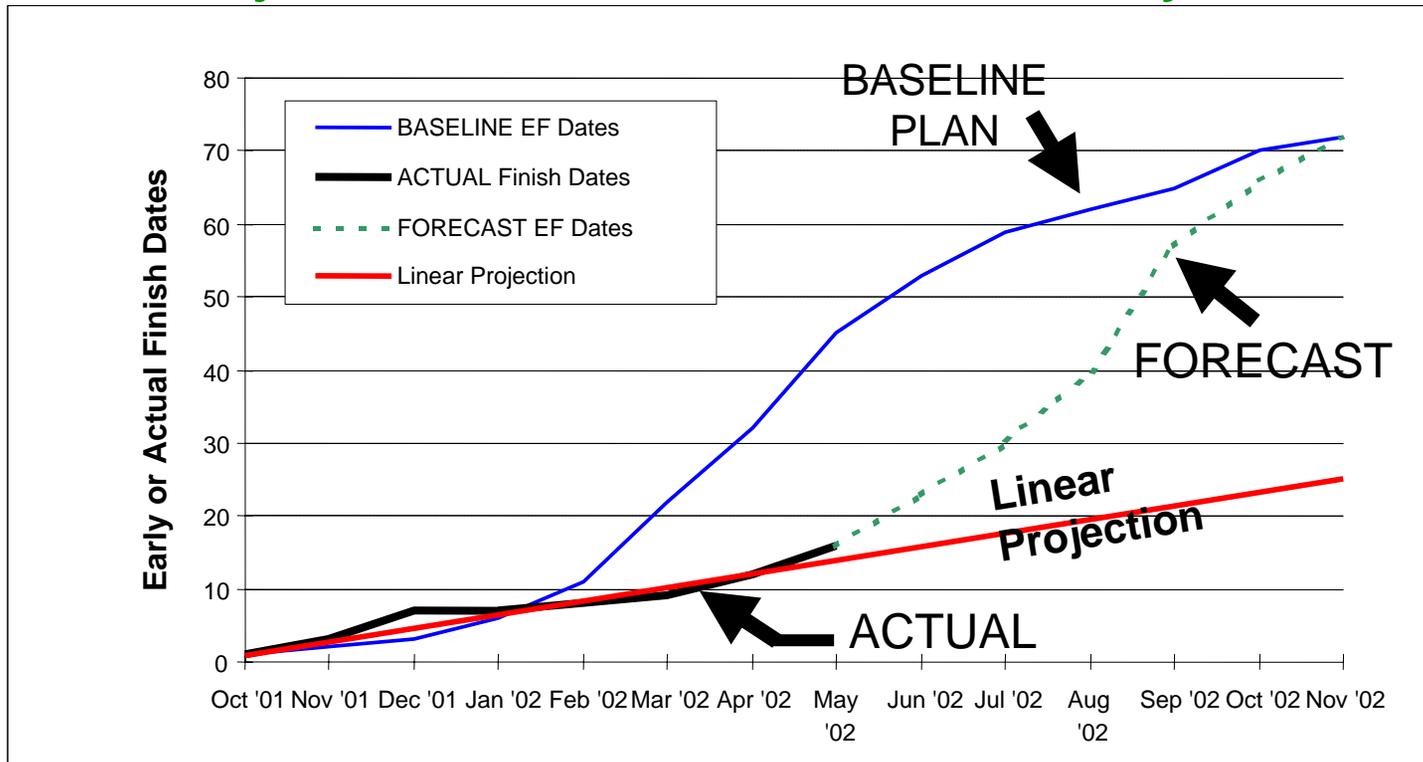
<u>Activity</u>	<u>Risk</u>	<u>Impact</u>	<u>Probability</u>	<u>Expected Value of Reserve</u>
Observatory Mechanical Integration	Late MGSE	30 days	x .10 =	3 days
Observatory Vibration Test	Component damage	45 days	x .20 =	9 days
Observatory EMI Test	Noise anomaly	40 days	x .60 =	24 days
Thermal Vacuum Test	Instrument failure	80 days	x .50 =	<u>40</u> days

Starting Point for Reserve Determination → 76 days

Schedule Forecasting:

what is the predicted future schedule performance?

