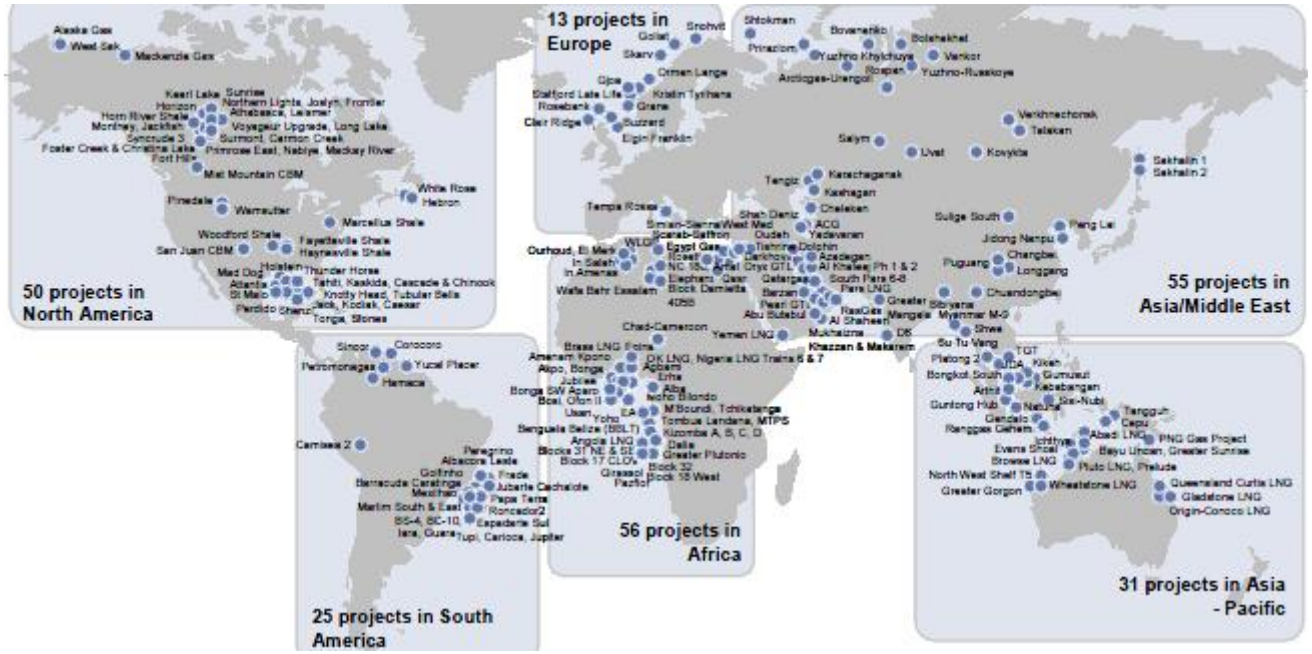
Decision Strategies

Project Derailed? Finding Timeline Drivers to Get Back on Track

DAAG, April 2010

Oil and gas projects all over the world are behind schedule and over budget.



Source: Global Energy, Goldman Sachs, Feb 2009

- A 2009 Goldman Sachs study of 230 large oil or gas projects found that many were significantly behind schedule.
- “[T]he average start-up delay has been 20 months, with a 135% cost increase."

Plant Construction Timeline Project

- This is a fictionalized version of a real project, which was executed in two weeks.
- Plant was within a year of operation-readiness.
- Growing concern that time lost due to a hurricane could not be made up.
- Possibility of $100k/day liquidated damages.
- Detailed timeline (>1000 tasks), with precedence information and point estimates of durations.

Developing the Model

- Replicated client's point-estimate timeline results in our Value Tools™ simulation platform.
  - We have VBA code to translate Primavera precedence data into Excel logic.
- Categorized the tasks into six activity classes.
  - Mechanical, Insulation, Instruments & Electrical, Tanks, Commissioning, and Miscellaneous
- Interviewed experts to develop costs and duration factors for each activity class.
  - Breaking them down to sub-classes as necessary.
  - Considering external uncertainties as necessary.

