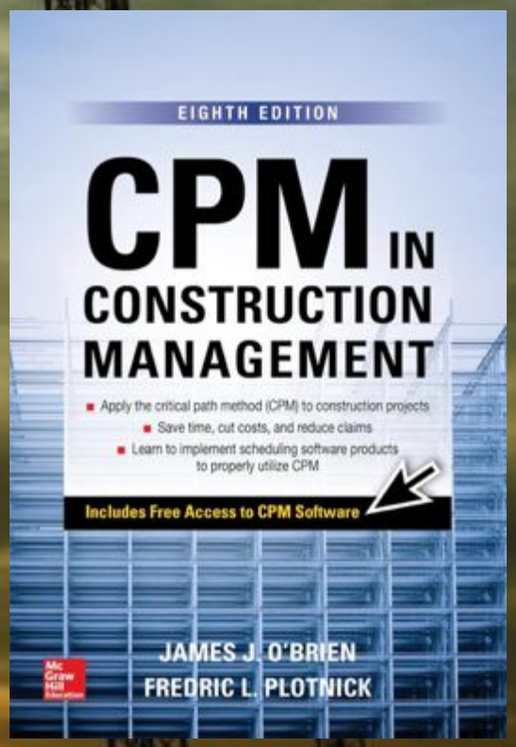
REAL WORLD PROJECT MODELING IN **AURORA** THAT SUPPORTS SOME RELATIONSHIP DIAGRAMING METHOD (RDM) & RELATIONSHIP DIAGRAMMING CRITICAL PATH METHOD (RDCPM) FUNCTIONALITY

CPM Construction Conference 2026

Rob Richards, PhD
Stottler Henke Associates, Inc.

www.AuroraScheduling.com

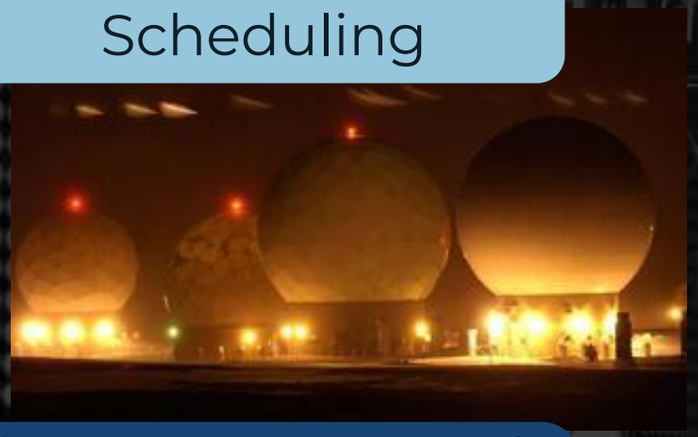


Stottler Henke

Lessons Learned from Clients

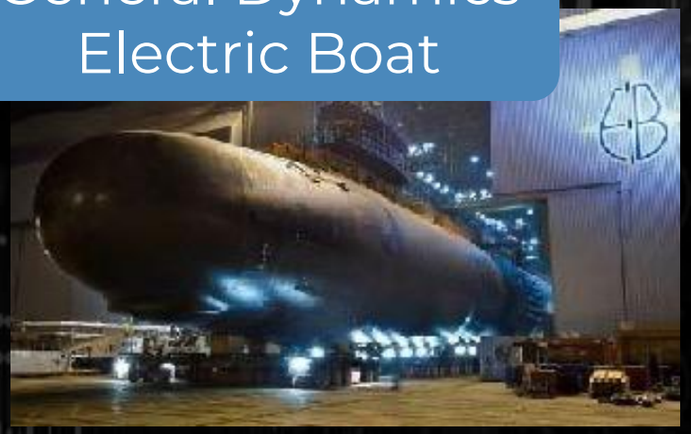
The Boeing Company

Air Force Satellite Scheduling



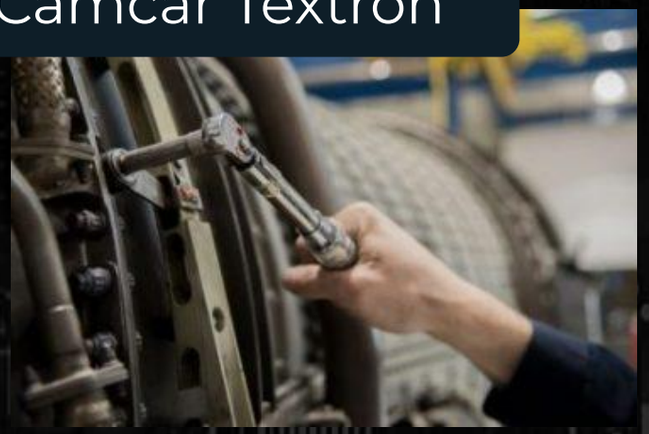
Mitsubishi Heavy Industries

General Dynamics Electric Boat



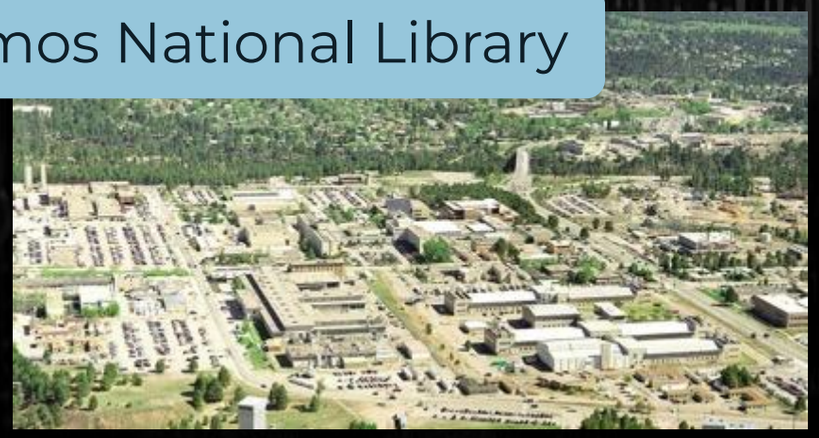
Siemens Integrated Program Planning & Execution

Camcar Textron



Spirit AeroSystems

Los Alamos National Library



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
  - RDM & RDCPM
- 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

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
  - RDM & RDCPM
- Reveal & explain the schedule
- Easy & fast to perform scenarios / what-ifs
- 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

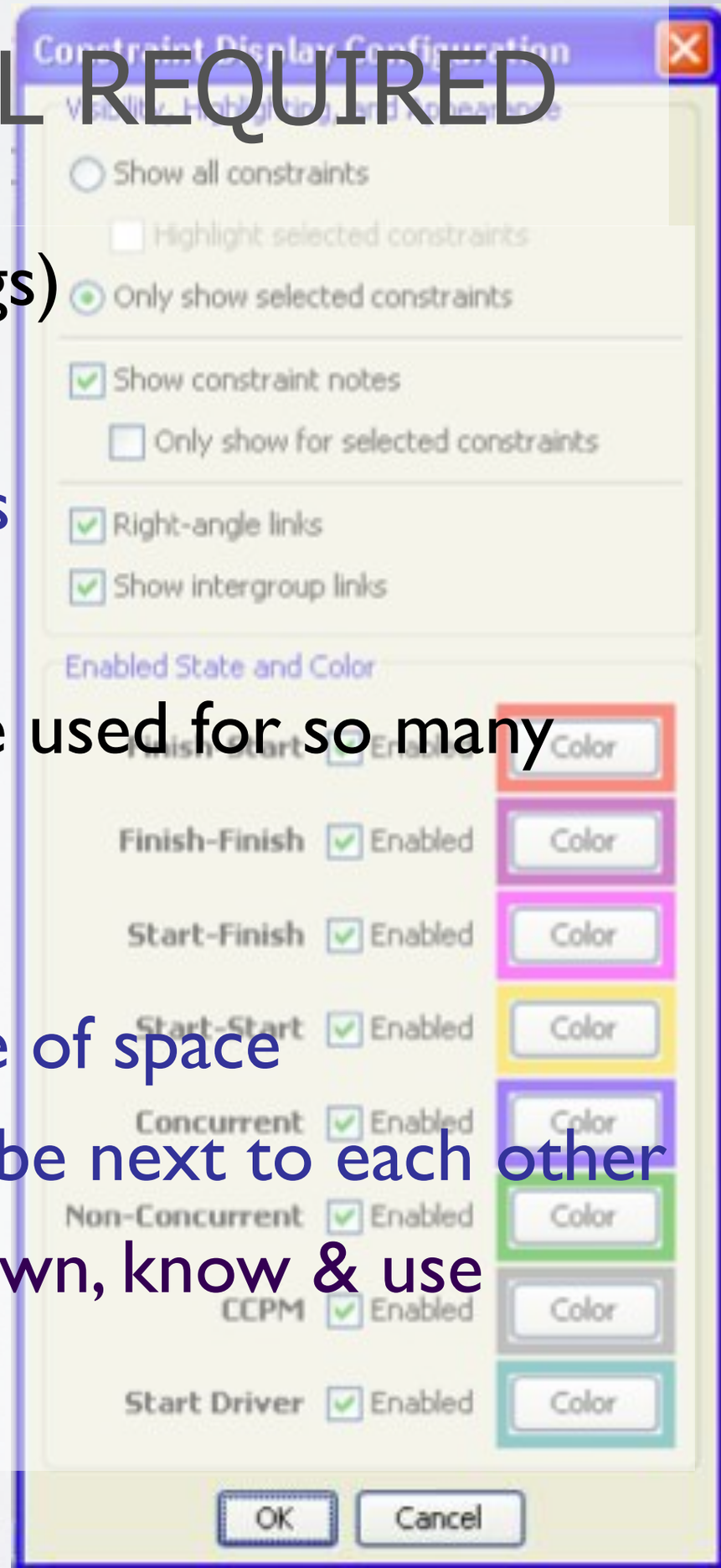
LEARN FROM HUMAN SCHEDULERS

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
  - RDM & RDCPM
- Reveal & explain the schedule
- Easy & fast to perform scenarios / what-ifs
- Results: Reduced project duration & greater transparency

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

(Canadian Fabricating & Welding, 2019)

Flux Cored Arc Welding

(Venus Wires, 2018)