NBT Project Schedule Performance – as of May 30, 2002



	Oct '01	Nov '01	Dec '01	Jan '02	Feb '02	Mar '02	Apr '02	May '02	Jun '02	Jul '02	Aug '02	Sep '02	Oct '02	Nov '02
CUM Baseline	1	2	3	6	11	22	32	45	53	59	62	65	70	72
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Projection Based on Efficiency-To-Date

ASTRO Project Software Module Code & Checkout Completion: As of 5/31/02

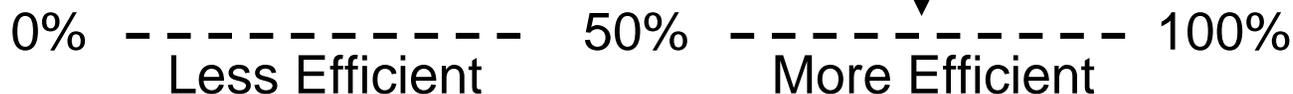
	2001			2002										
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
CUM Baseline	1	2	3	6	11	22	32	40	50	59	62	65	67	70
CUM Actual	1	3	7	7	8	15	24	30						
CUM Forecast									37	46	52	60	66	70

TO DATE

30 modules ÷ 8 months = 3.75 (actual rate)
 40 modules ÷ 8 months = 5 (baseline rate)
 $3.75 \div 5 = 75\%$ efficiency-to-date

TO GO

Actual rate to date = 3.75 modules
 40 modules ÷ 6 months = 6.7 (forecast rate)
 $6.7 \div 3.75 = 178\%$ efficiency-to-complete !



To date, schedule efficiency is 75%. To go, the forecast-to-complete efficiency of 178% is probably unrealistic - unless something has changed (e.g. new technical approach, add more programmers, descope work, etc.)



“What-If” Schedule Analysis: *how will changes affect the schedule?*

“What-If” Schedule

- ❑ Projects the effect on the baseline or current operating schedule of a potential problem, new constraint, or changed assumption
- ❑ Provides the project team with insight into the impact of potential changes on the project’s schedule objectives