Interview Notes: I&E Time

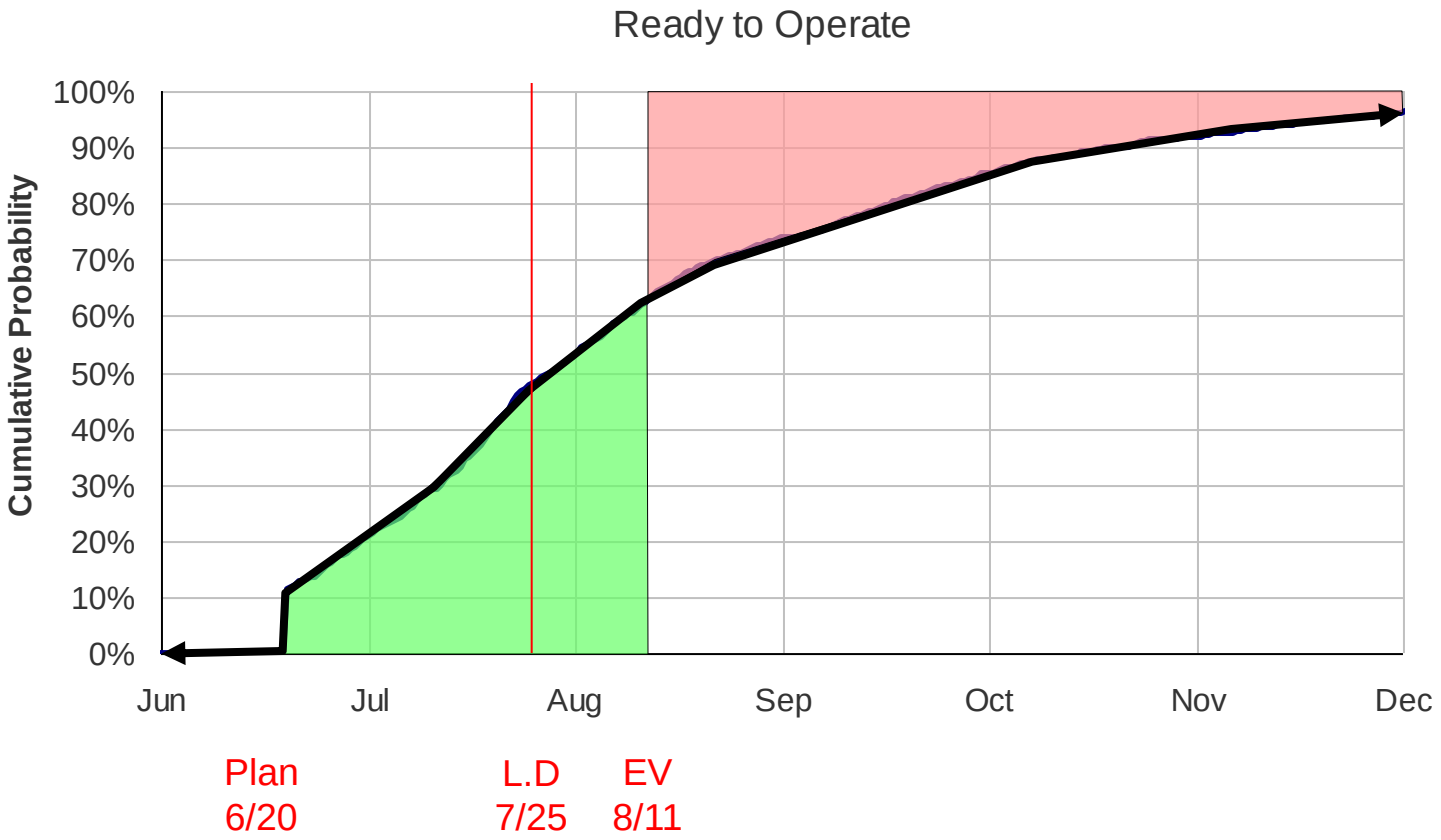
Experts: Expert A, Expert B, Expert C	**Dates**: 12/29, 12/31, 1/5
Definition: Duration for all I&E (instrumentation and electrical) tasks, relative to remaining duration in Dec 23 schedule	
Factors Making it Quick: • Continuing to work weekends • No significant rain or flood • High quality installation - no rework • Better supervision & QA/QC • Doing termination work during rainouts	**Factors Making It Slow**: • Rainy weather • Rework of poor quality installation • Lack of skilled labor at primary contractor • Delivery of hurricane-delayed cables • Rework of problematic engineering design

	Quick	Slow
Outdoor I&E	100%	150%
Indoor I&E	100%	120%

Sub-categorization like this led to 18 activity classes.

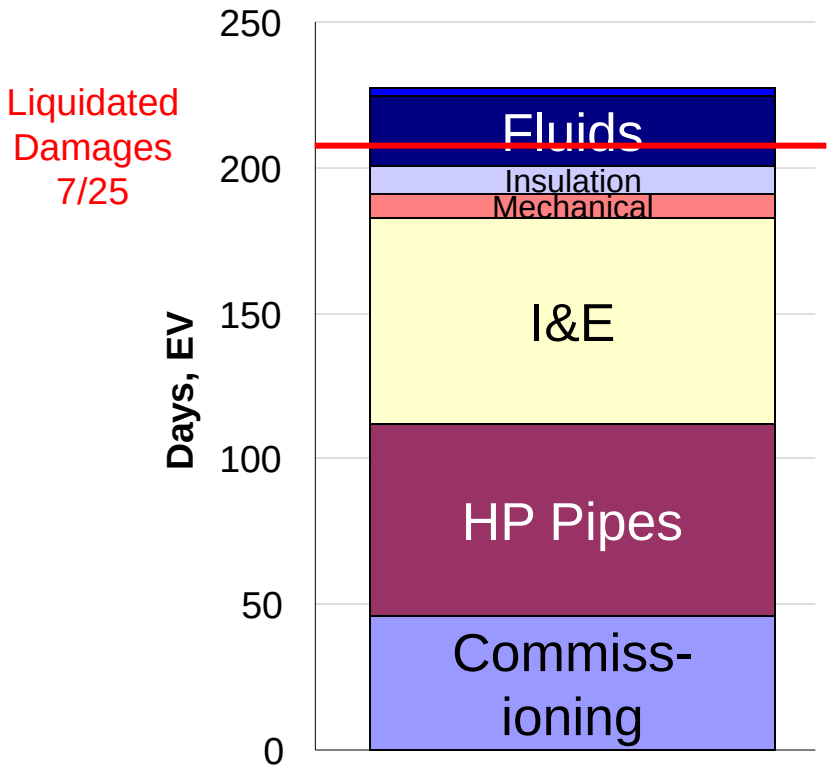
Per-day costs are handled similarly.

There was a 50% chance that the project would incur liquidated damages.