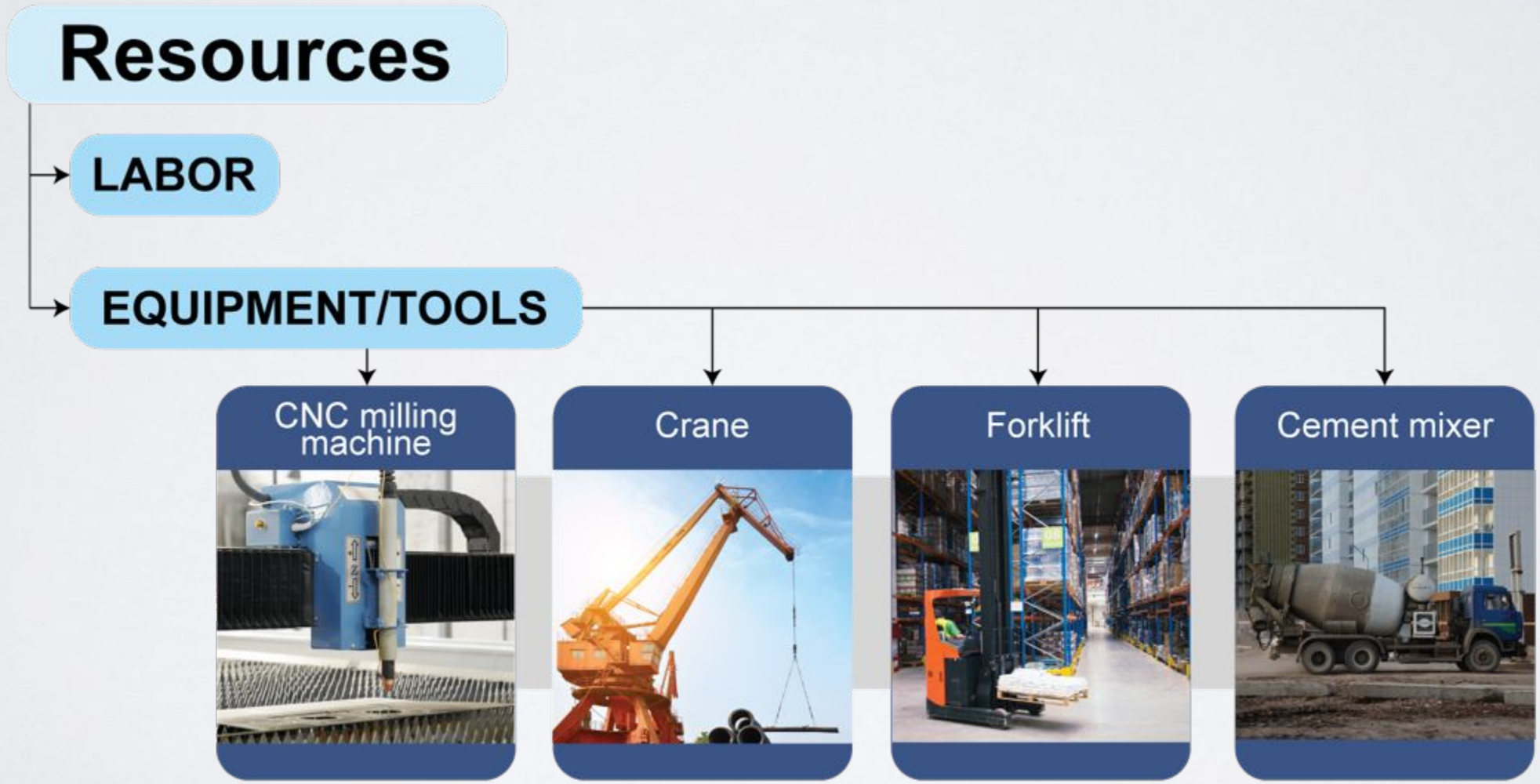
Gas Tungsten Arc Welding

Gas Tungsten Arc Welding 6″ Pipe

Gas Metal Arc Welding

(TEK, 2020)

EQUIPMENT RESOURCES



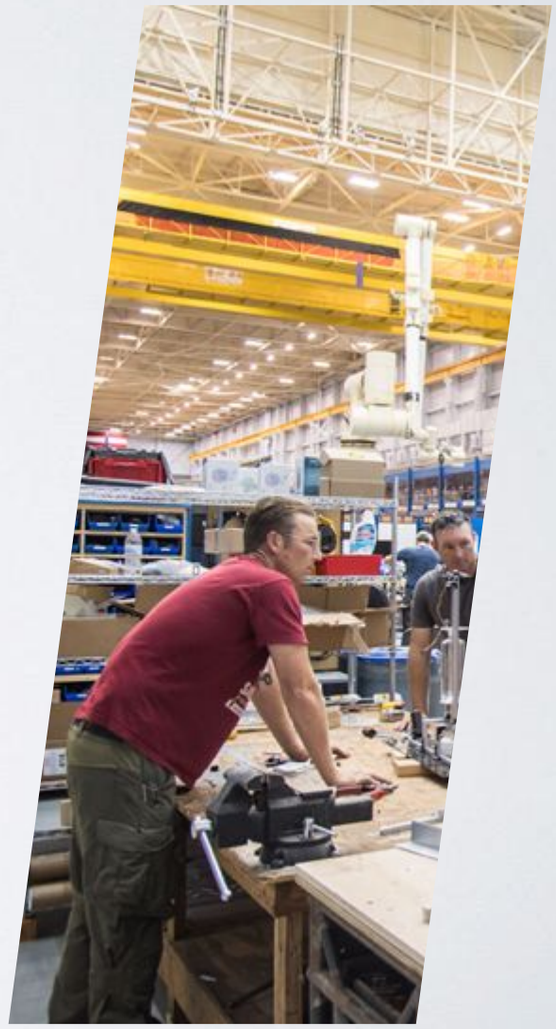
EQUIPMENT SUBSTITUTIONS

- Equipment down, know & use substitutes

PREFERRED RESOURCES

Specify a preference order when defining a set of resources that are mostly interchangeable.

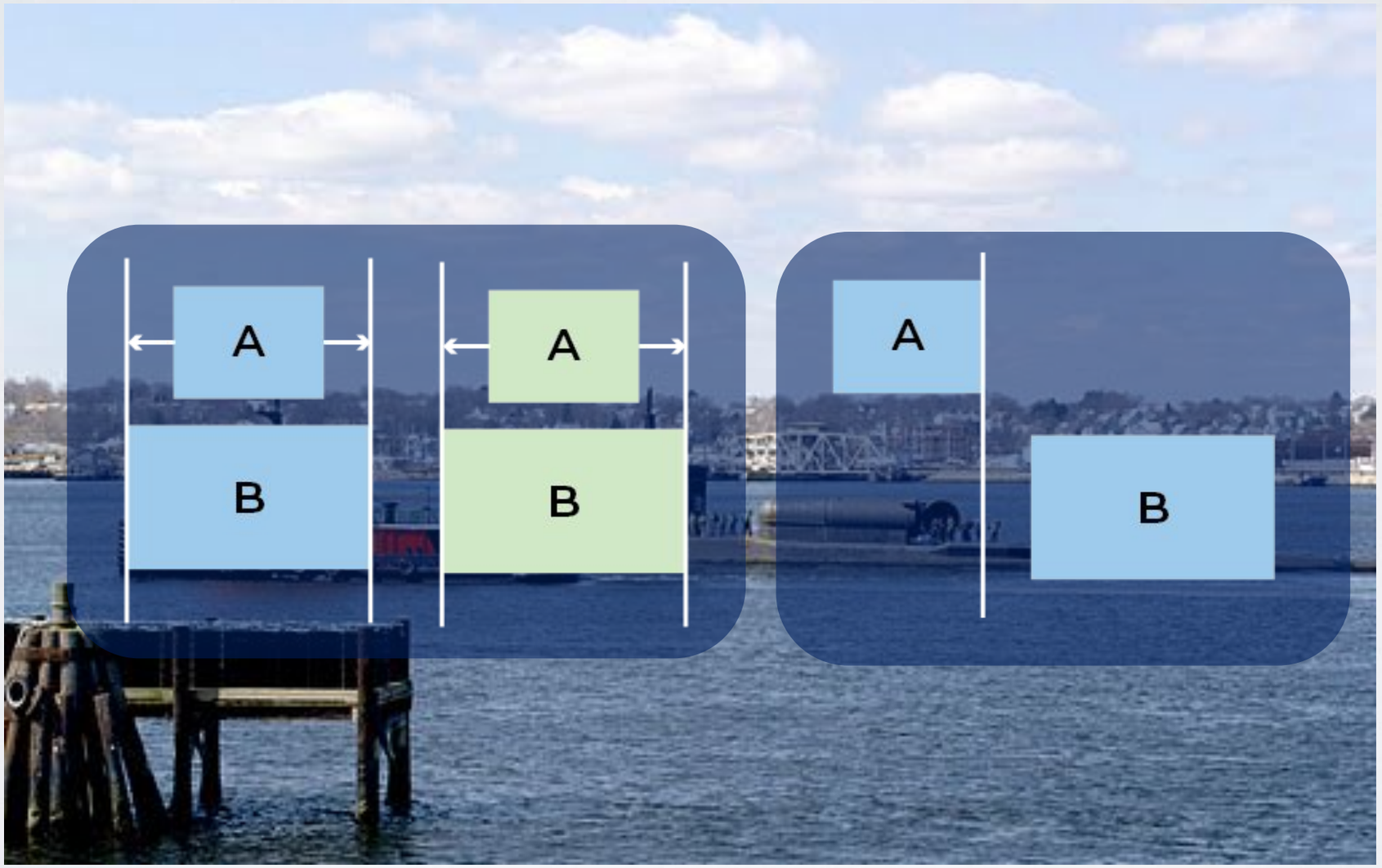
- Prefer work in default shop
- Prefer work by tech, but supervisor can substitute
- Prefer certain equipment
- Prefer certain lab space
- Use consistent auditors for a client