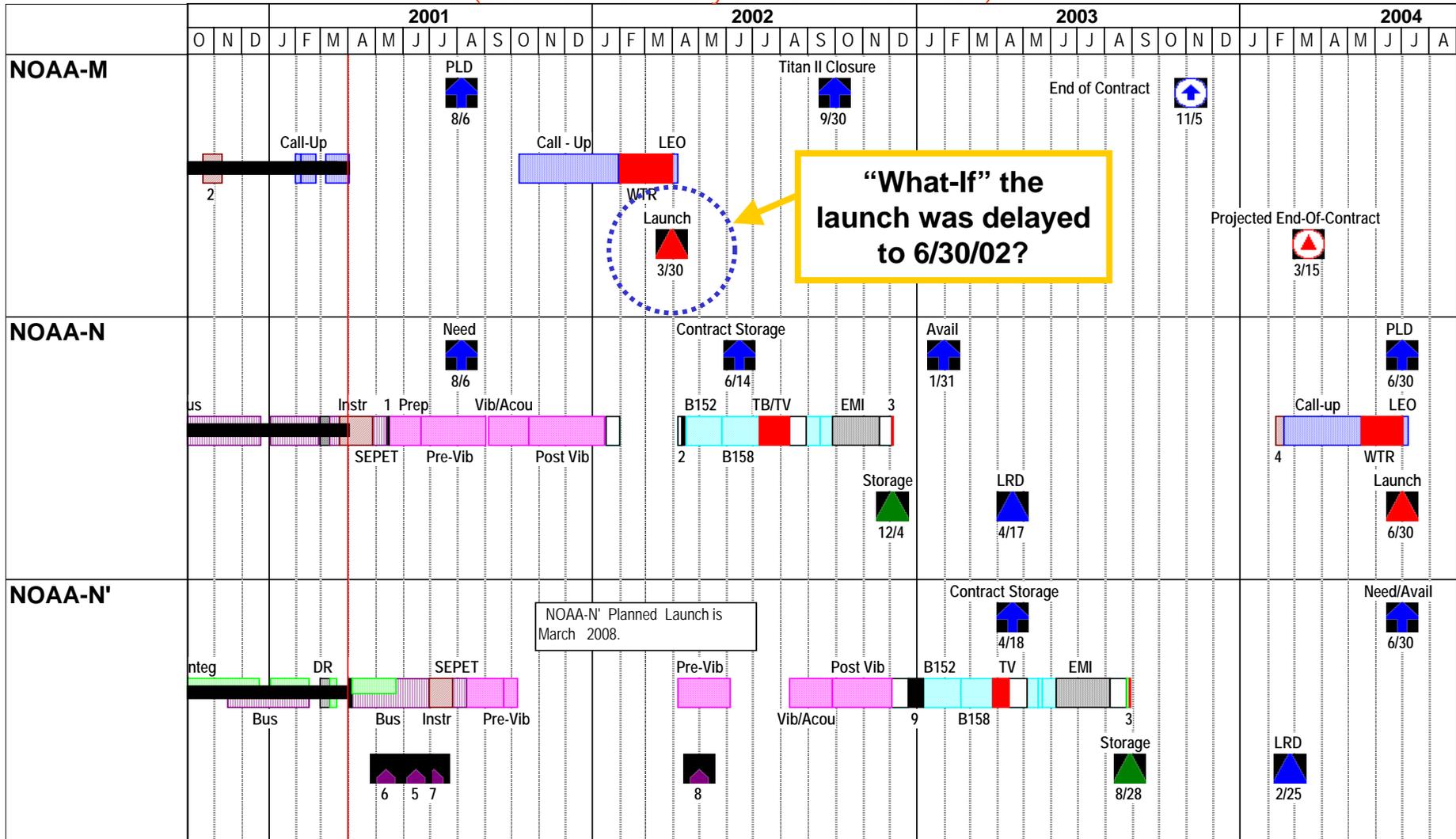
Analysis Approach

- ❑ Develop a “What-If” schedule by modifying the baseline and/or current operating schedule to reflect a desired schedule change
- ❑ Examples:
 - *Change a key assumption*
 - *Funding shortfalls*
 - *Late parts or GFE delivery*
 - *Staffing shortages*
 - *Descope of work*



NOAA M-N' I&T Summary Schedule As of 3/31/01

(Based on Preliminary LMMS Rev S Schedule)



