NEED FOR & BENEFITS OF ADDITIONAL REAL-WORLD PROJECT MODELING CAPABILITIES PART 2

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Many of Needs learned from NASA

Other Sources of Lessons from Boeing, LANL, GDEB, Bombardier, Axiom Space, …

Aurora Software incorporates all of these lessons and is licensed to all of NASA

NASA has designated Aurora a Small Business Innovation Research Success Story

NASA created a Hallmark of Success video about Aurora

NASA has featured Aurora in multiple articles

LESSONS & RESULTS

- Project models require more real-world constraints
  - Significant productivity lost due to inferior model details
- Learn from the human schedulers
- Model to level of detail required
- Reveal & explain the schedule
- Easy & fast to perform scenarios / what-ifs
- Results: Reduced project duration & greater transparency
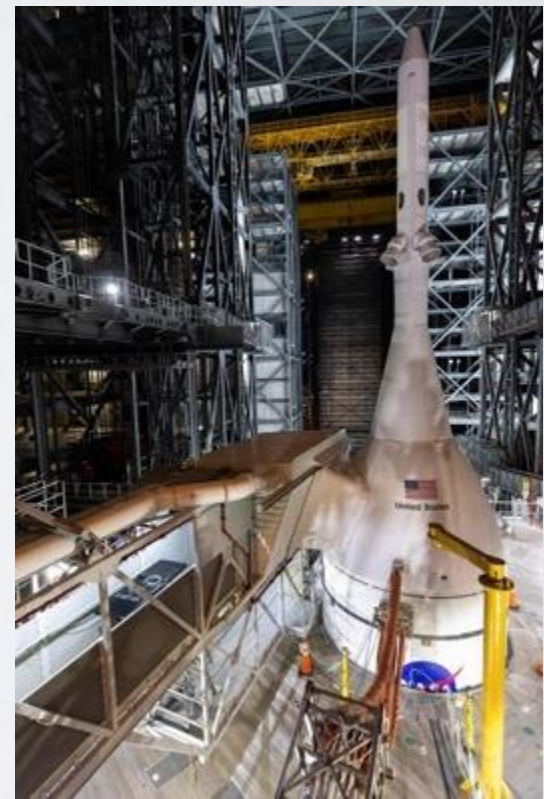
# PROJECT MODEL NEEDS TO BE REALISTIC

- Inability to model many real-world situations causes model to update inaccurately during execution

EXECUTION EXCELLENCE

1. Model to the level of detail needed

2. Generated Global Priorities based on model & current situation

3. Humans make final decisions on what to work based on global priorities & other real-world factors, then update model with status

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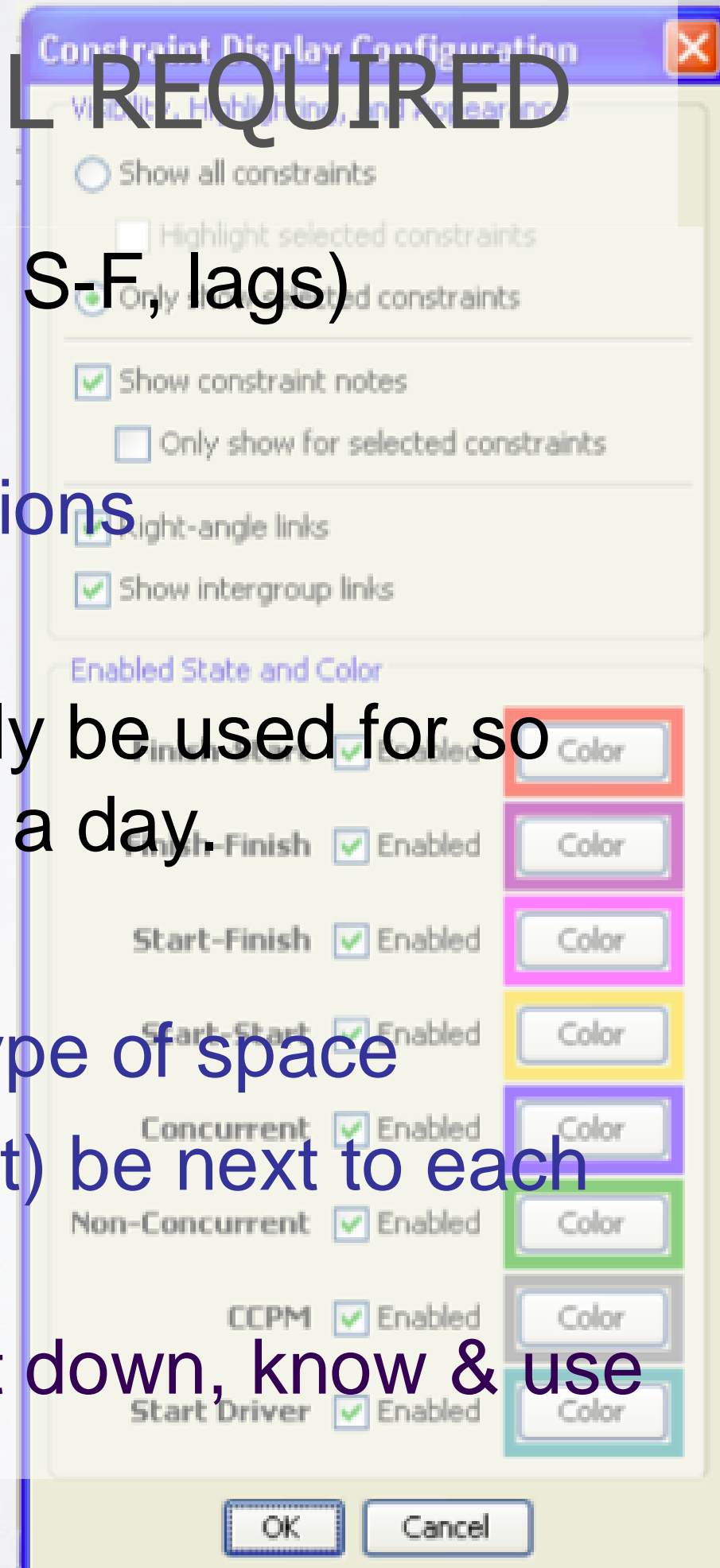- Results: Reduced project duration & greater transparency
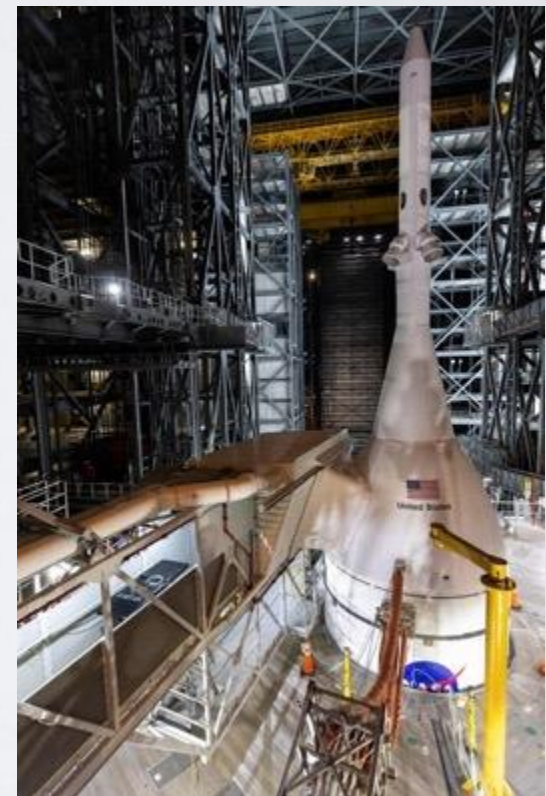
LEARN FROM HUMAN SCHEDULERS

- Different scheduling applications generally require some different modeling capabilities, but many overlap

  - Human experts help drive the best decision per what non-standard modeling capabilities are most apropos

- When decisions / tradeoffs need to be made, use the expertise of expert schedulers