EQUIPMENT: USAGE CONSTRAINTS

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

CONCURRENT & NON-CONCURRENT



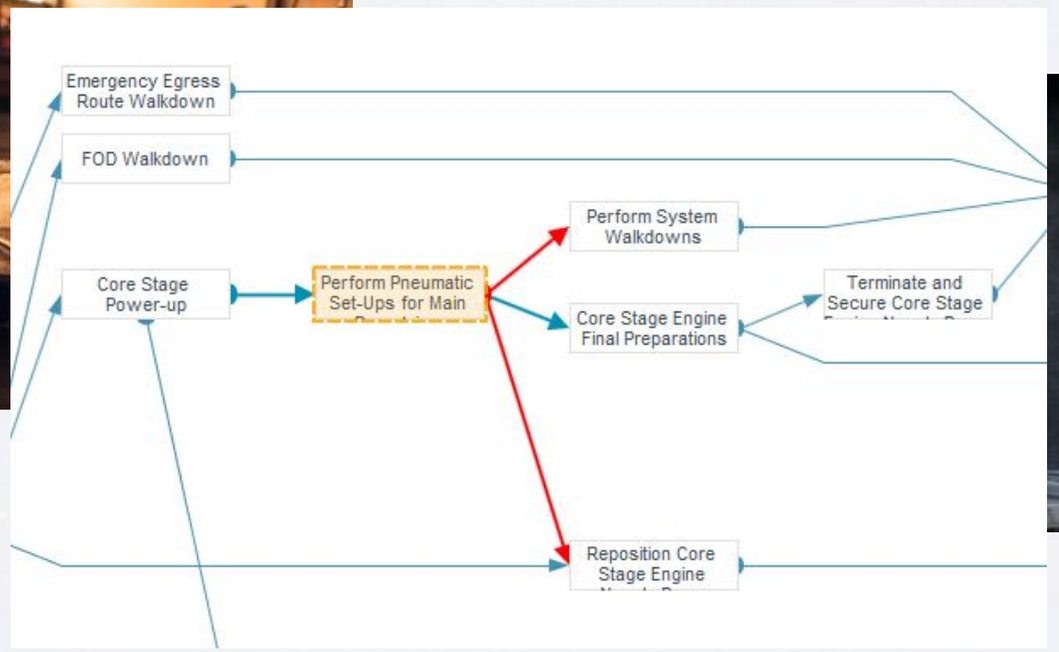
SPATIAL / PHYSICAL SPACE CONSTRAINTS

- 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

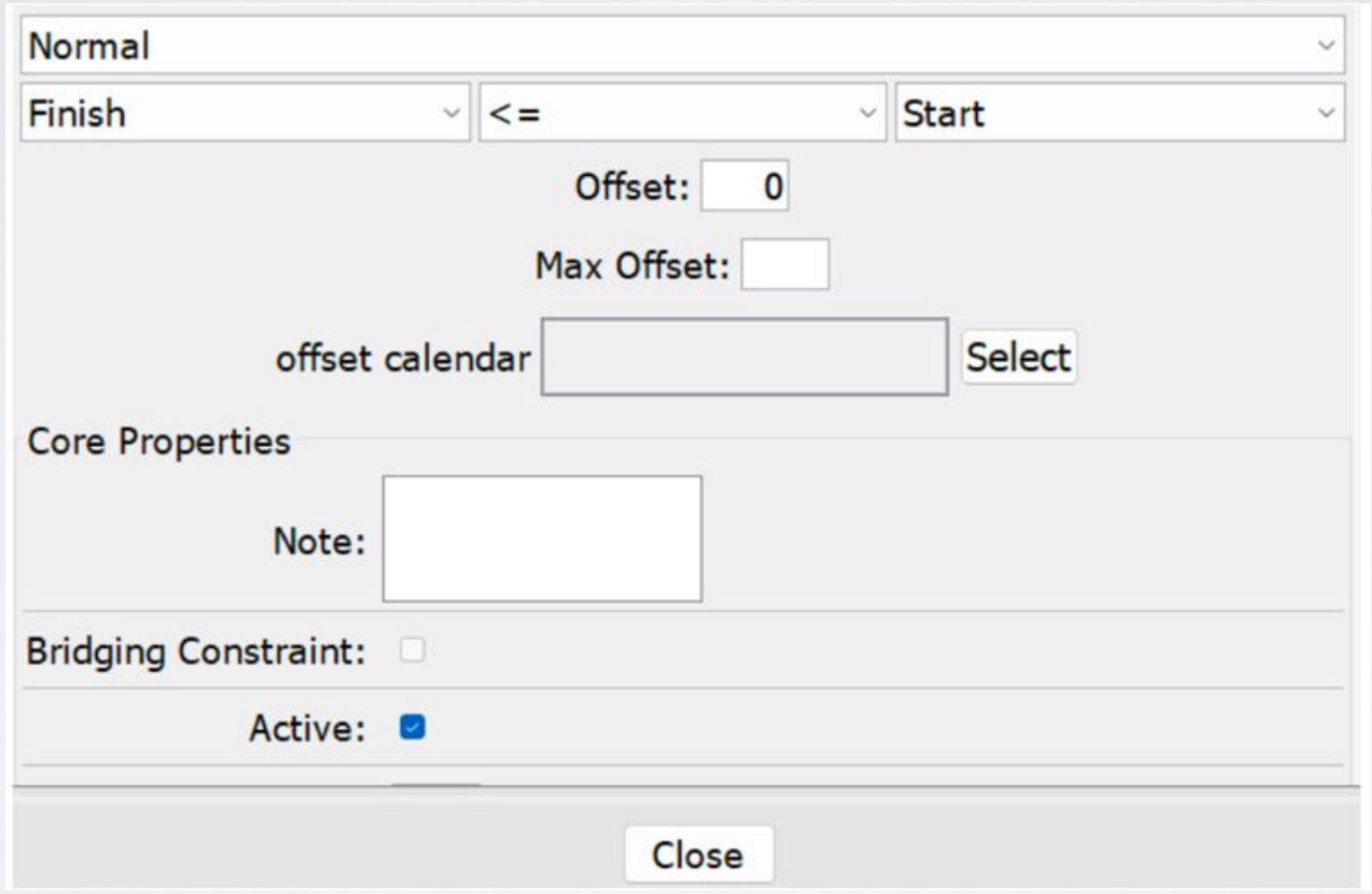
SHIFT-BASED CONSRAINTS

- 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 days but requires the same human resources each day until completed.

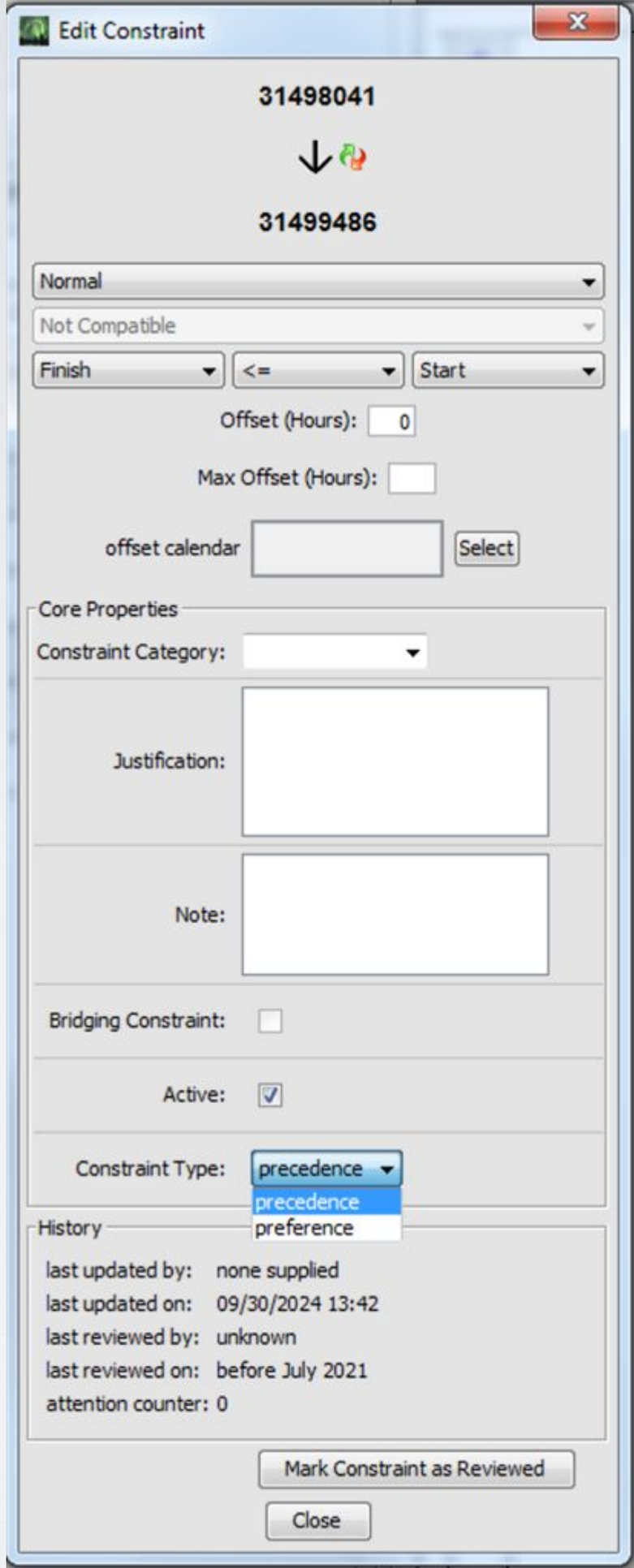
ALTERNATIVE RESOURCE COMBINATIONS

- 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



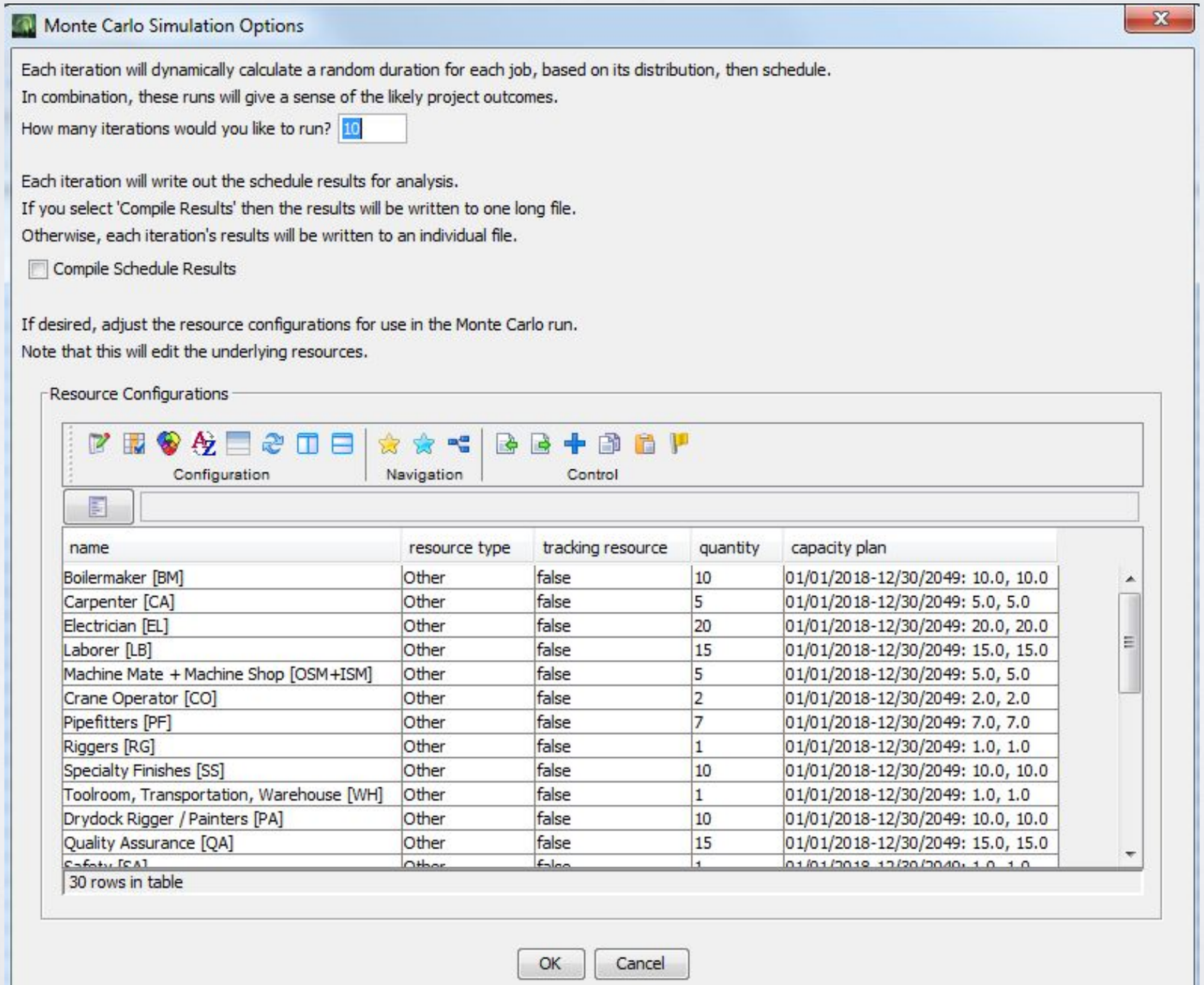
ENHANCED CONSTRAINT DIALOG



INTEGRATION WITH DIGITAL TWIN

- Aurora is incorporated in the Siemens Integrated Project Planning & Execution (IPP&E) Xcelerator product.
- Links schedule tasks with digital twi

MONTE CARLO RISK SIMULATION



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
  - RDM & RDCPM
- Reveal & explain the schedule
- Easy & fast to perform scenarios / what-ifs
  - Results: Reduced project duration & greater transparency

OVERLAP WITH RDM & RDCPM

- CT – Contiguous
- CC – Concurrent
- Continuous / Interruptible
- Risk / Monte Carlo
- Calendars of Durations of Activities and Restraints
- Event Codes
- Passage versus progress
- Reason/Why Codes: Reason/Why Restraint Code, Other Restraint Codes and Restraint Description Fields

CT – CONTIGUOUS
CC – CONCURRENT

- Aurora has the same functionality in the ABSOLUTE Finish-to-Start constraints, F=S.