* = Not yet in LMMS Master Schedule

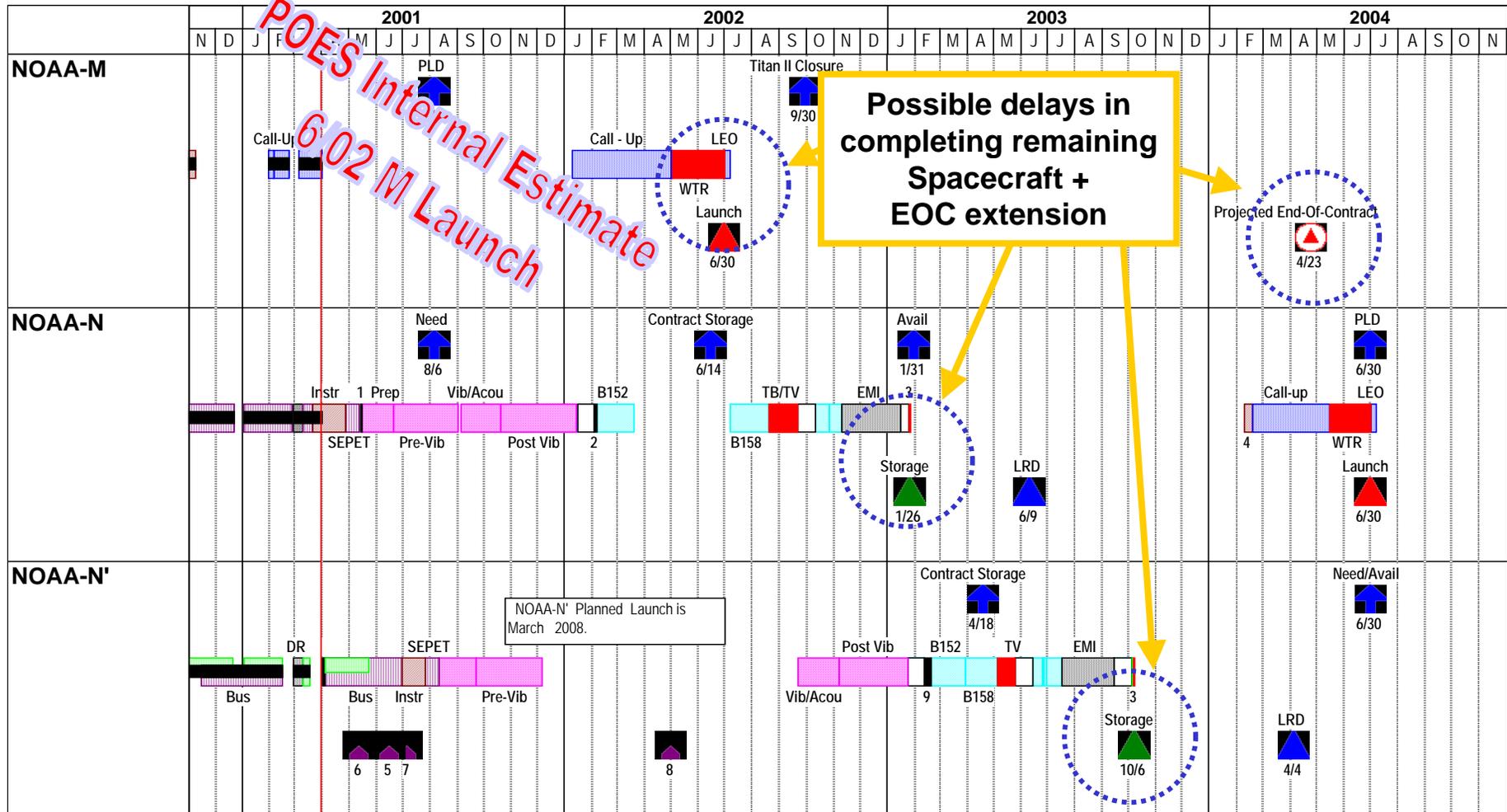
Foot Notes:

1. A303 Removal; Installation of Mass Models*
2. A303 Re-Integration & IPF/DET*
3. SEM & SBUV* Removal
4. SEM & SBUV* Re-Integration

5. SARR Delivery 6/15/01
6. A303 Installation on N' 5/13/01
7. SBUV Delivery 7/6/01
8. SARP/ADCS Delivery 4/30/02
9. SARP & ADCS Integration*

NOAA M-N' I&T Summary Schedule: 6/30/02 M Launch

(Based on Preliminary LMMS Rev S Schedule)



Foot Notes:

- | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <ul style="list-style-type: none"> 1. SEM, SBUV, AVHRR & H303 Removal 2. SEM, SBUV, AVHRR & H303 Re-Integration 3. A303 Removal; Installation of Mass Model* 4. A303 Re-Integration & IPF/DET* 5. SEM & SBUV* Removal | <ul style="list-style-type: none"> 6. SEM & SBUV* Re-Integration 7. SARP & ADCS Software Upgrades* 8. SARP/ADCS Delivery 4/30/02 9. SARP & ADCS Integration* | <p>* = Not yet in LMMS Master Schedule</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|

NOAA-M Launch From VAFB, CA - 6/24/02



Schedule Risk Analysis:

what is the likelihood of overrunning the schedule?