  - So that the scheduling system reacts as a human expert wants it to

  - E.g., when to work overtime, when to outsource

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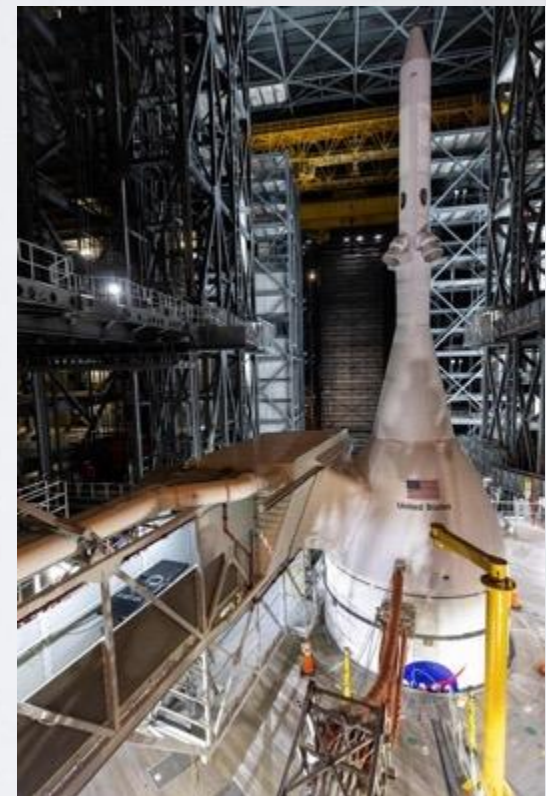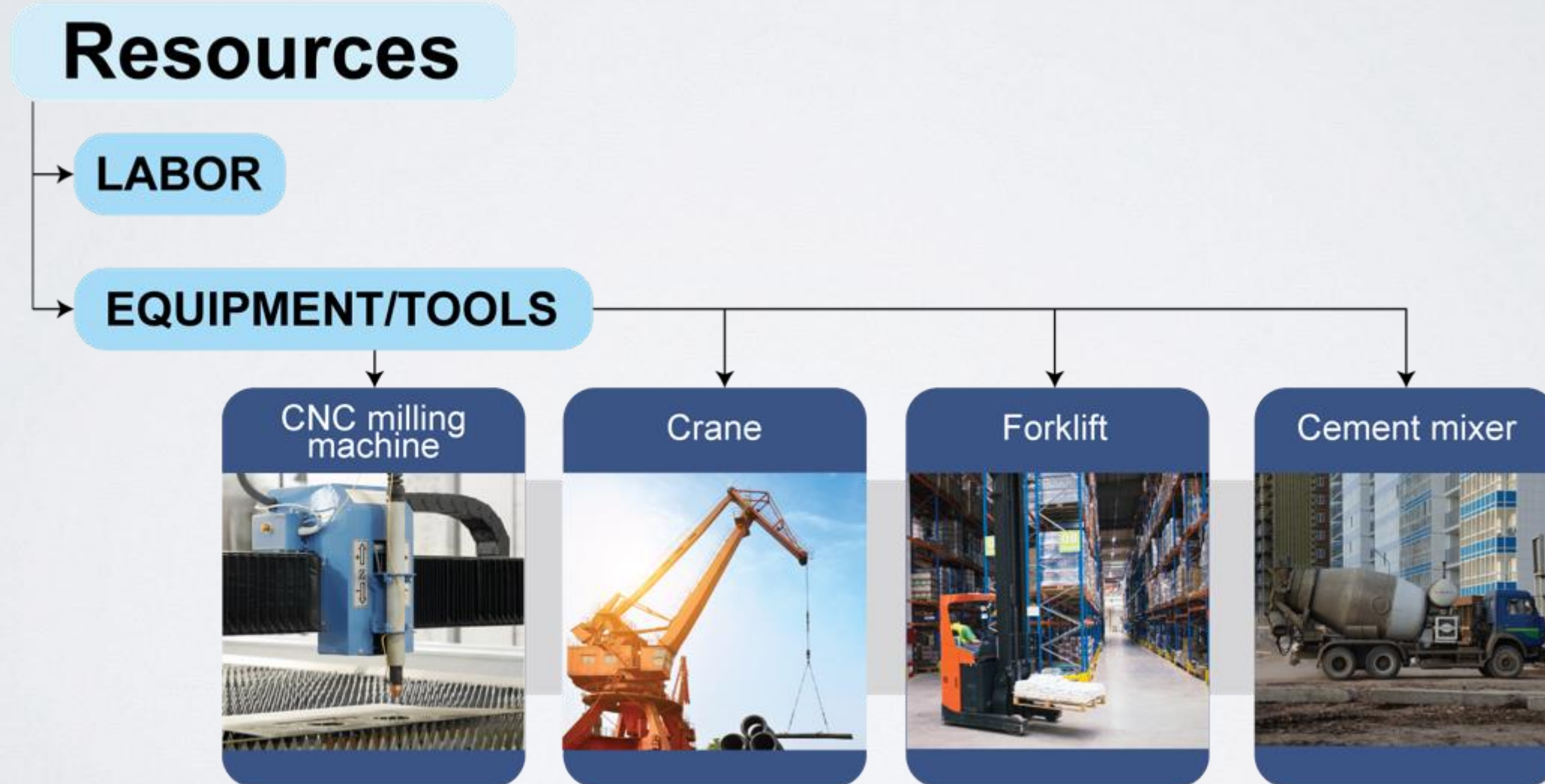
MODEL TO LEVEL OF DETAIL REQUIRED

- Technical constraints (E.g., F-S, F-F, S-F, lags)
- Resources
  - Labor: Occupation, skills, certifications
  - Equipment, Tools (e.g., cranes)
- Usage constraints – e.g., tool can only be used for so many hours continuously &/or during a day.
- Spatial / physical space – e.g.,
  - job requires a certain location or type of space
  - two elements should (or should not) be next to each other
- Equipment substitutions – equipment down, know & use substitutes

HIERARCHY OF RESOURCES

Resources

↳ **LABOR**

→ **Occupation:** e.g., Welding

→ **Skills/Certifications**

Submerged Arc Welding	Flux Cored Arc Welding	Gas Tungsten Arc Welding	Gas Metal Arc Welding
(Canadian Fabricating & Welding, 2019)	(Venus Wires, 2018)	Gas Tungsten Arc Welding 6" Pipe	(TEK, 2020)

EQUIPMENT RESOURCES

Resources

- LABOR
- EQUIPMENT/TOOLS
  - CNC milling machine
  - Crane
  - Forklift
  - Cement mixer

EQUIPMENT SUBSTITUTIONS

- Equipment down, know & use substitutes

EQUIPMENT: USAGE CONSTRAINTS

- E.g., tool can only be used for so many hours continuously &/or during a day.