- Aurora supports concurrent constraints.
  In addition, Aurora supports non-concurrent constraints

CONTINUOUS / INTERRUPTIBLE

RISK / MONTE CARLO

- Aurora supports both continuous and interruptible activities.

- Aurora supports Monte Carlo analysis
  - Including fully resource loaded models with all the sophisticated modeling capabilities described herein and other capabilities unique to Aurora.

CALENDARS OF DURATIONS OF ACTIVITIES AND RESTRAINTS

EVENT CODES

- Aurora supports complex calendars.
  Aurora supports shift-based constraints

- In Aurora (a subset of) Event Codes can be supported via Aurora's ability to support a large amount of user defined fields. So, a user defined field could be created called
  - Event Code Start
  - Event Code End
- If an Event Code is needed within an activity, then the activity can be split into multiple sub-activities connected with ABSOLUTE Finish-to-Start constraints, F=S.

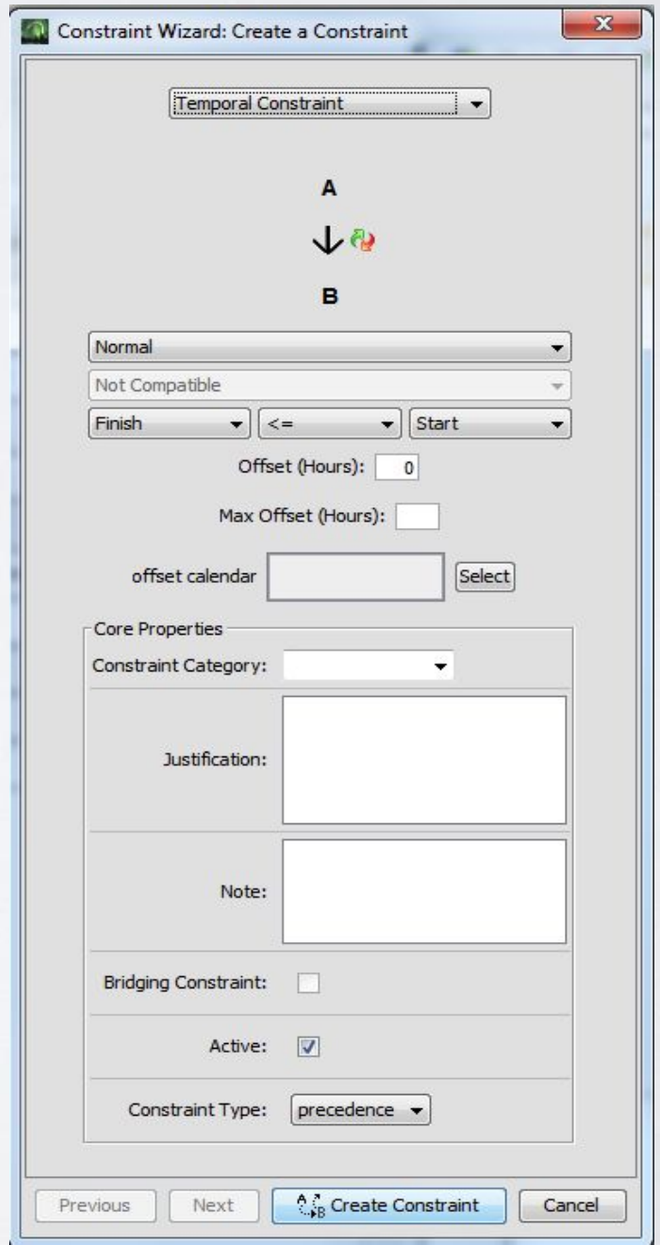
PASSAGE VERSUS PROGRESS

- In Aurora the default offset lead/lag capability satisfies the passage version of "overlap of activities".

- The usage of sub-activities connected with ABSOLUTE Finish-to-Start constraints, F=S, can be used so that a sub-activity is created to represent the amount of progress required, and then another constraint would be created between the sub-activity and the other activity that was waiting for the progress to complete.

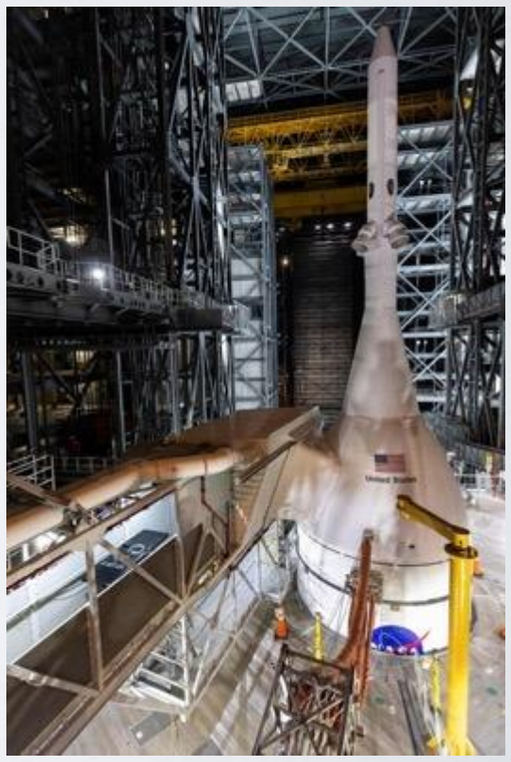
REASON/WHY RESTRAINT CODE & RESTRAINT DESCRIPTION FIELDS

- For physical constraints, the Reason/why can be entered as part of the constraint definition, Justification field.