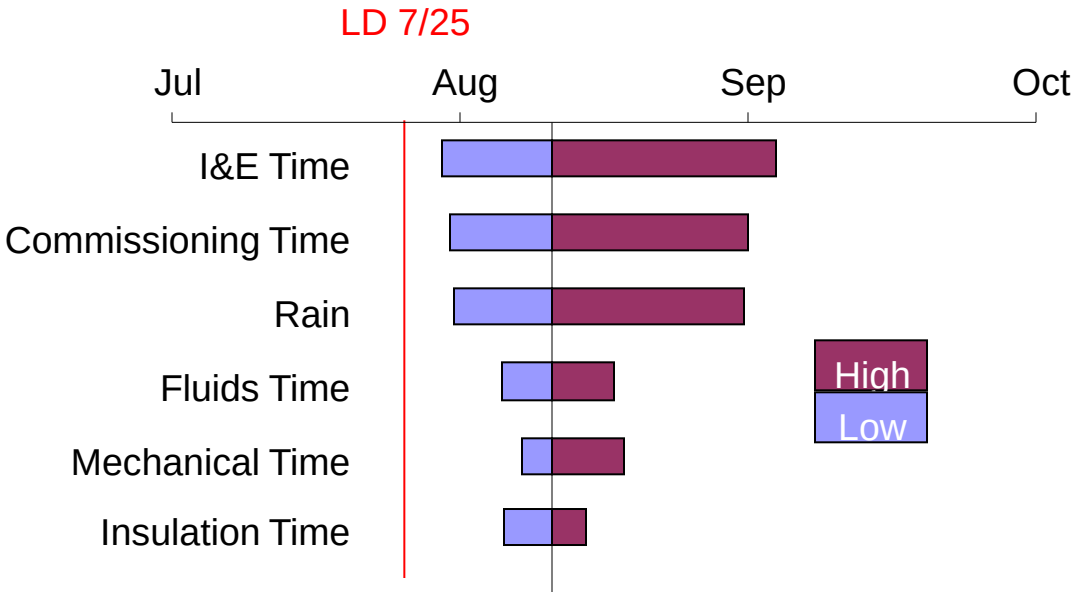
In this analysis, we explore what drives the EV (average) RTO date;
i.e. the date for which green upside and red downside have the same area.

Components of the EV Critical Path



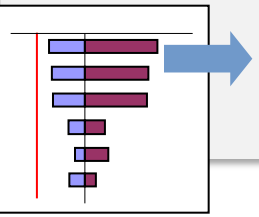
- This critical path decomposition shows how much of the average critical path duration is contributed by each activity class.
- On average, client will incur almost three weeks of liquidated damages.
- Commissioning, HP Pipes, I&E, and Fluids tasks comprise most of the remaining critical path.

Tornado Diagram showing the impact of each uncertainty on readiness date.



Dozens of factors were analyzed. Only the ones with a material impact are shown here.

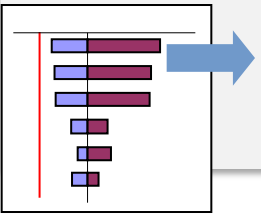
- The biggest opportunities for improvement are I&E and Commissioning.
- Even though Mechanical and Insulation tasks comprise a tiny portion of critical path, these are areas where uncertainty, or interventions, can make a material difference.
- Conversely, while HP Piping tasks constitute a large portion of the remaining critical path, there is little opportunity for them to be accelerated.



Review interview notes from important factors to identify interventions: I&E Time

Experts: Expert A, Expert B, Expert C	**Dates**: 12/29, 12/31, 1/5
Definition: Duration for all I&E (instrumentation and electrical) tasks, relative to remaining duration in Dec 23 schedule	
Factors Making it Quick: • Continuing to work weekends • No significant rain or flood • High quality installation - no rework • Better supervision & QA/QC • Doing termination work during rainouts	**Factors Making It Slow**: • Rainy weather • Rework of poor quality installation • Lack of skilled labor at primary contractor • Delivery of hurricane-delayed cables • Rework of problematic engineering design

