

Modeling how Project Managers Typically React to Schedule Overruns: Conditional Branching

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- Hulett & Associates, LLC Risk Management Consultants in Los Angeles CA for 30 years
- Spearheading new concepts in quantitative cost and schedule risk analysis, advising Monte Carlo simulation software companies
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- Something You Don't Know About Me: I sang the "Pish Tush" character in the Mikado in High School

- Intaver Institute, (est. 2002), Calgary, Alberta
- A&D, Engineering, Healthcare, Construction
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- There is an issue using Simulation of a CPM schedule – Stay with the Plan
- But Project Managers can React to Schedule Overruns
- Probabilistic and Conditional Branches Illustrated
- Case Study, Offshore Gas Production Platform, Project Risks
- Describe Plan A (Base Plan) and Plan B (if Detailed Engineering is late)
- Results
 - No Branching – Stay with the Base Plan
 - Conditional Branching if Engineering is 2 months late
 - Conditional Branching to give Plan A a 50% likelihood
 - Conditional Branching requiring Engineering to be on time as scheduled
- Conclusions

- The CPM schedule represents the plan at a point in time
- But, simulating the schedule / plan implies that the project manager follows the same plan without regard to how it is going
- It is reasonable to believe that project managers would react to schedule delays early on and change the plan in response to a delay
 - Experienced project managers state that the PM will react predictably to schedule delays by adding resources with the intent to shorten later tasks, trying to keep the project on schedule
- Conditional branching can model this decision during simulation, changing the plan in each iteration of the Monte Carlo simulation based on schedule events

- Project owners, contractors and managers often react to prospective schedule overruns by adding resources to try to make up time
 - This behavior leads to more cost overruns as it moderates (hopefully reverses) the schedule overruns
 - Projects that are schedule-driven will experience this pressure more acutely as the owners of the finished project have been promised a date
- For NASA, promises made to Congress include estimates of both time and money but schedule is increasingly important
 - Any serious delay jeopardizes the relationship with Congressional committees by either overrunning the schedule, descoping the final product or both.

- Typically, analysts model the current plan as if the manager will not react if the schedule is jeopardized. This is not realistic.
- Unless this event can seamlessly be translated to a schedule overrun without penalty, management can be expected to react to recover schedule
- Conditional Branching can represent the project manager's response to a schedule event such as the detailed engineering's finishing later than anticipated
 - Leading ultimately to a delayed finish date if the current plan is followed
 - Unless the plan is changed
 - What is the alternative plan (Plan B) and what is the trigger event to call on it?

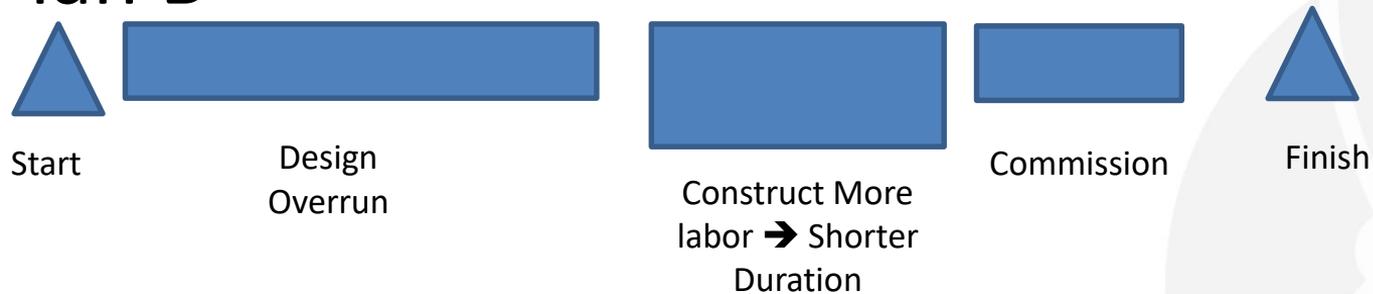
- Probabilistic branching in a Monte Carlo simulation means that some event happens according to a “coin toss” with some pre-set probability of landing “heads”
 - The successor occurs or not depending on that coin toss
- Conditional branching models some event or activities’ happening depending on a schedule event such as engineering being late
 - The successor is chosen depending on a schedule event’s (trigger) occurring on each iteration
- For Instance, engineering being late affects the final delivery date, unless the project manager can add resources to shorten execution