CONCURRENT & NON-CONCURRENT
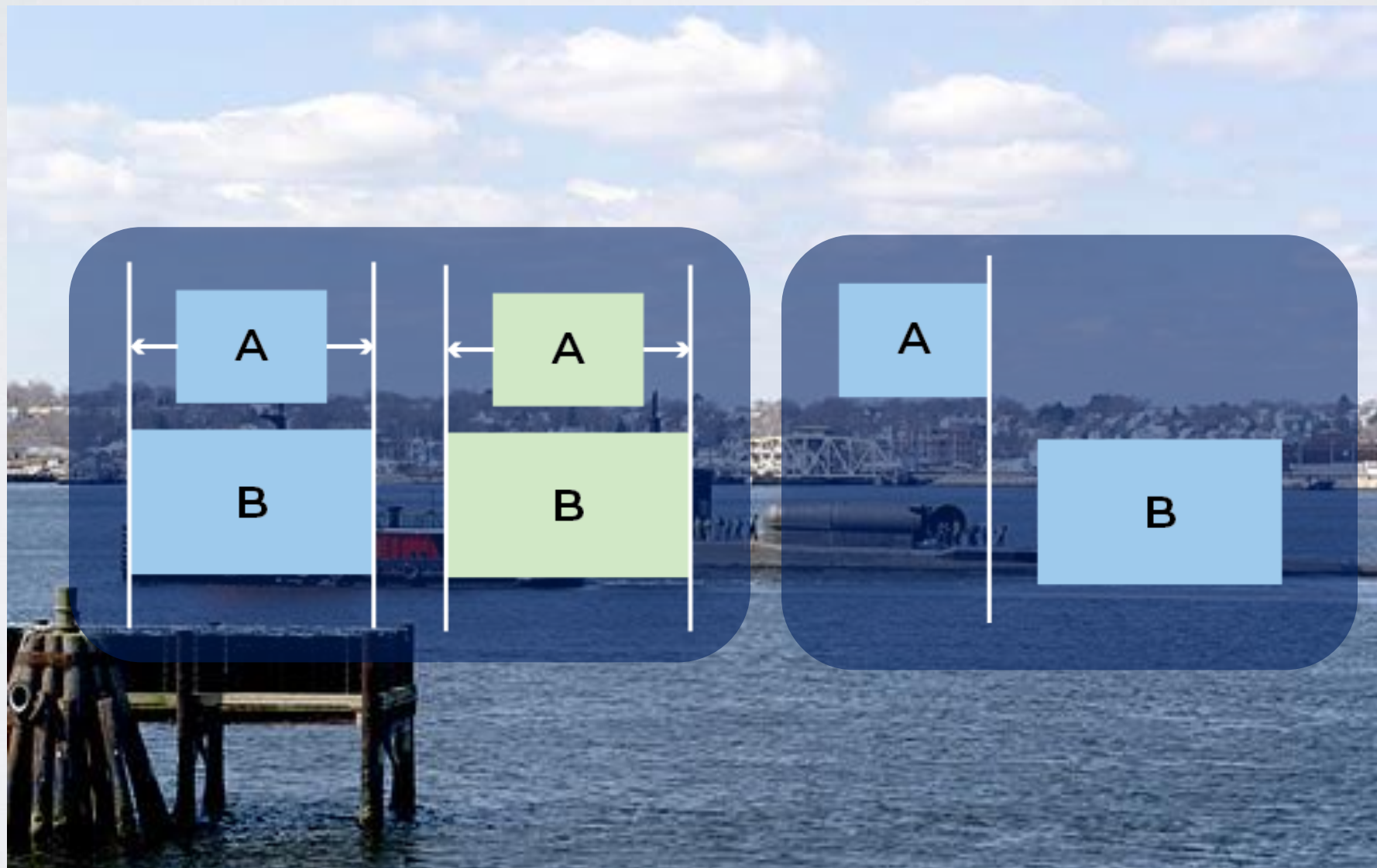
SPATIAL / PHYSICAL SPACE CONSTRAINTS

- For example:

  Job requires a certain location or type of space

  Two elements should (or should not) be next to each other
  Concurrent or non-concurrent constraint
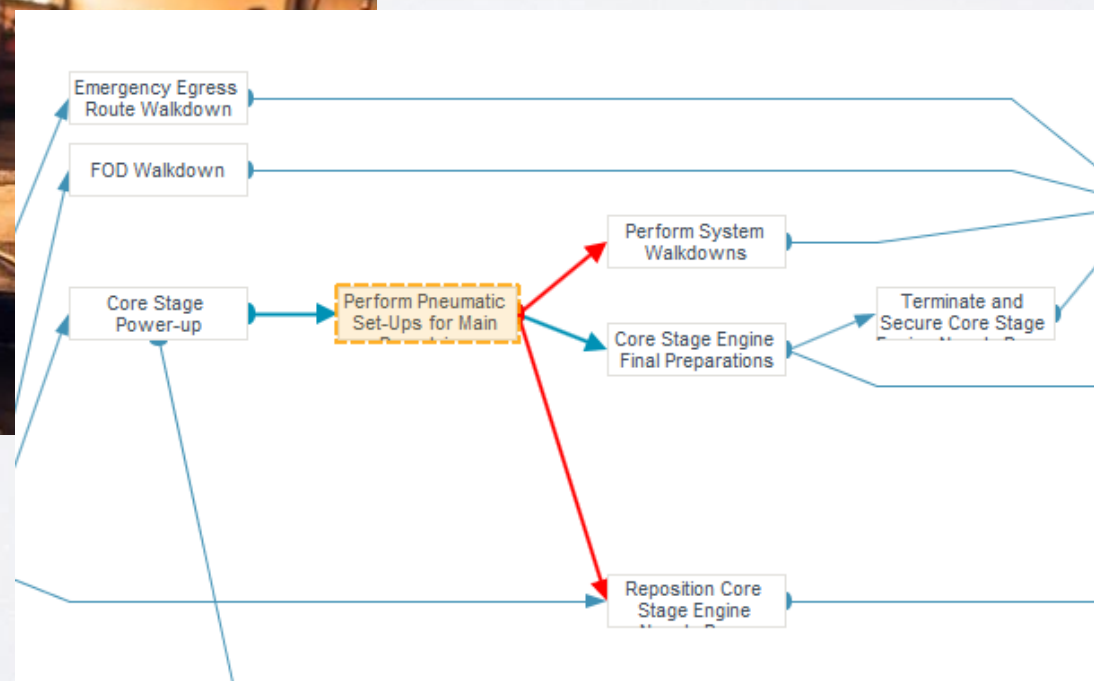
ERGONOMIC CONSTRAINTS – INDIVIDUAL LIMITATIONS ON WORK CONDITIONS

- E.g., only work so long:
  continuously requiring kneeling, and/or
  so much kneeling during a shift

SHIFT-BASED CONSRAINTS

- This is a set of properties that allows the user to control how jobs interact with shift breaks

- Only start a job if it can finish during the same shift

- Job can only be performed during the day shift

- Job can take multiple shifts, but requires same resource constraints

ALTERNATIVE RESOURCE COMBINATIONS

- a task may require a Plumber and a Mechanic; however, there may also be Cross-trained person that can perform Plumber and Mechanic operations. So, the resource requirements for a task could be
(Plumb & Mech) OR (Cross-trained).

- For cases where the same number of people are always needed, the resource requirement could be
((Plumb & Mech) OR (Cross-trained & Mech) OR (Plumb & Cross-trained) OR (2 Cross-trained)).

- Aurora's intelligent scheduling assigns the Cross-trained individuals to maximize throughput

SUCCESSOR START WITHIN LIMITED TIME FRAME
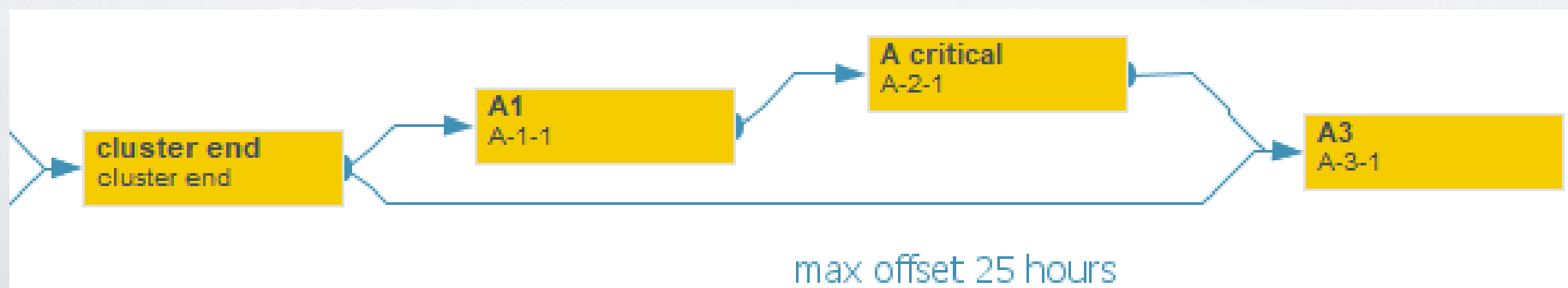
ENHANCED CONSTRAINT DIALOG

INTEGRATION WITH DIGITAL TWIN

- Aurora is incorporated in the Siemens Integrated Project Planning & Execution (IPP&E) Xcelerator product.