Risk: a threat or uncertainty that could adversely impact the project's schedule objectives

Analysis Approach:

- ❑ **Project Risk Listing:** multi-disciplined subgroup of the project team lists and ranks qualitative or “gut feel” risks based on past experience early in the project life cycle
- ❑ **Formal Risk Management Systems:** establish and track schedule risks with parameters using alert zones or thresholds that when triggered lead to corrective action planning
- ❑ **Simulation Analysis:** mathematical modeling which translates the uncertainties associated with activity durations into their potential impact on the project's overall duration and schedule objectives (“Monte Carlo” technique)

Quantifying Schedule Risk

- Could a range of duration estimates help us quantify schedule risk?

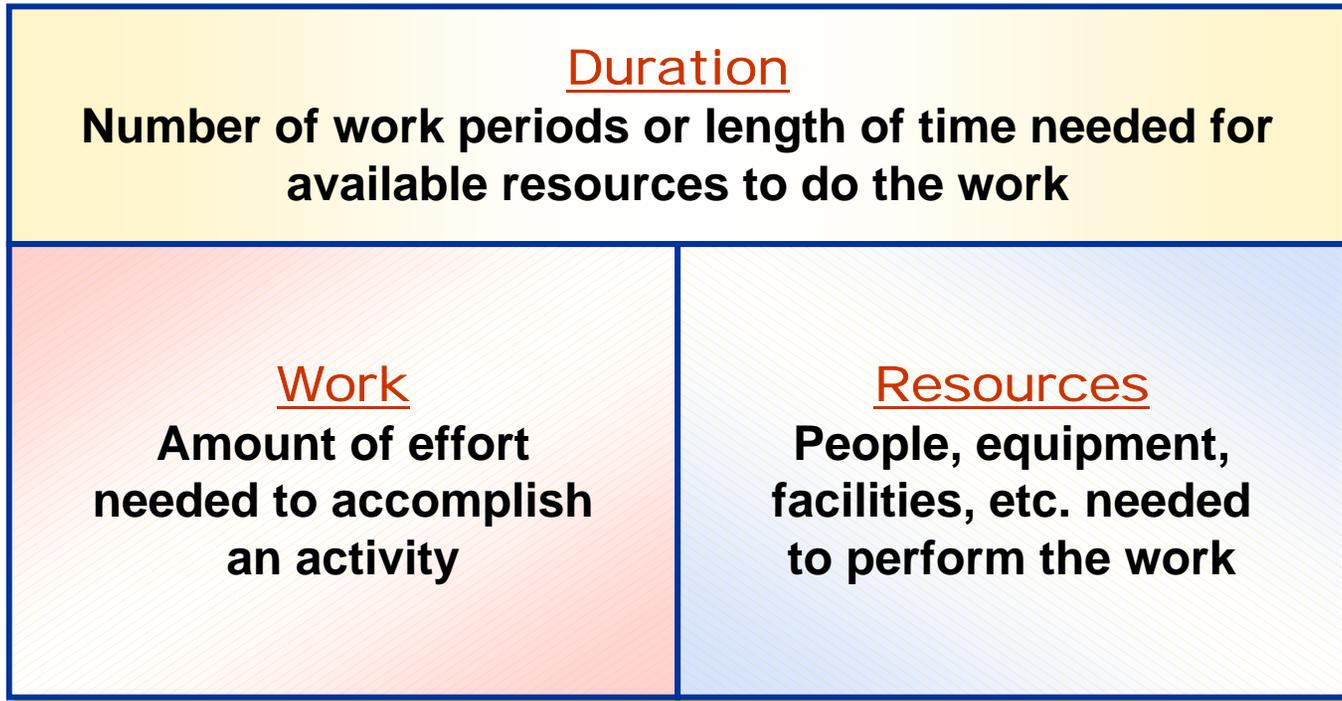
Activity Duration Estimates - Work Days				
Activity	Network Duration	Low Estimate	High Estimate	Average/Expected
Design	30.00	10.00	60.00	33.33
Fab & Assy	40.00	20.00	75.00	45.00
I&T	20.00	15.00	40.00	25.00
Total	90.00	45.00	175.00	103.33

← Example Project
with 3 serial
activities

- The difference between the most likely duration (*used in the logic network*) and the average/expected duration computed from the distribution is expressed as a potential overrun or delay:

$$103.33 - 90 = 13.33 \text{ work days of potential overrun}$$

Resource Analysis:
have resources been considered?