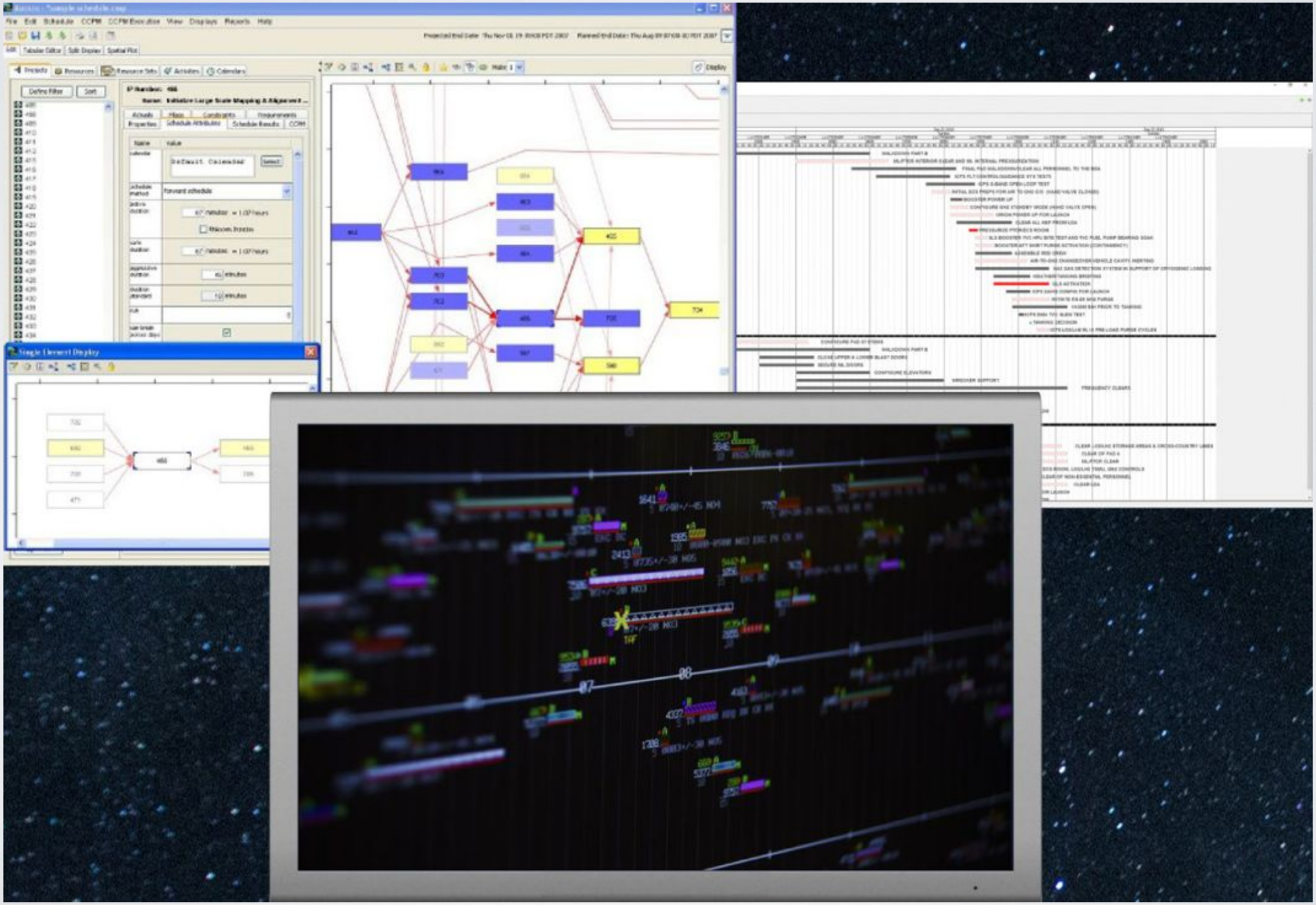


LESSONS & RESULTS

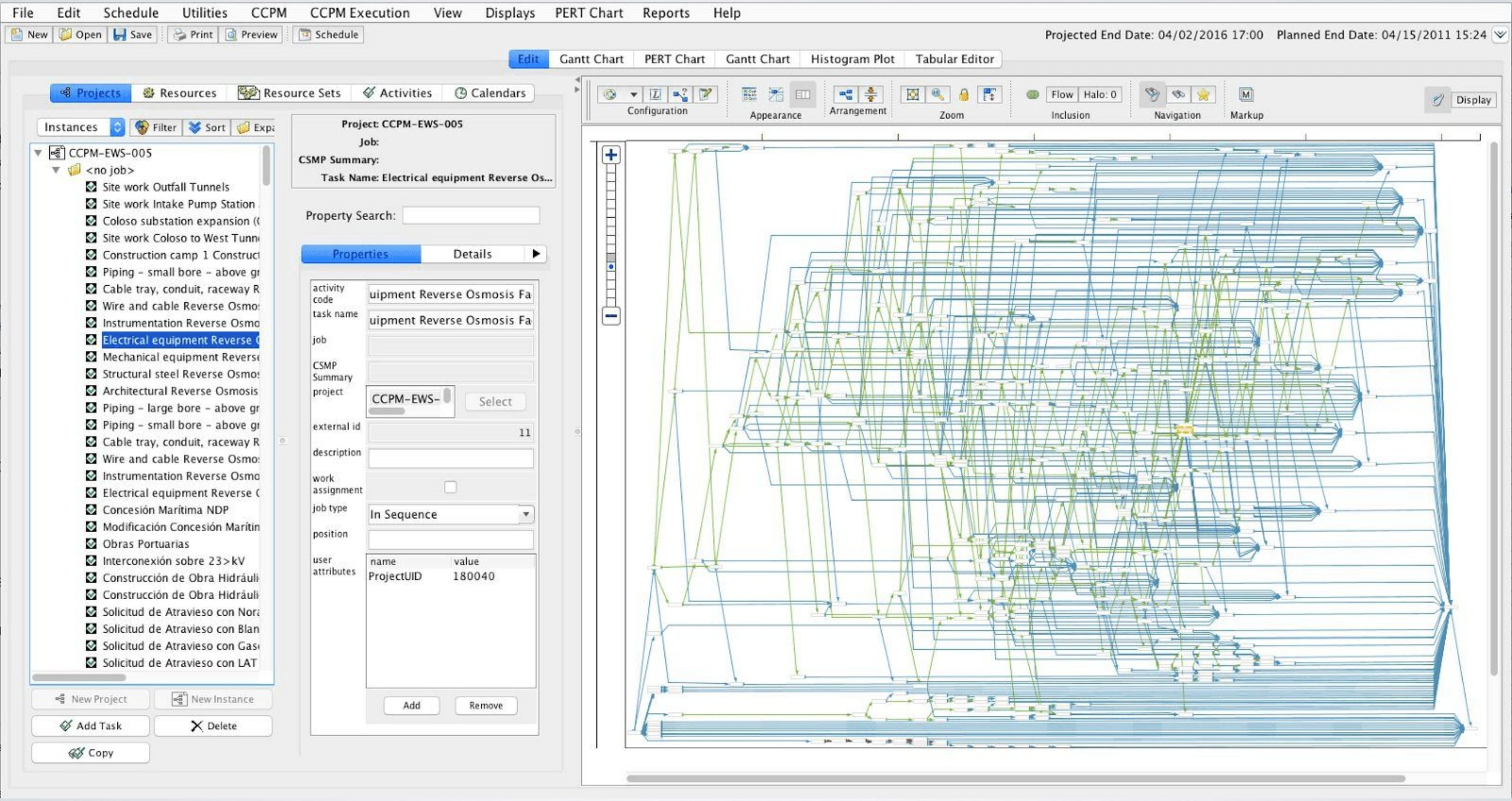
- Project models require more real-world constraints
  - Significant productivity lost due to inferior model details
- Learn from the human schedulers
- Model to level of detail required
  - RDM & RDCPM
- Reveal & explain the schedule
- Easy & fast to perform scenarios / what-ifs
  - Results: Reduced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