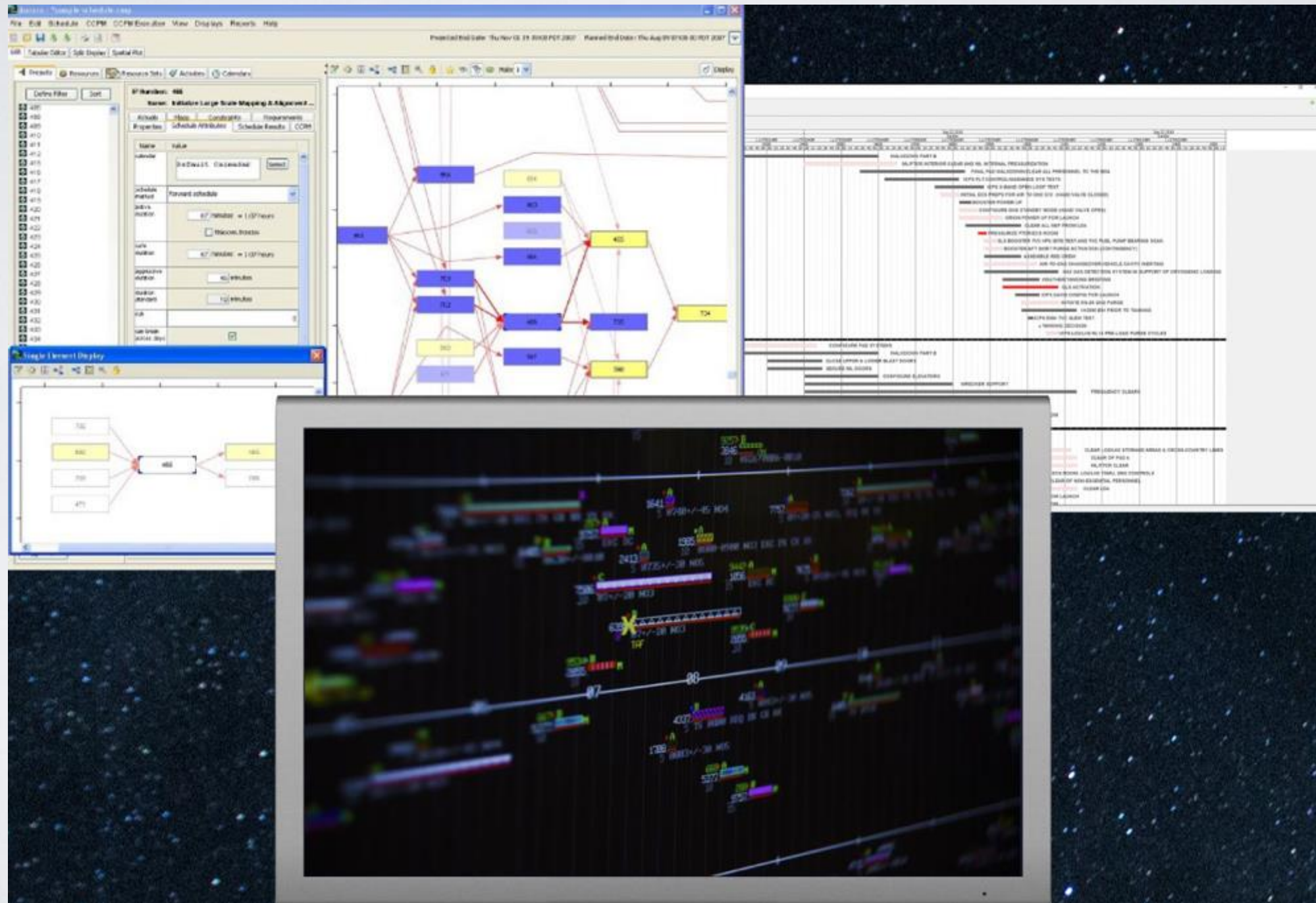- Links schedule tasks with digital

MONTE CARLO RISK SIMULATION

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REVEAL AND EXPLAIN THE SCHEDULE

PROJECT NETWORK

# GANTT CHART COLOR-CODED PER USER DESIRED CRITERIA
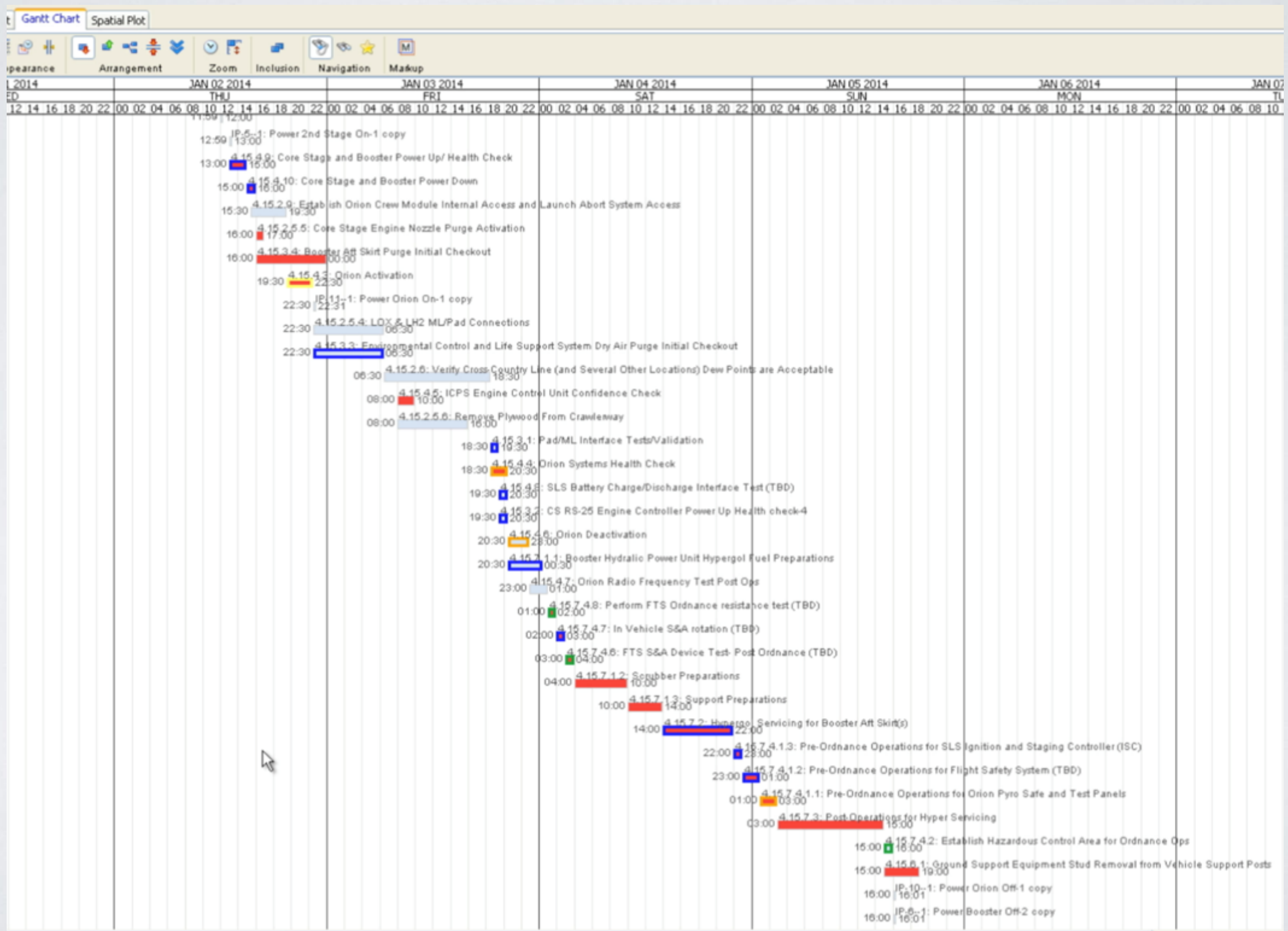
RESOURCE CONTENTION: VISUAL

- Viewing resource contentions

In this sample schedule, each task has a resource requirement attached as follows