	Quick	Slow
Outdoor I&E	100%	150%
Indoor I&E	100%	120%

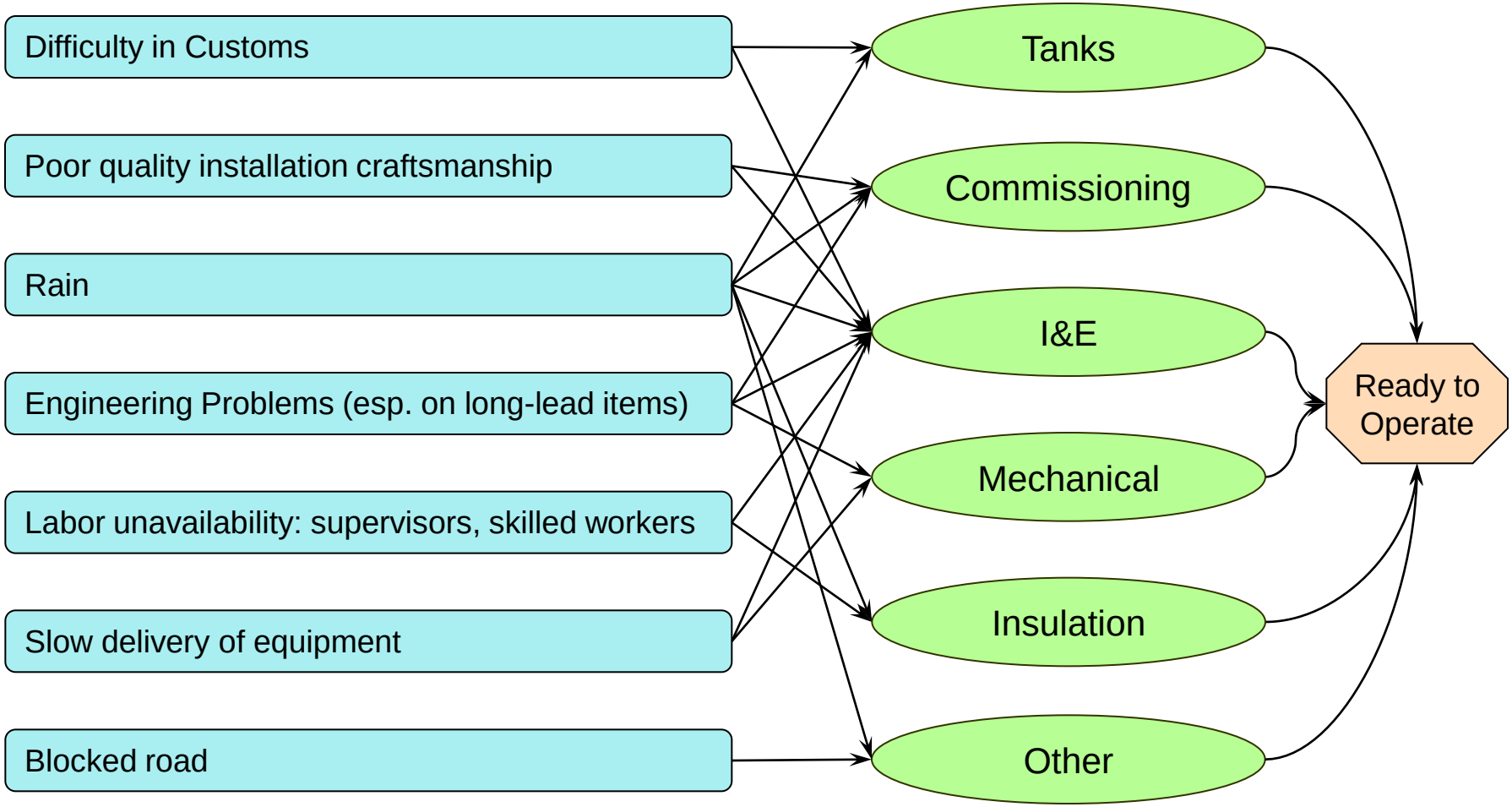


Review interview notes from important factors to identify interventions: Commissioning Time

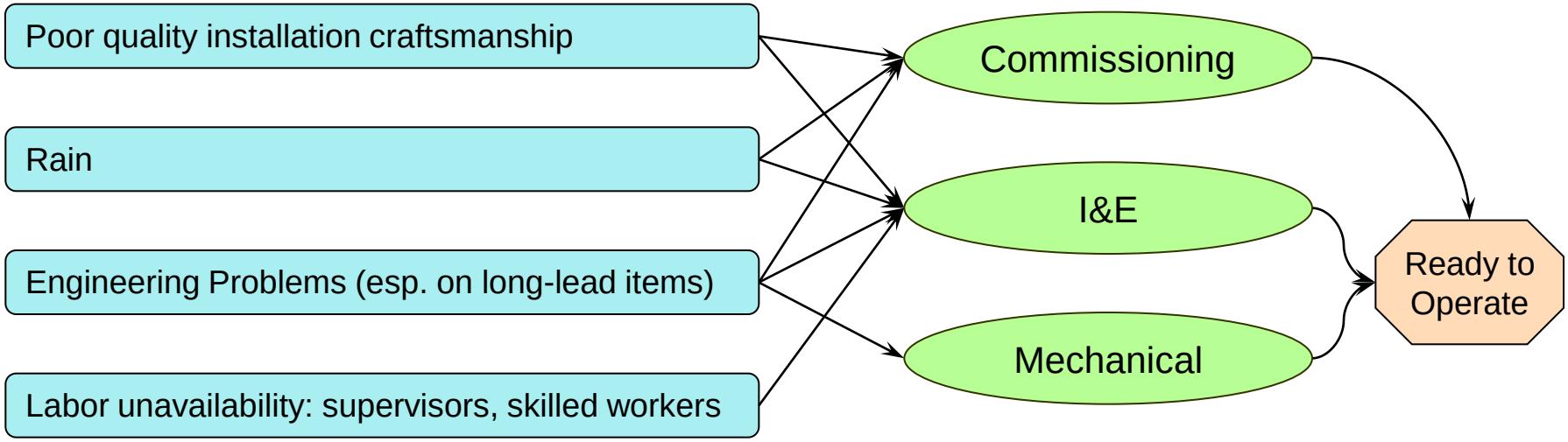
Experts: Expert A, Expert B, Expert C	**Dates**: 12/29, 1/6
Definition: Duration for all commissioning tasks, relative to remaining duration in 12/23 schedule	
Discussion: • These estimate include making up for rain on the weekends, and some night work. • Schedule includes seven days to review each system; we cannot afford this for each subsystem. • The engineering has been accepted by the Client, but the interface to controls often fails.	
Factors Making it Quick: • Procurement expeditor on site • Joint walk-down prior to handoff • Additional trained LNG supervisors • Blow down HP pipes immediately after testing • Fewer rain-outs • Tighter interface between engineering, construction, and commissioning	**Factors Making It Slow**: • Slow procurement of replacement parts • Cleaning up documentation before handoff • More rain • Limited interaction with construction • Unrealistic commissioning procedures • Corrosion damage from delay due to hurricane

	Quick	Slow
Commissioning	100%	200%

Expert interviews identified many factors that influence project duration.



Tornado diagram told us which of these we should focus on.