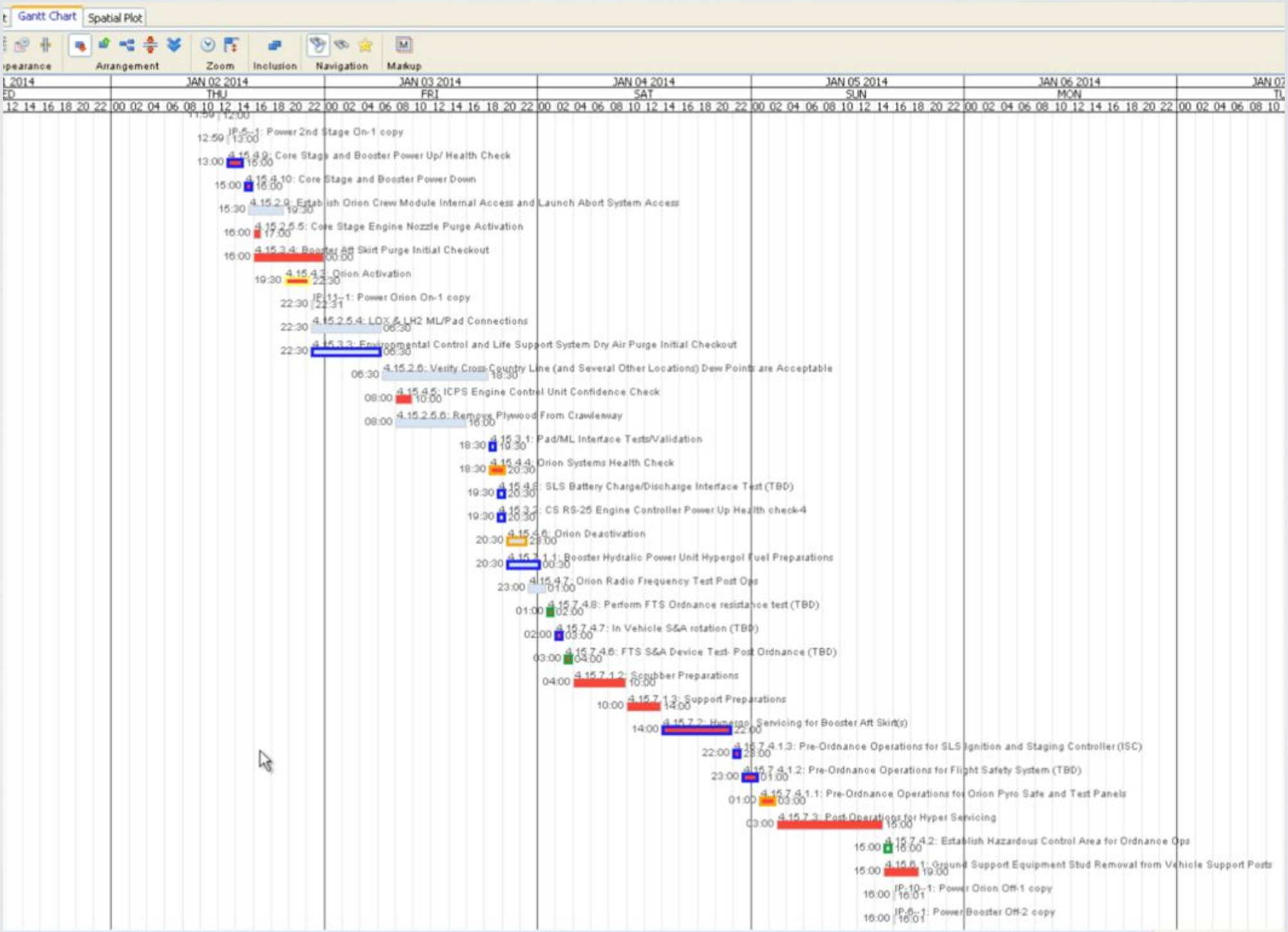
REVEAL AND EXPLAIN THE SCHEDULE



PROJECT NETWORK



GANTT CHART COLOR-CODED PER USER DESIRED CRITERIA



RESOURCE CONTENTION: VISUAL

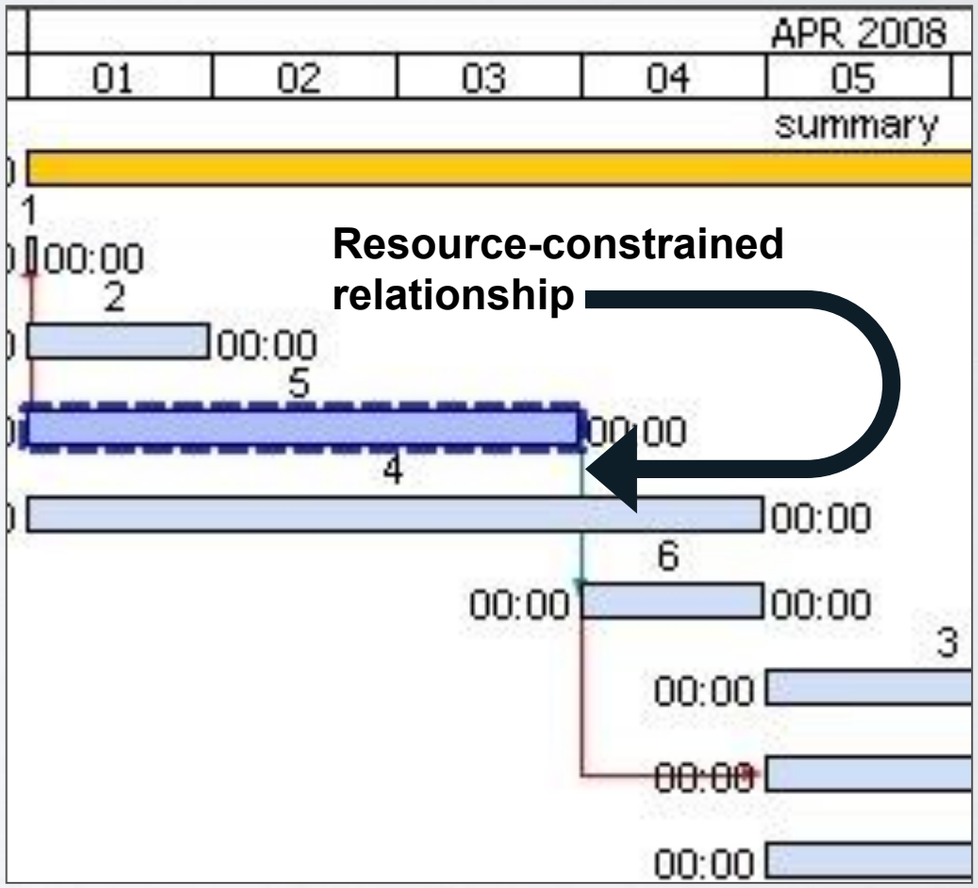
- Viewing resource contentions

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

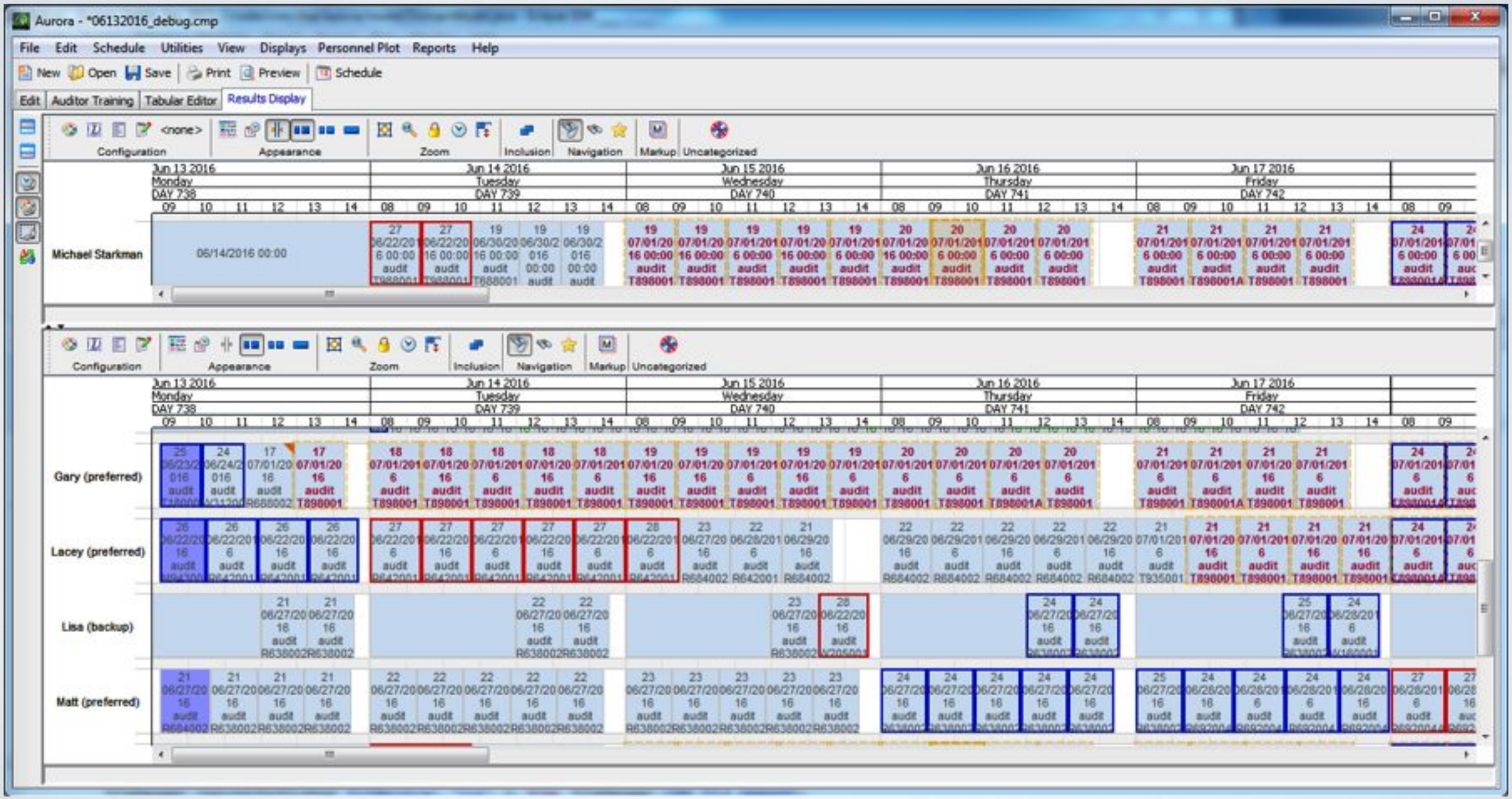
Task #	Resources Needed
2	1
3	2
4	2
5	2

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.

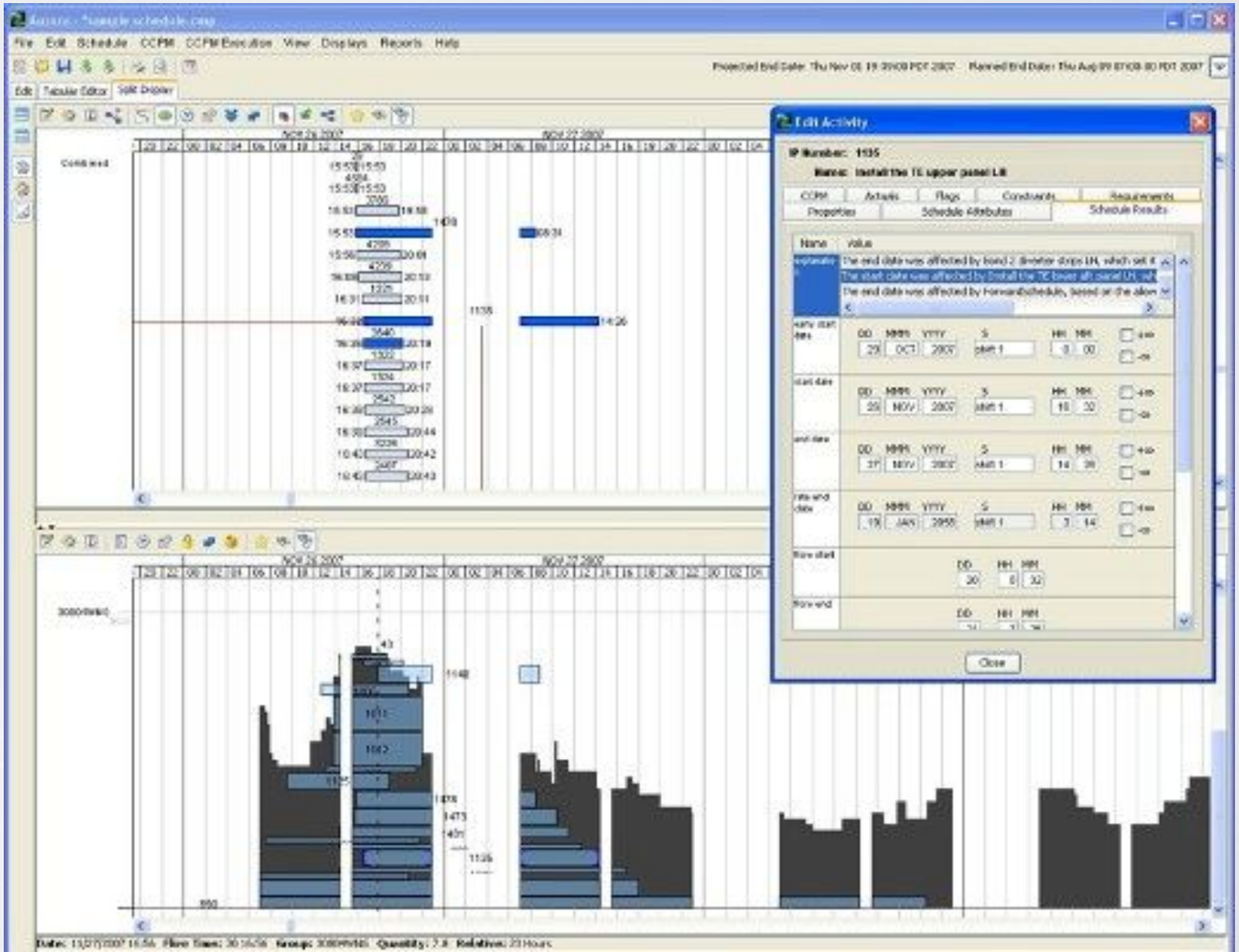
Aurora shows you this resource-constrained relationship with a blue-grey line between the two Tasks.