Task #	Resources Needed
2	1
3	2
4	2
5	2

Note that there is a total amount of only 5 resources. Tasks 2, 4, and 5 are started at the same time (5 resources used). Task 2 completes, but there are not enough resources left to start Task 6, so Task 6 must wait until Task 5 is complete.
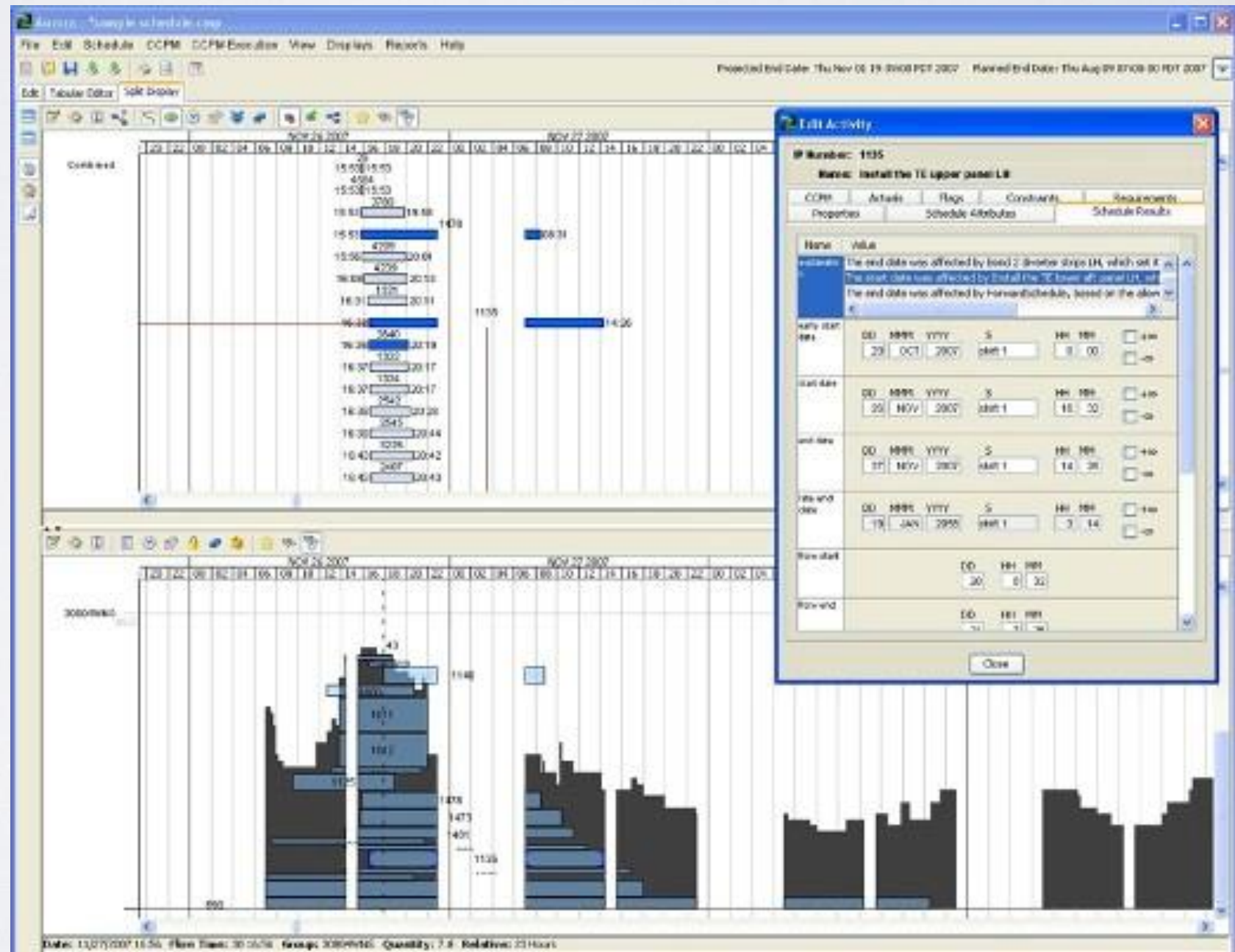