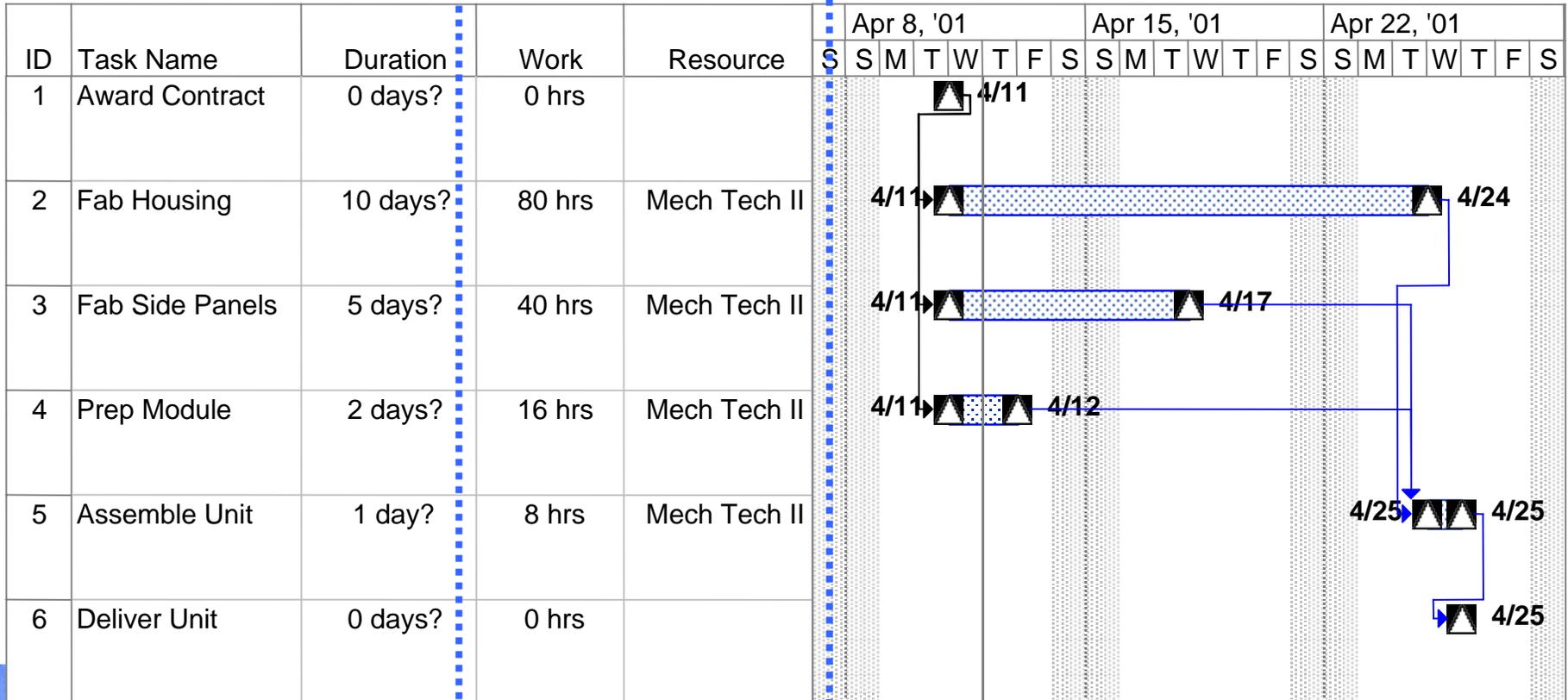


Realistic schedules must account for resource availability – which help define an accurate cost estimate and budget.