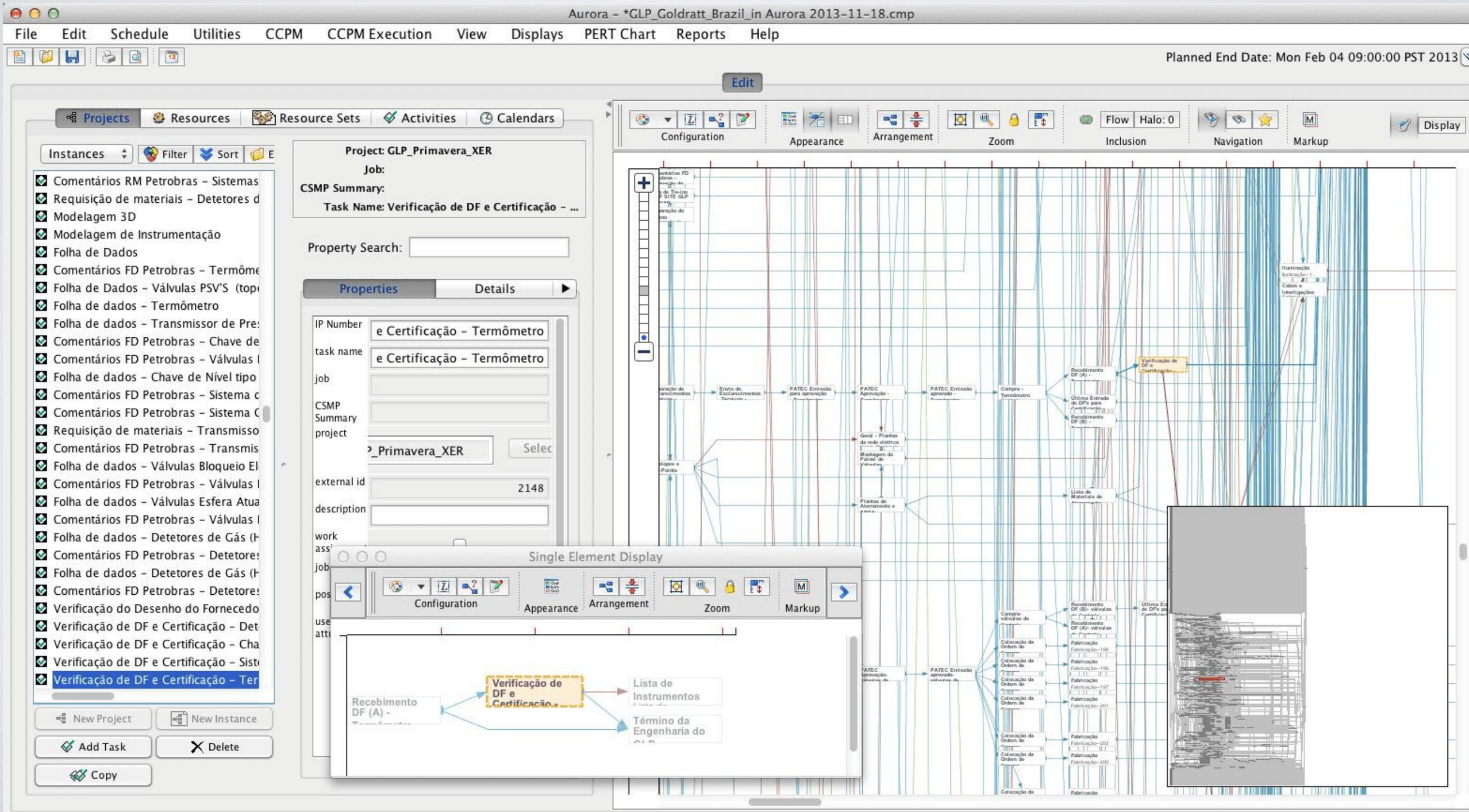
TEAM ASSIGNMENT DISPLAY



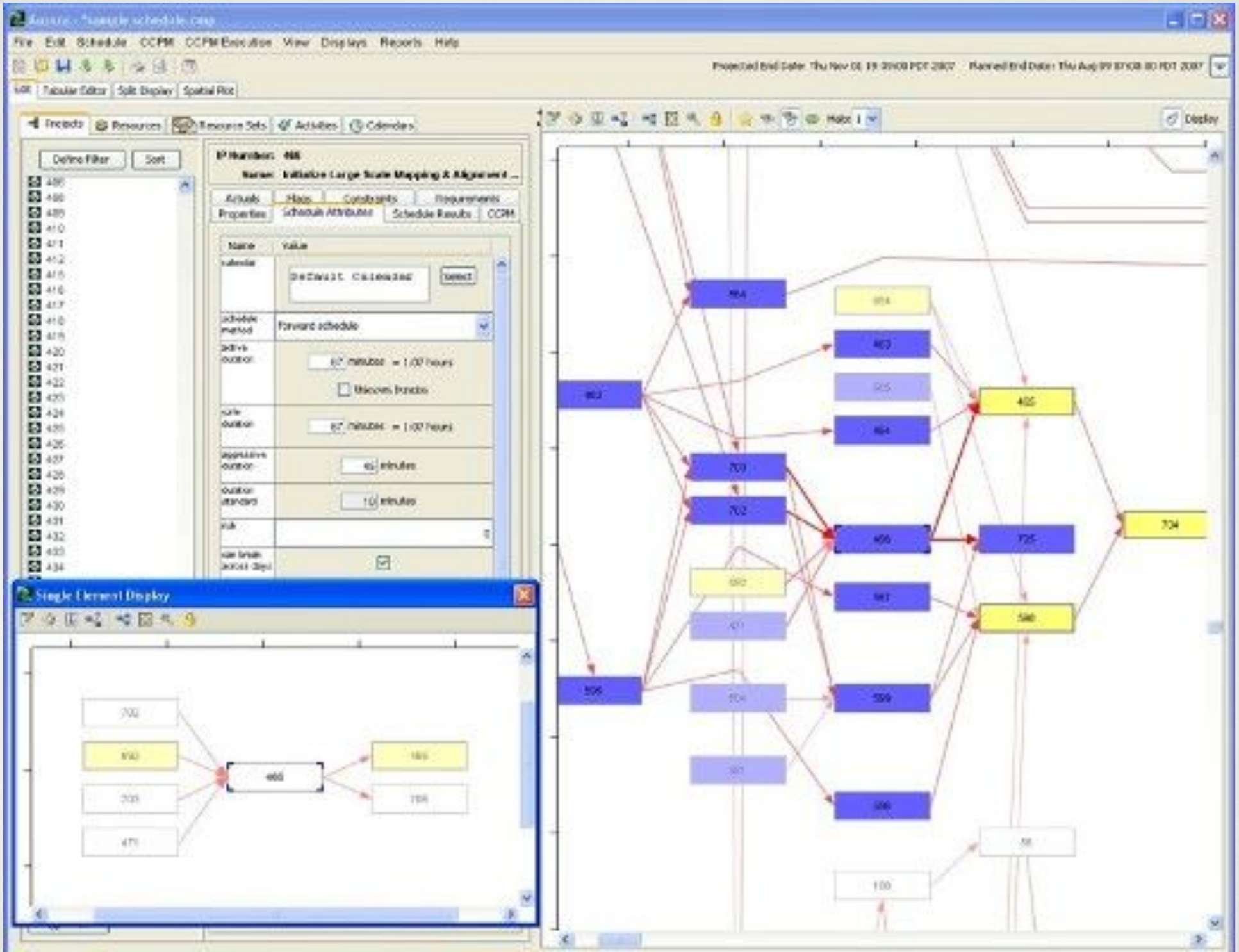
SPLIT VIEW SHOWING GANTT CHART SAME TIME SLICE AS HISTOGRAM, SHOWING ACTIVITIES CONSTITUTING RESOURCE NEED FOR ONE TIME INSTANCE