Aurora shows you this resource-constrained relationship with a blue-grey line between the two Tasks.
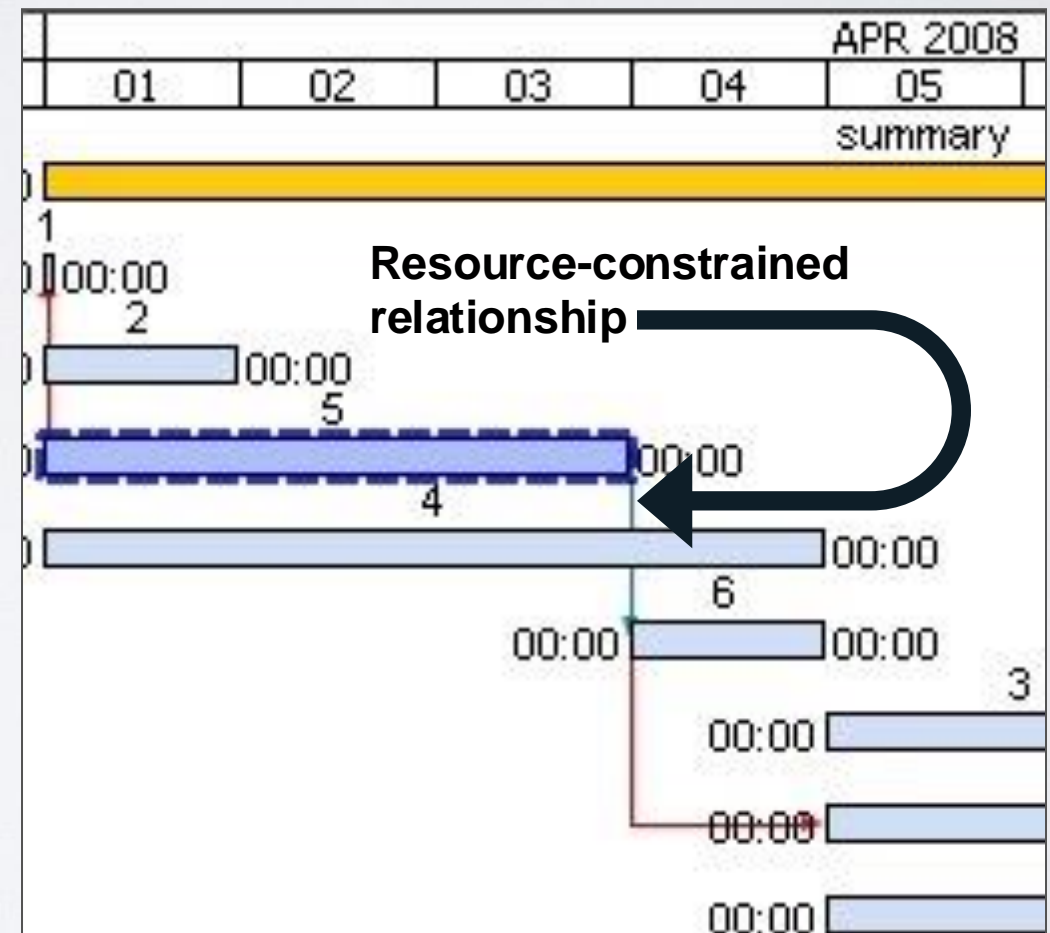
TEAM ASSIGNMENT DISPLAY
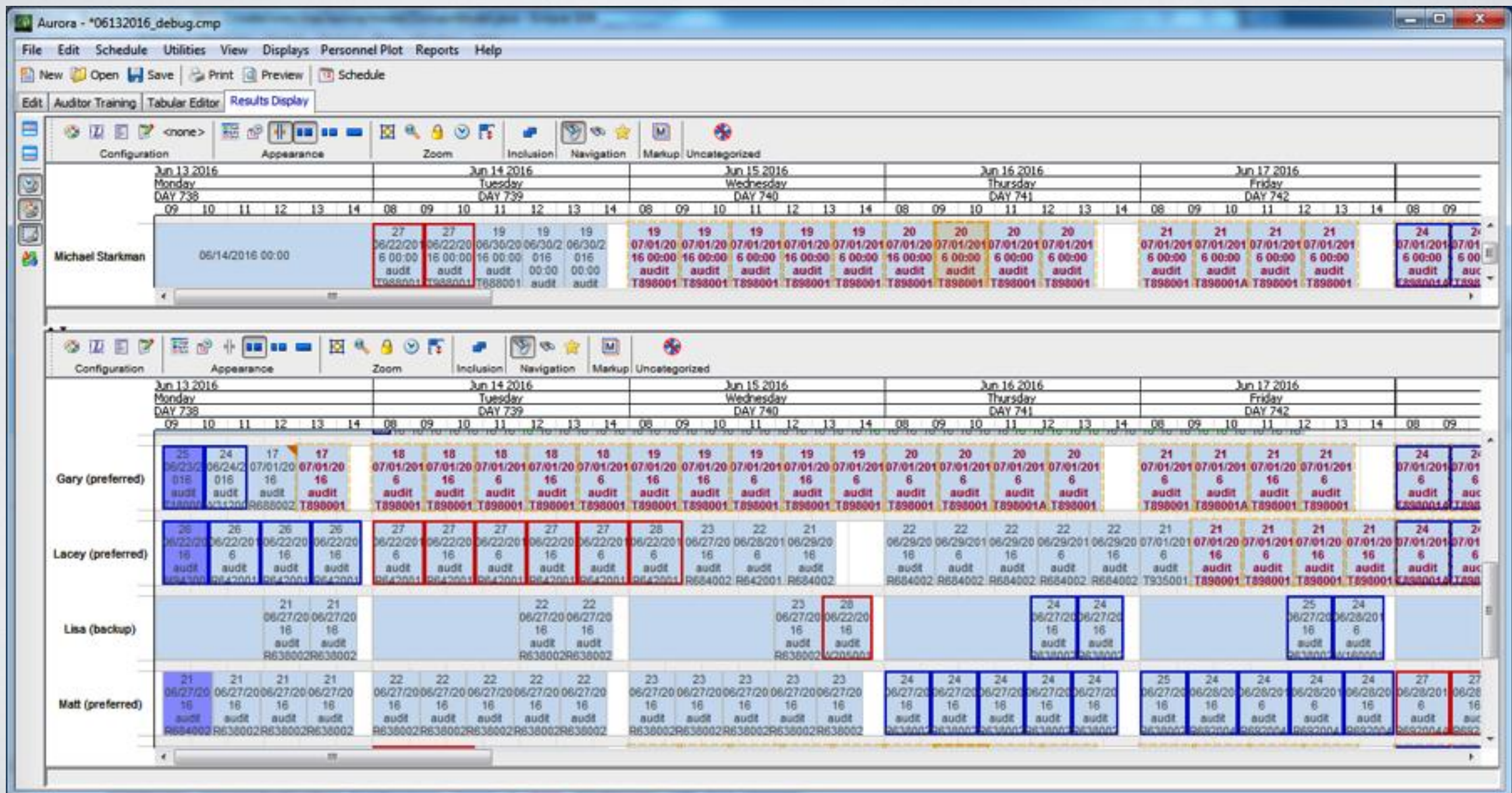
SPLIT VIEW SHOWING GANTT CHART SAME TIME SLICE AS HISTOGRAM, SHOWING ACTIVITIES CONSTITUTING RESOURCE NEED FOR ONE TIME INSTANCE