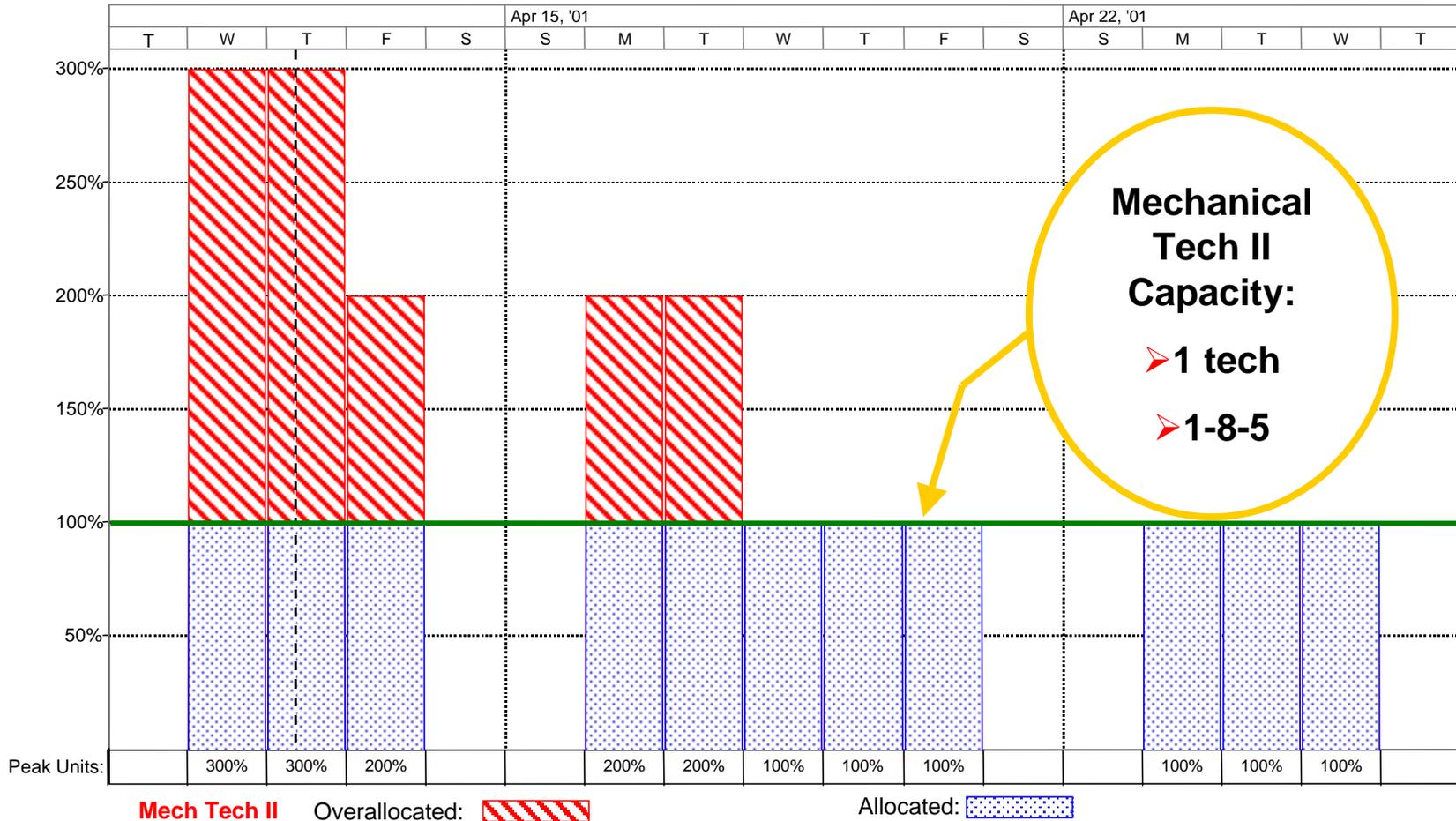
Resource Identification & Allocation

Resource Identification: the selection and definition of resource categories that are needed to accomplish the project's activities (e.g. people, equipment, funds)

Resource Allocation: assigning and “loading” activities with the amounts of resources estimated to accomplish them