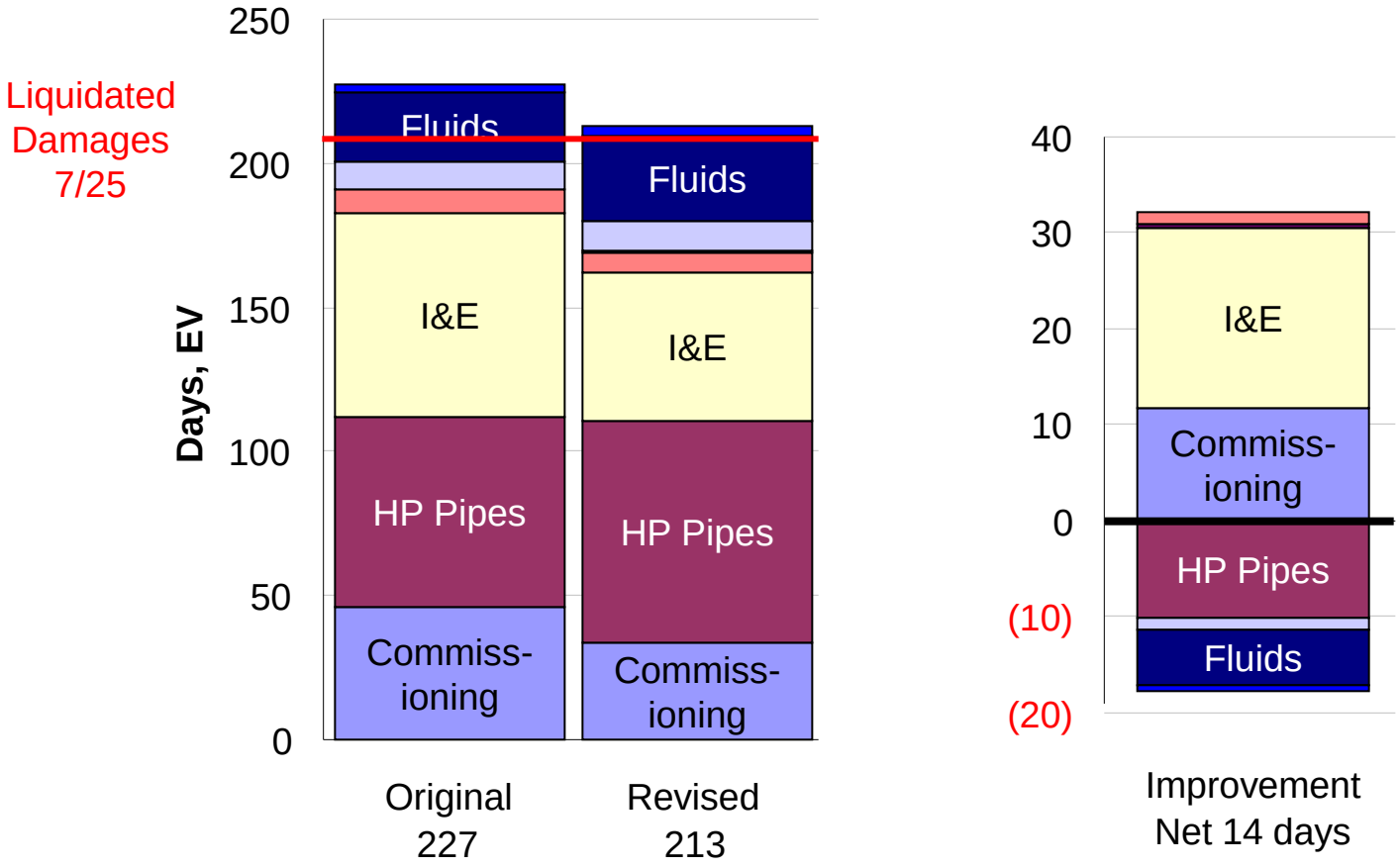


This sparked ideas for a Revised Plan.

- Add trained staff to expedite these areas: QA/QC, commissioning, construction, and procurement.
- Supervisors to be onsite, to ensure proper installation.
- Joint construction & commissioning walk-down at handoff.

- This adds 10% to the per-day cost of commissioning, mechanical and I&E, but reduces delays.
- Is it worthwhile?

Revised Plan can shave two weeks off the schedule, based on reduced time in I&E and commissioning.