NETWORK DIAGRAM W/ MINI-MAP DISPLAY & SINGLE ELEMENT VIEW

NETWORK DIAGRAM SHOWING SINGLE-ELEMENT VIEW OPTION
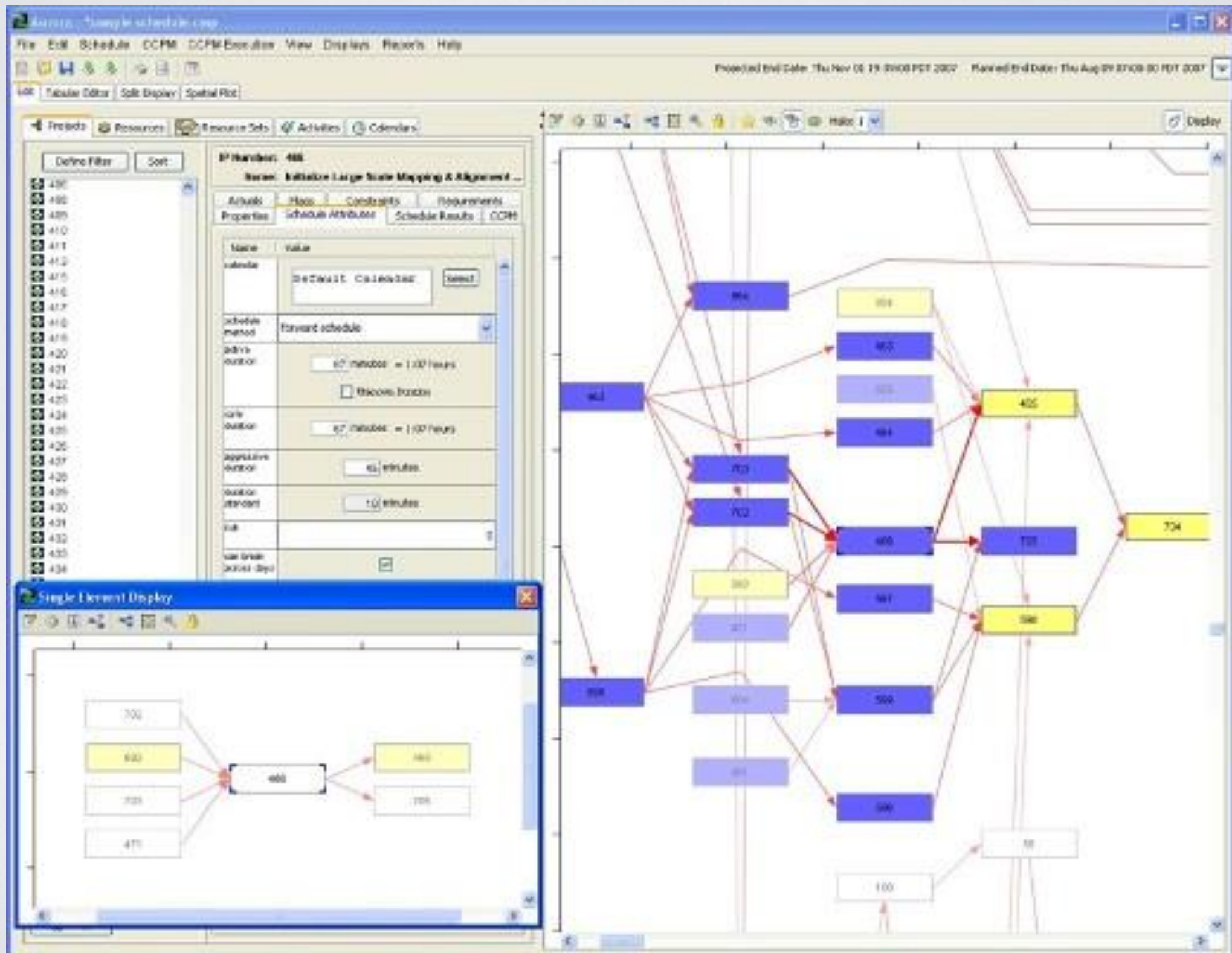
SINGLE ELEMENT DISPLAY
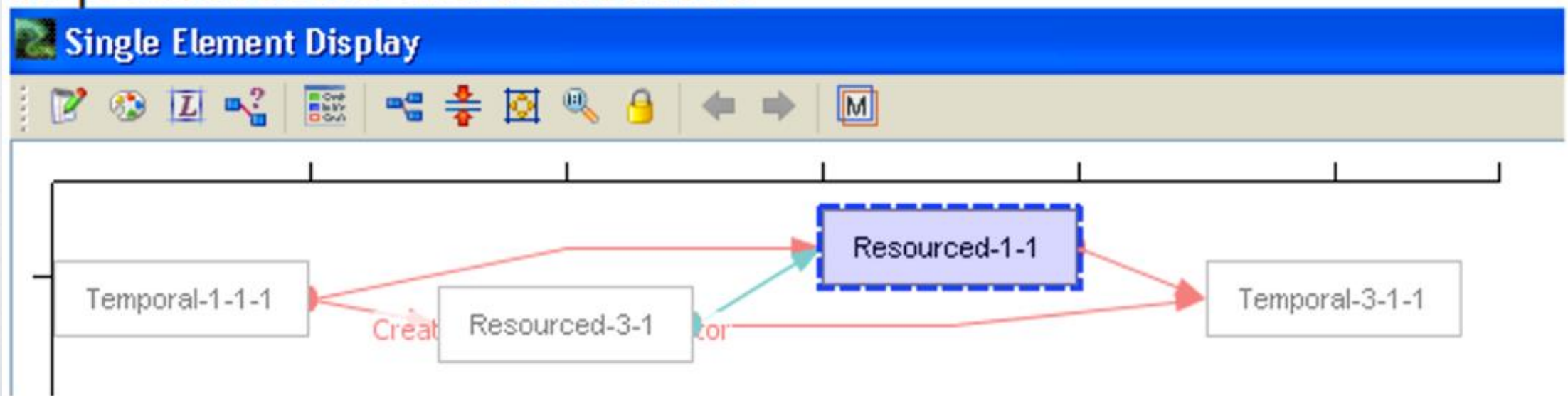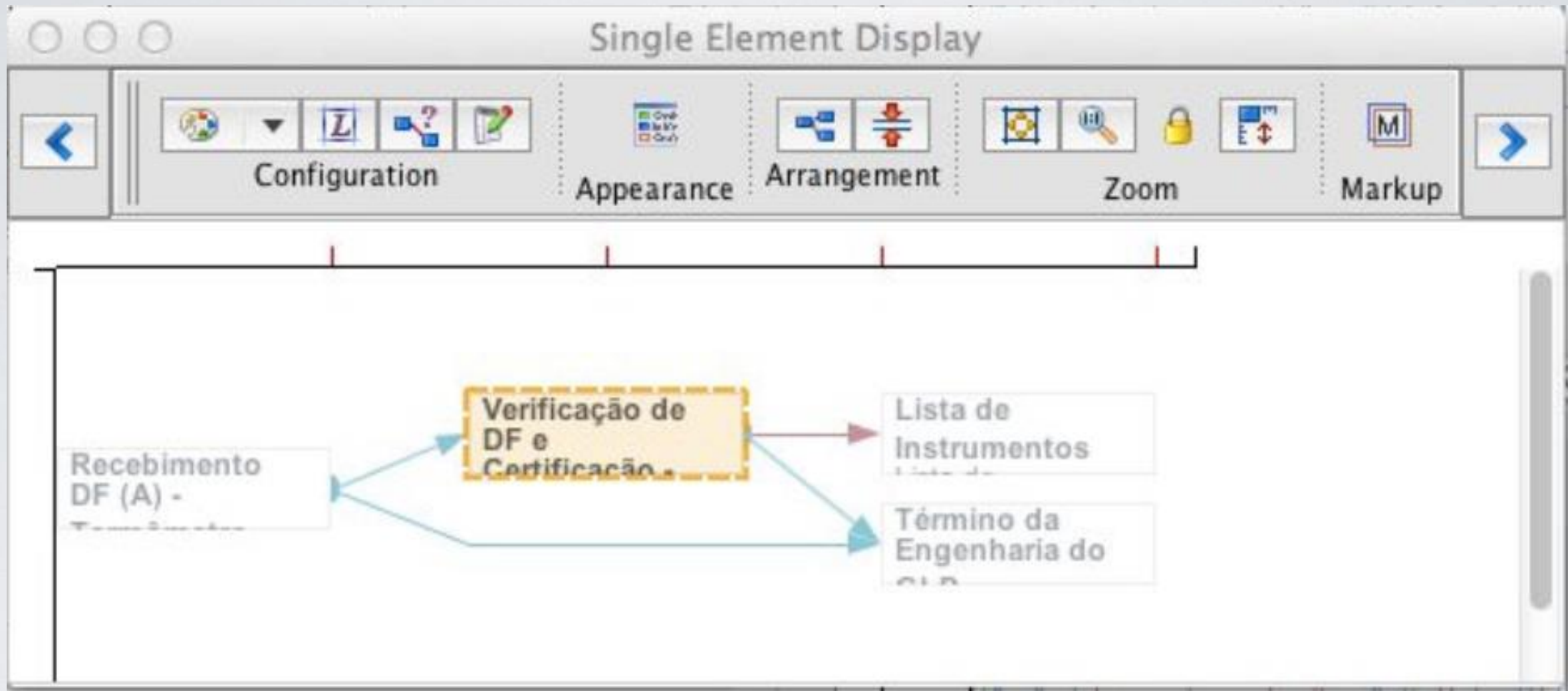
SINGLE ELEMENT DISPLAY FROM GANTT CHART

BURNDOWN CHART

Burndown by Day (start date)

EXPLAIN THE SCHEDULE

Name: Post-Operations for Hyper Servicing

Property Search:

Properties | Details | Geometry | Duration Info | Schedule Attributes | Schedule Results | CCPM | Analysis | Actuals | Integrations | Flags | Constraints | Requirements