Initial Resource Profile



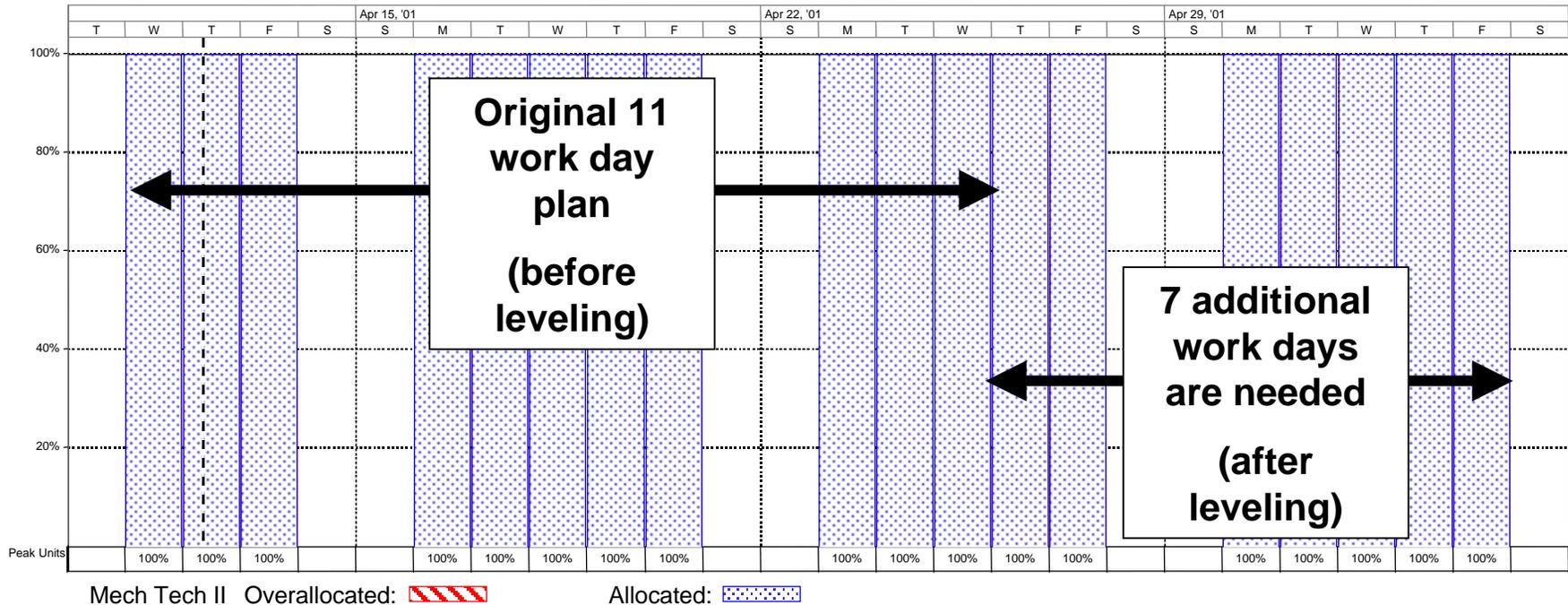
The shortage or over-commitment of resources is determined by profiling the requested resources and comparing them to their availability or capacity.

Resource Analysis

- **Resource Analysis:** resolution of inconsistencies between resource supply and demand in a specific period of time including:
 - *Add more of the resource (e.g. 2nd shift)*
 - *Find a substitute for the resource (e.g. subcontract)*
 - *Delay some activities (examine free slack)*
 - *Perform some activities earlier than planned (examine logic)*
 - *Combination of the above*

- **Resource Leveling:** the “smoothing” of resources so planned utilization matches availability in the most efficient manner while still meeting the project schedule’s objectives if possible
 - *Schedule slack is a key consideration in leveling*
 - *Leveling most useful for critical, near-term activities*

“Leveled” Resource Profile



The “leveling” or smoothing of the “Mechanical Tech II” resource allocation to fit the available capacity of one MTII.

Summary

- ❑ A baseline schedule is just a starting point
- ❑ Project teams need information to help keep things on track in order to meet objectives
- ❑ Schedule analysis techniques can augment earned value analysis by:
 - *Evaluating schedule results*
 - *Assessing the magnitude, impact, and significance of actual and forecast variations to the baseline schedule and/or current operating schedule*