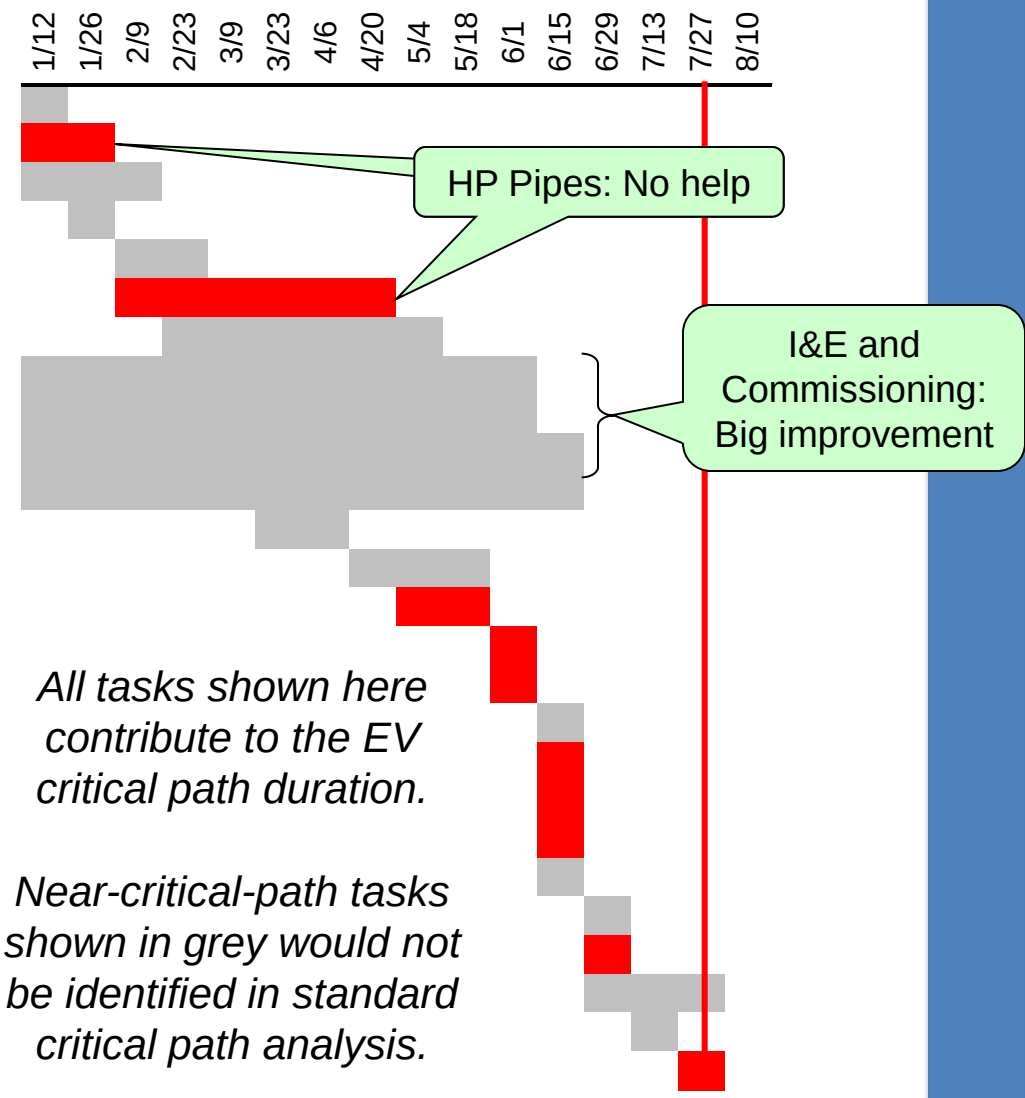


Due to parallel near-critical paths, an improvement of over a month to the targeted activity classes nets only 14 days overall.

Revised Plan improves average duration, even though it increases the criticality of HP pipe tasks.

Task

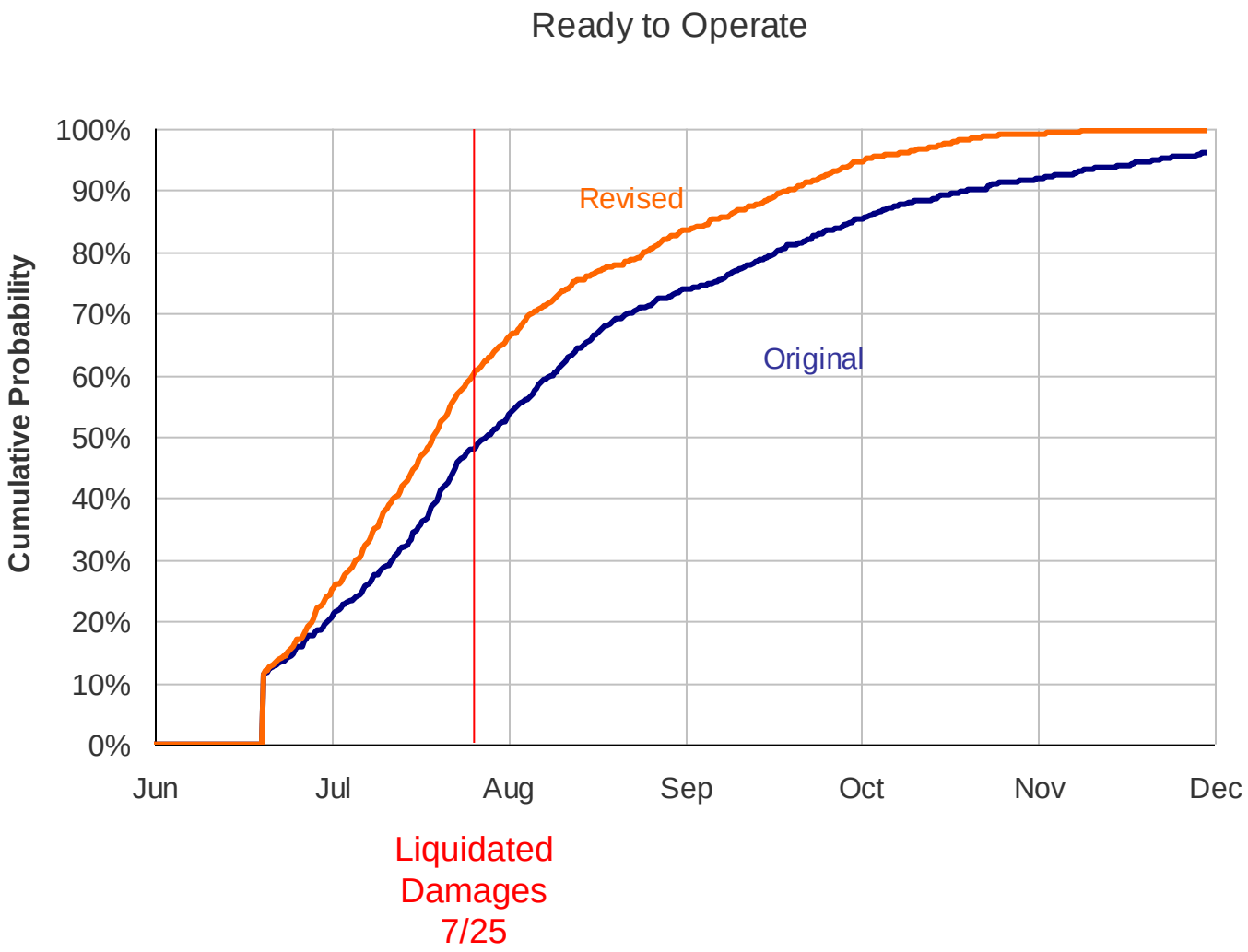
Mobilize Nitrogen Subcontractor
Fab & Receive HP Spools @ Area 311
Fab & Receive Spools @ Area 313
Install Temporary N2 Piping
Tank 1 Dry & Purge with N2
Install HP Spools A 311 SO Pumps
Install East SCV Spools A 313 Rack D
Inspect Water Bath- SCV's
Install Area 313 Instruments
Install Area 312 Instruments
Install Insulation
Tank 2 Dry & Purge N2
Tank 3 Dry & Purge N2
HP Test LNG A 311 Pipe SO Pumps SCV's
S.O. Pumps Header to SCV's 4012
Confirmation Air Blow Piping (HP Sendout)
Area 313 East SCVs
Tightness Test Piping (HP Send Out)
Re-Instate Piping (HP Send Out)
Inert Piping (HP Send Out)
Fill with Water - SCV's
Demobilize Tank 3 Jobsite
Introduce Export NG for dist. in Cold FG header
Function Test Instruments - SCV's
Run Air Blower and Adjust Air Flows
Test Burners on Minimum Fire