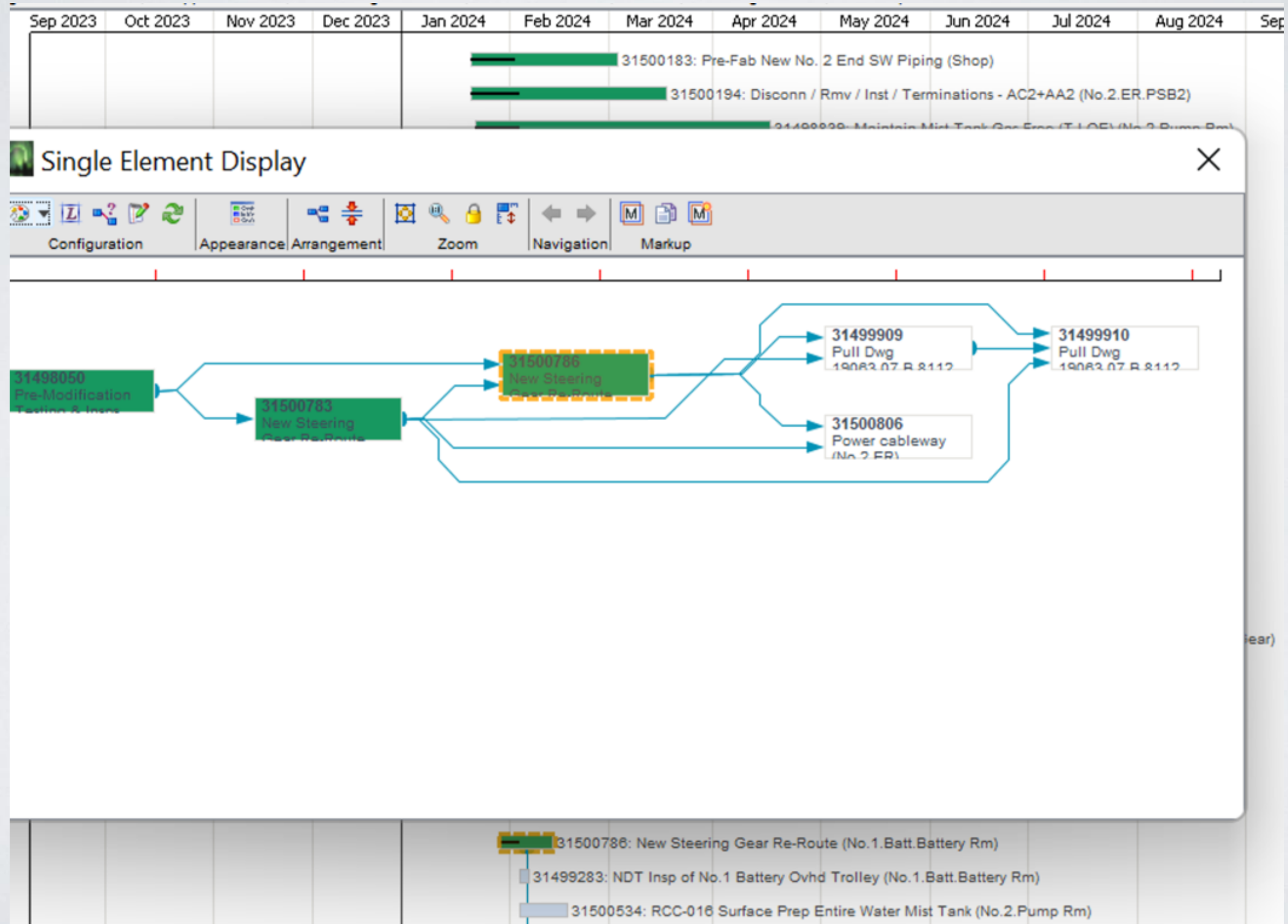| scheduled order	42
explanation	The end date was affected by the maximum flow time of 7300.00 days, which set it to 12/27/2033 00:00
	The start date was affected by Hypergol Servicing for Booster Aft Skirt(s), which set it to 01/03/2014 00:00
	The end date was affected by Establish Hazardous Control Area for Ordnance Ops, which set it to 12/25/2033 10:49
	The start date was affected by Hypergol Servicing for Booster Aft Skirt(s), which set it to 01/04/2014 22:00
	The start date was affected by ForwardSchedule, restricted by availability of Hazardous Pad-1; waiting for Pre-Ordnance Operations for Orion Pyro Safe and Test Panels, which set it to 01/05/2014
	The end date was affected by ForwardSchedule, based on duration and start time, which set it to 01/05/2014 15:00

The start date was affected by the flow start time, which set it to 12/01/2017 00:00
The end date was affected by the maximum flow time of 7300.00 days, which set it to 11/26/2037 00:00
The start date was affected by null--66, which set it to 12/27/2017 11:00
The end date was affected by null--108, which set it to 10/29/2037 12:00
The start date was affected by null--66, which set it to 01/06/2018 11:00
The start date was affected by ForwardSchedule, restricted by availability of LWUA; waiting for null--72, which set it to 01/16/2018 11:00
The end date was affected by ForwardSchedule, based on duration and start time, which set it to 01/17/2018 17:00

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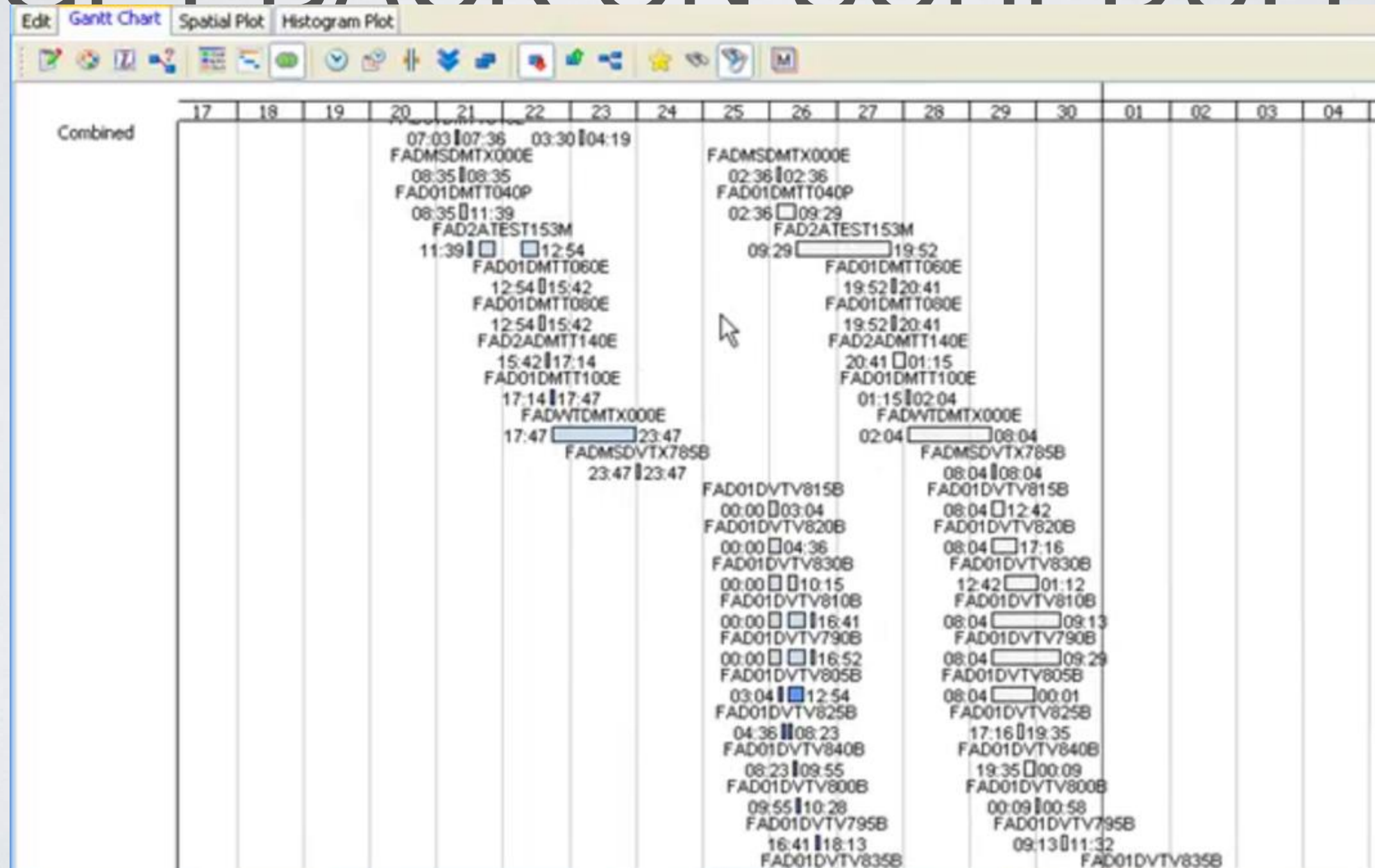- Results: Reduced project duration & greater transparency

EASY & FAST TO PERFORM SCENARIOS / WHAT-IFS

- Wall clock minimization to run a scenario critical so human schedulers will actually run them

- Provide ways to graphically compare results

WHAT-IF: WORK WEEKEND TO
GET BACK ON SCHEDULE

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BENEFITS OF SOPHISTICATED UNDERLYING SCHEDULER

- Results in a more realistic initial schedule
- Execution: Schedule is more flexible and better able to accommodate change.
- Schedule is "self-aware" of what tasks can most easily be moved. I.e., tasks store information about why it was placed (where it is placed).

SIGNIFICANT PRODUCTIVITY LOST DUE TO NON-REALISTIC PROJECT MODELING

- If current tool can not model the project model correctly, it can not execute efficiently.

AURORA LICENSED TO NASA, LANL, BOEING

AURORA-VIEWER FREE FOR ALL

- https://aurorascheduling.com/aurora-viewer/
  - Primavera P6 XER file viewer (free)

QUESTIONS?

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