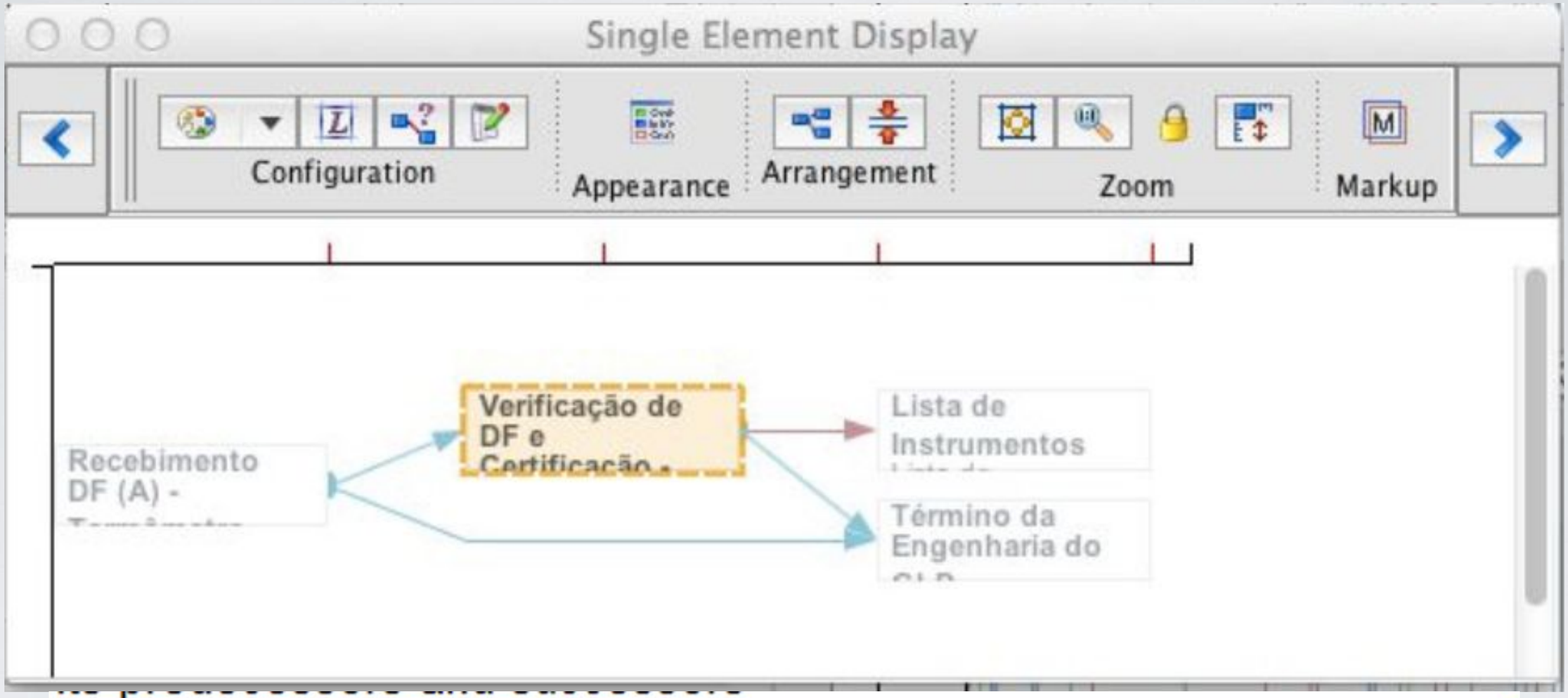
NETWORK DIAGRAM W/ MINI-MAP DISPLAY & SINGLE ELEMENT VIEW

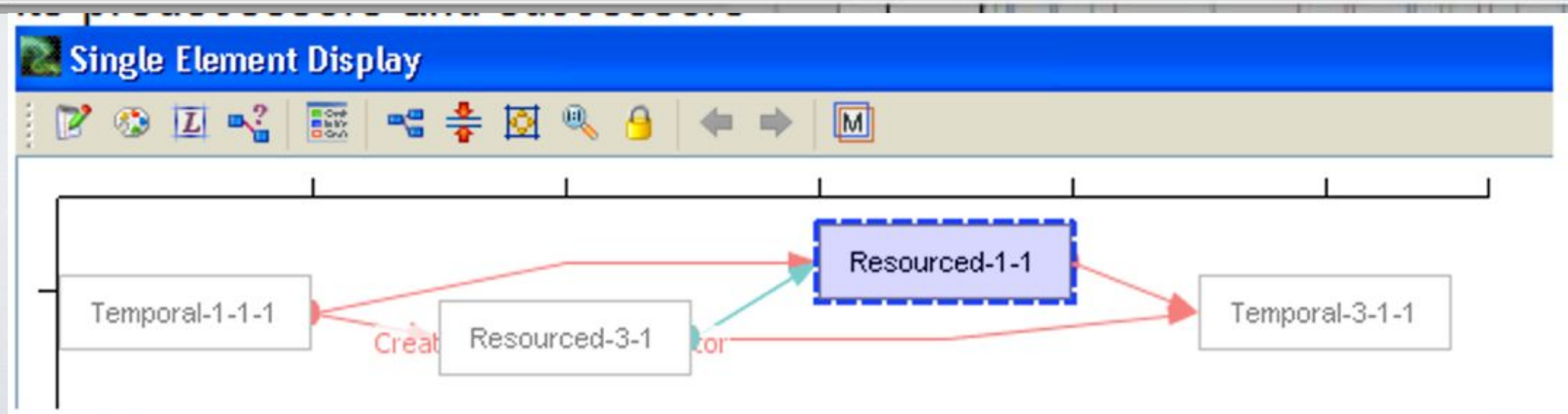


NETWORK DIAGRAM SHOWING SINGLE-ELEMENT VIEW OPTION

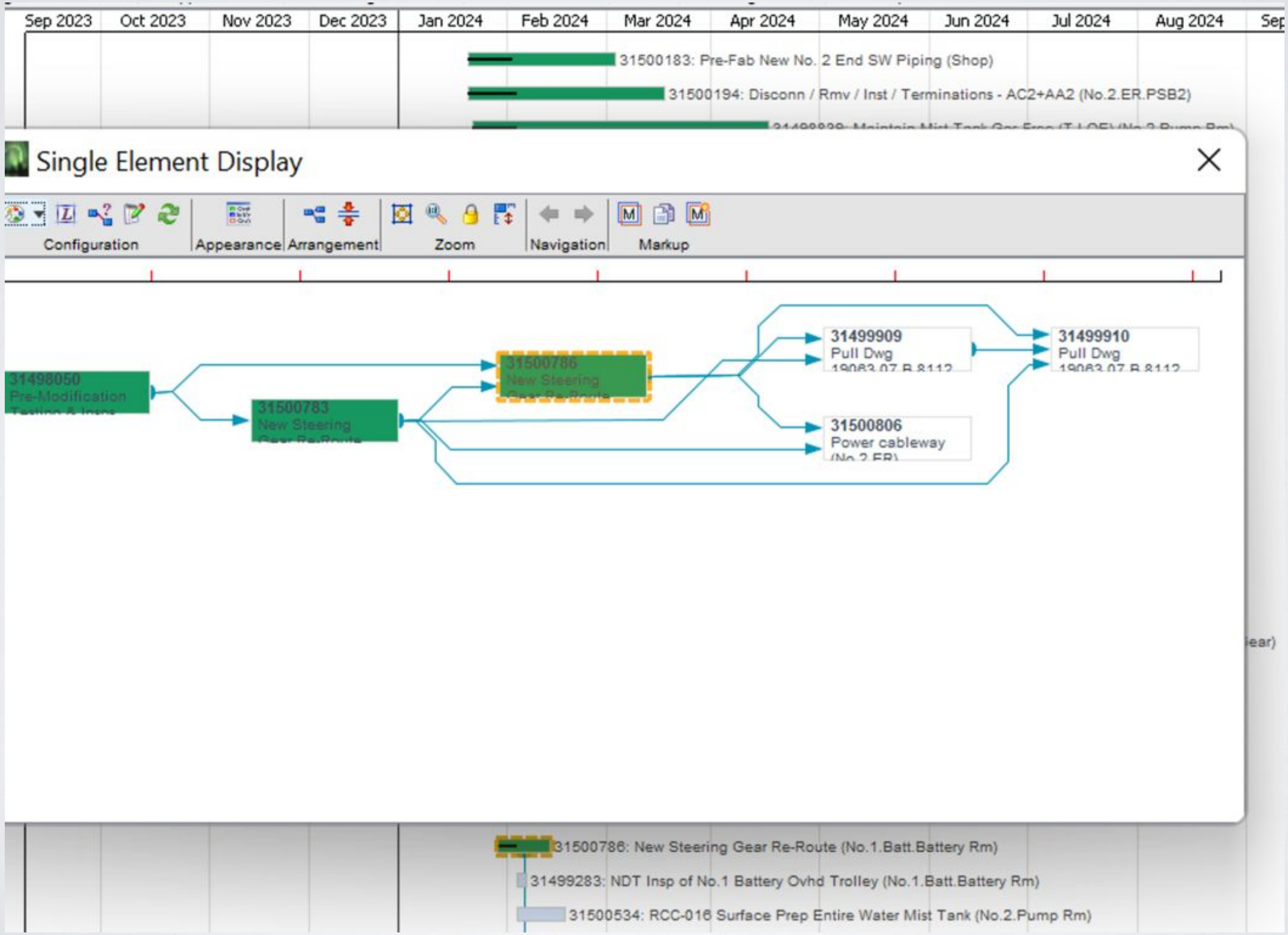


SINGLE ELEMENT DISPLAY

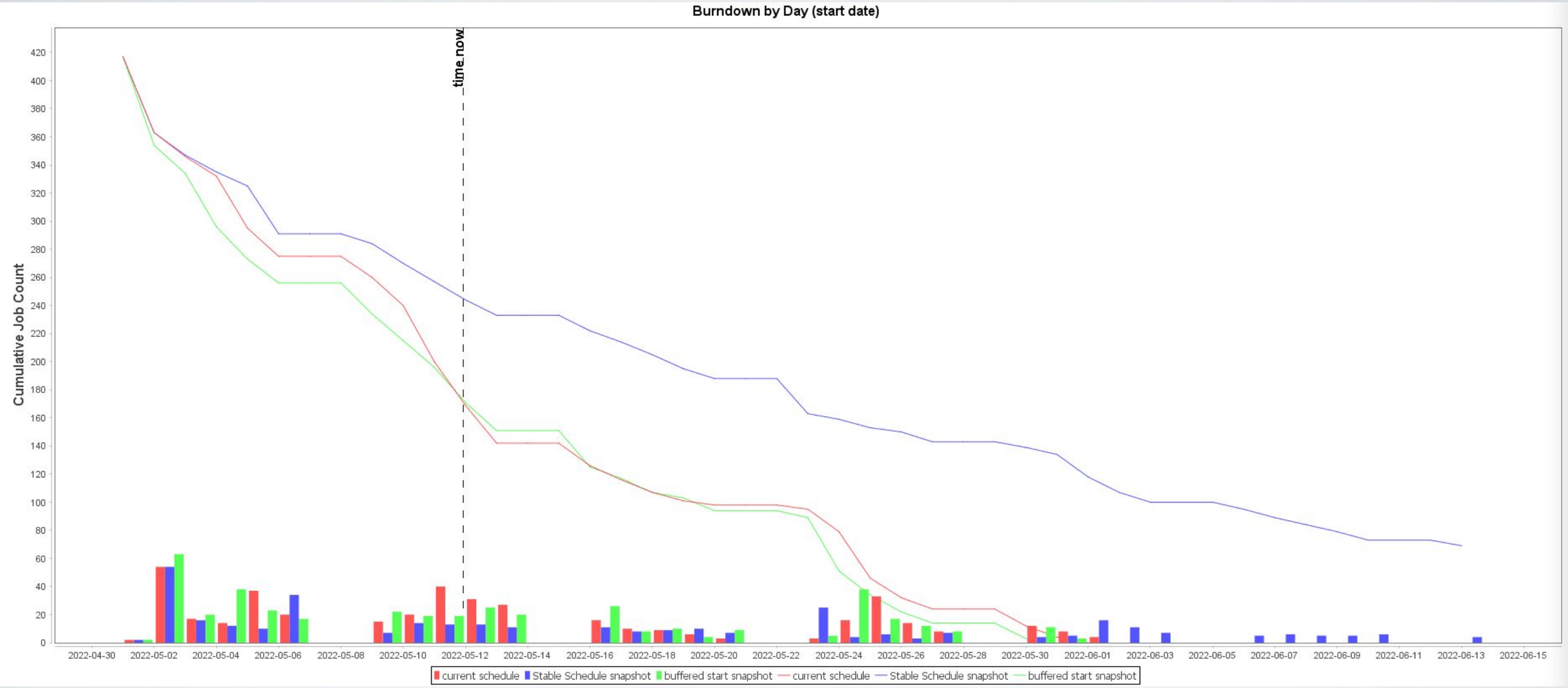




SINGLE ELEMENT DISPLAY FROM GANTT CHART



BURNDOWN CHART



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

LESSONS & RESULTS

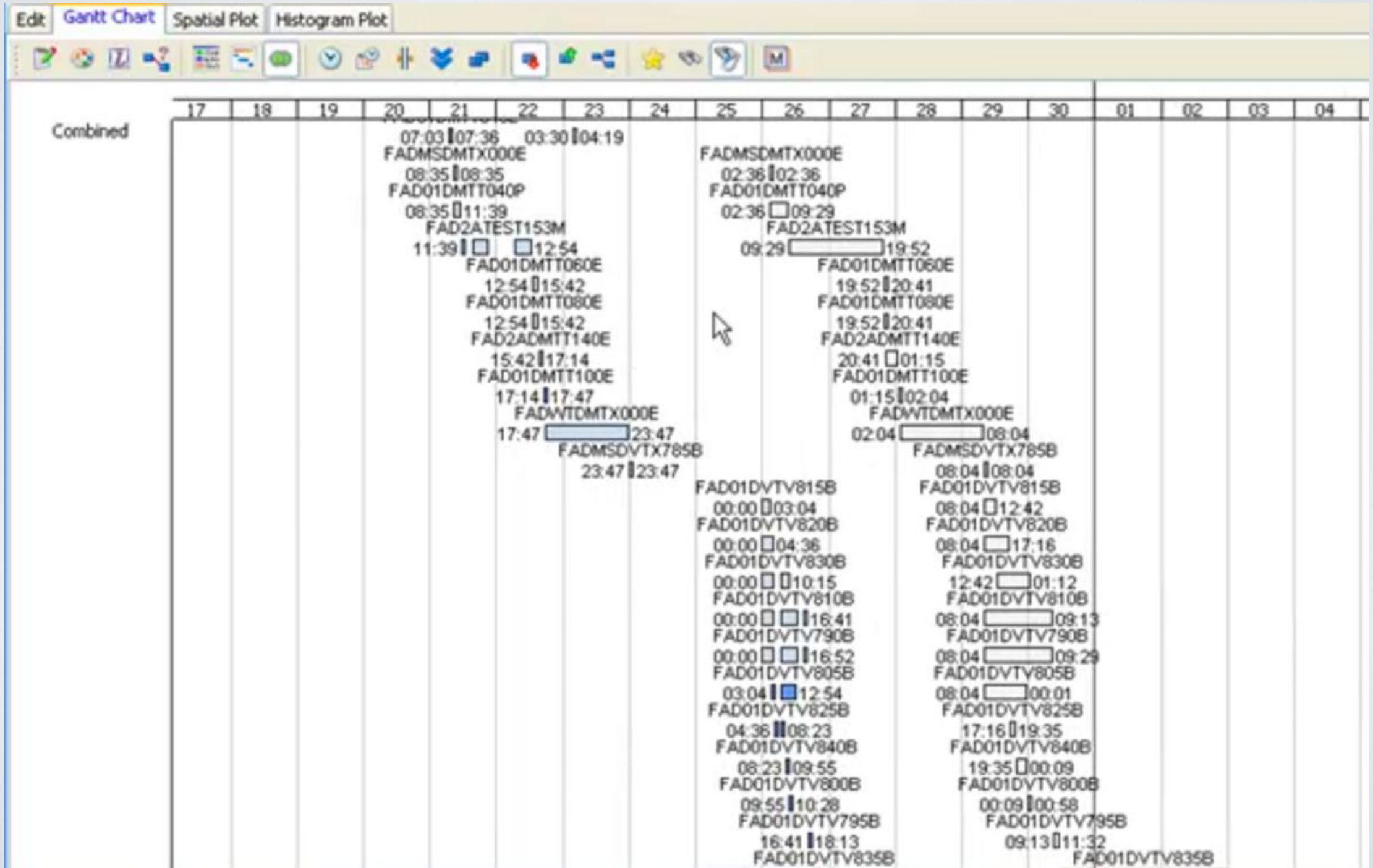
- Project models require more real-world constraints
  - Significant productivity lost due to inferior model details
- Learn from the human schedulers
- Model to level of detail required
  - RDM & RDCPM
- Reveal & explain the schedule
- Easy & fast to perform scenarios / what-ifs
  - Results: Reduced 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



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
  - RDM & RDCPM
- Reveal & explain the schedule
- Easy & fast to perform scenarios / what-ifs
- Results: Reduced project duration & greater transparency

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.

QUESTION S?

CPM Construction Conference 2026

Rob Richards, PhD
Stottler Henke Associates, Inc.
Richards@StottlerHenke.com
www.AuroraScheduling.com

Stottler Henke