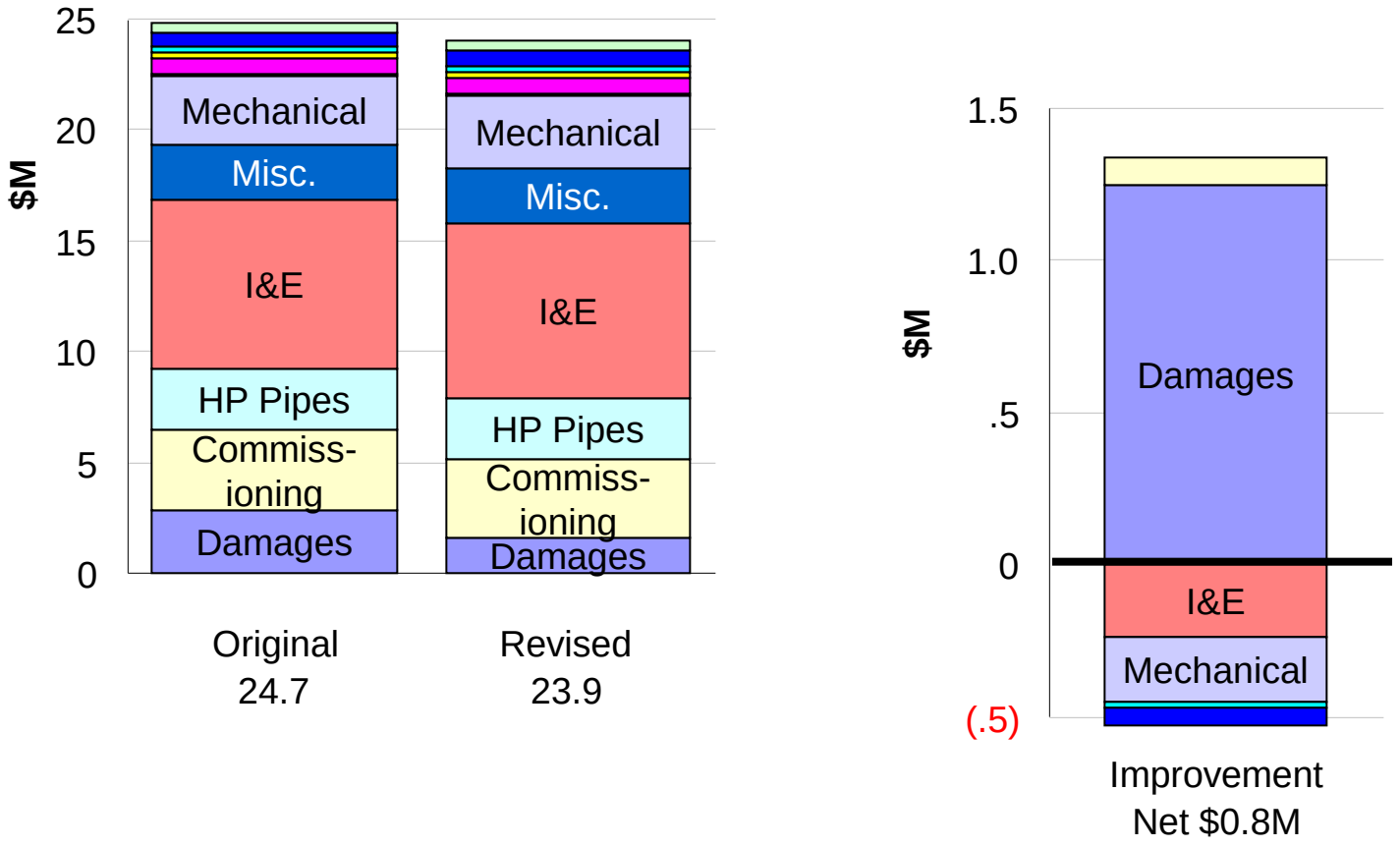
All tasks shown here contribute to the EV critical path duration.

Near-critical-path tasks shown in grey would not be identified in standard critical path analysis.

The Revised Plan is particularly useful past the liquidated damages date.

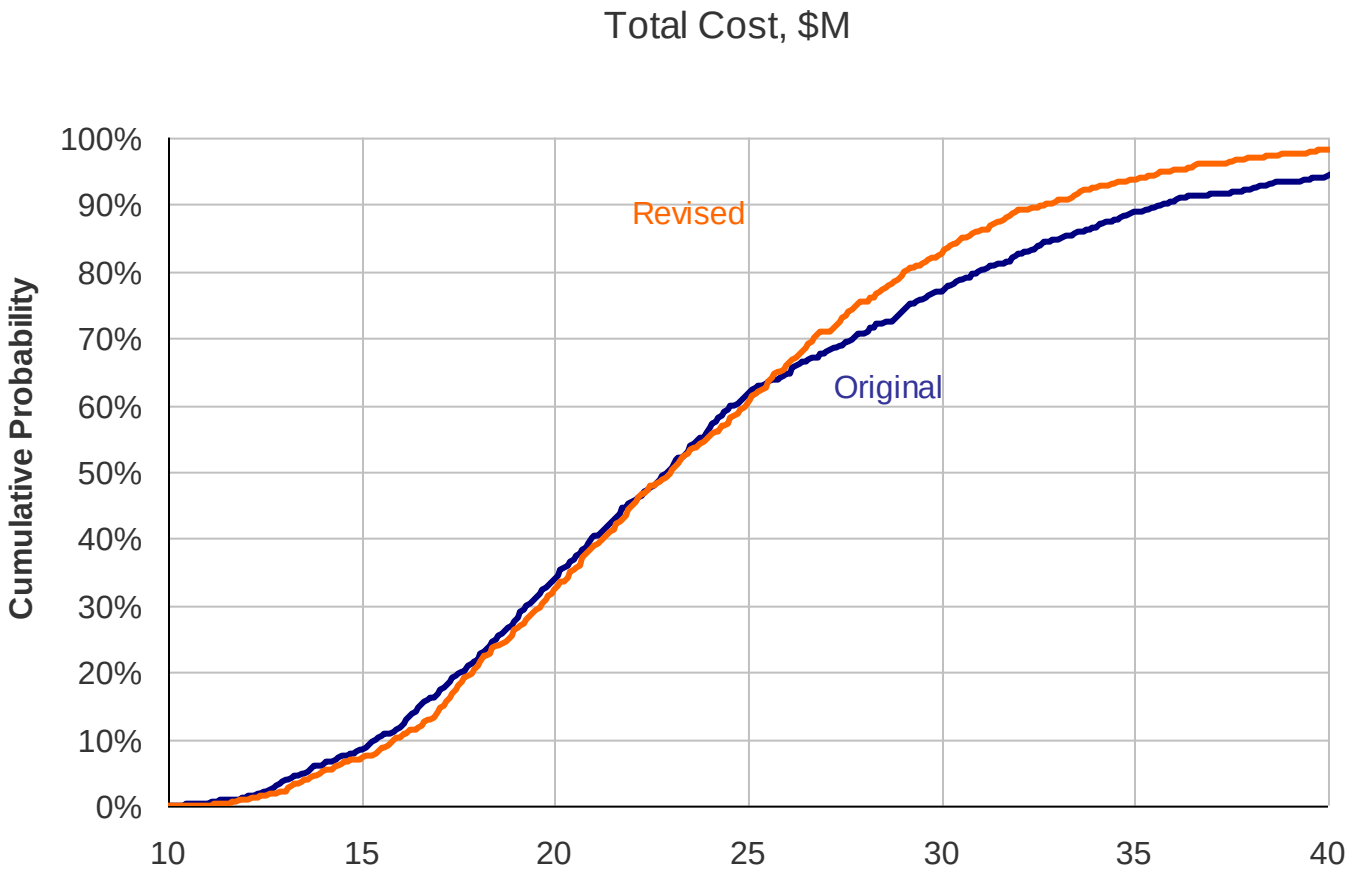


Revised Plan reduces liquidated damages, while increasing other costs ($M, EV).

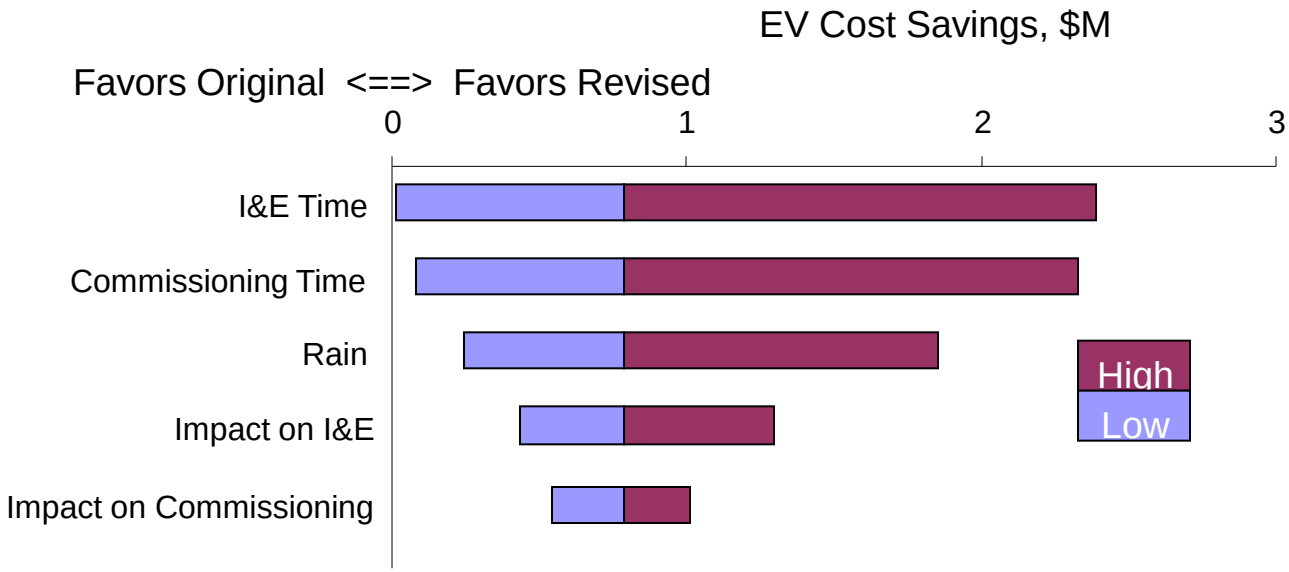


- Improvement to commissioning duration paid for its additional cost intensity.

Revised Plan costs less than Original, especially in unfavorable cases.



Further investigation is not likely to reverse the choice of the Revised Plan.



- No single variable can make the Original Plan look more favorable than Revised Plan.
- If we learn the problem is less severe, the benefit of Revised Plan is reduced to near zero.

Reflections

1. Defining activity classes and assessing their duration factors and daily costs captures expertise quickly and effectively.
2. Documenting driving factors in expert interviews improves information quality and suggests interventions.
3. Sensitivity analysis (tornado diagram) of critical path duration shows which factors merit intervention.
4. Decomposition of critical path duration identifies near-critical-path tasks, and shows how they affect total duration.
5. A timeline model can be extended for economic analysis.