- The typical use of conditional branching is to decide when to switch to PLAN B, when is PLAN A to be abandoned
 - The project plan is PLAN A
- If an early critical activity is late enough to cause the finish date to be unacceptable to the client, we need to switch to PLAN B
 - An alternative is PLAN B, which has an added resources leading to a shorter execution phase
- The shortening of execution activities is caused by applying more resources. Productivity is not linear.
- How much the duration will shorten, or how many additional resources are needed, is planned by the project management

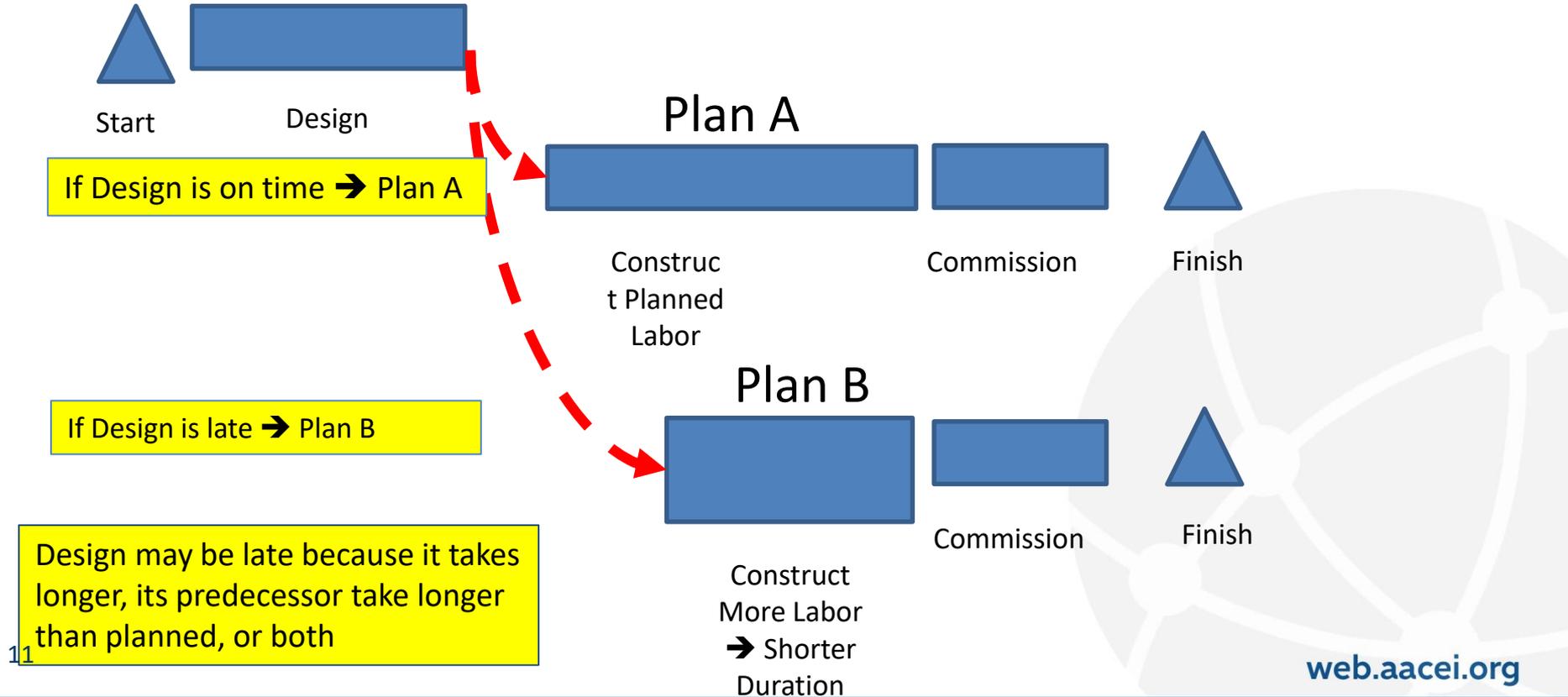
Plan A

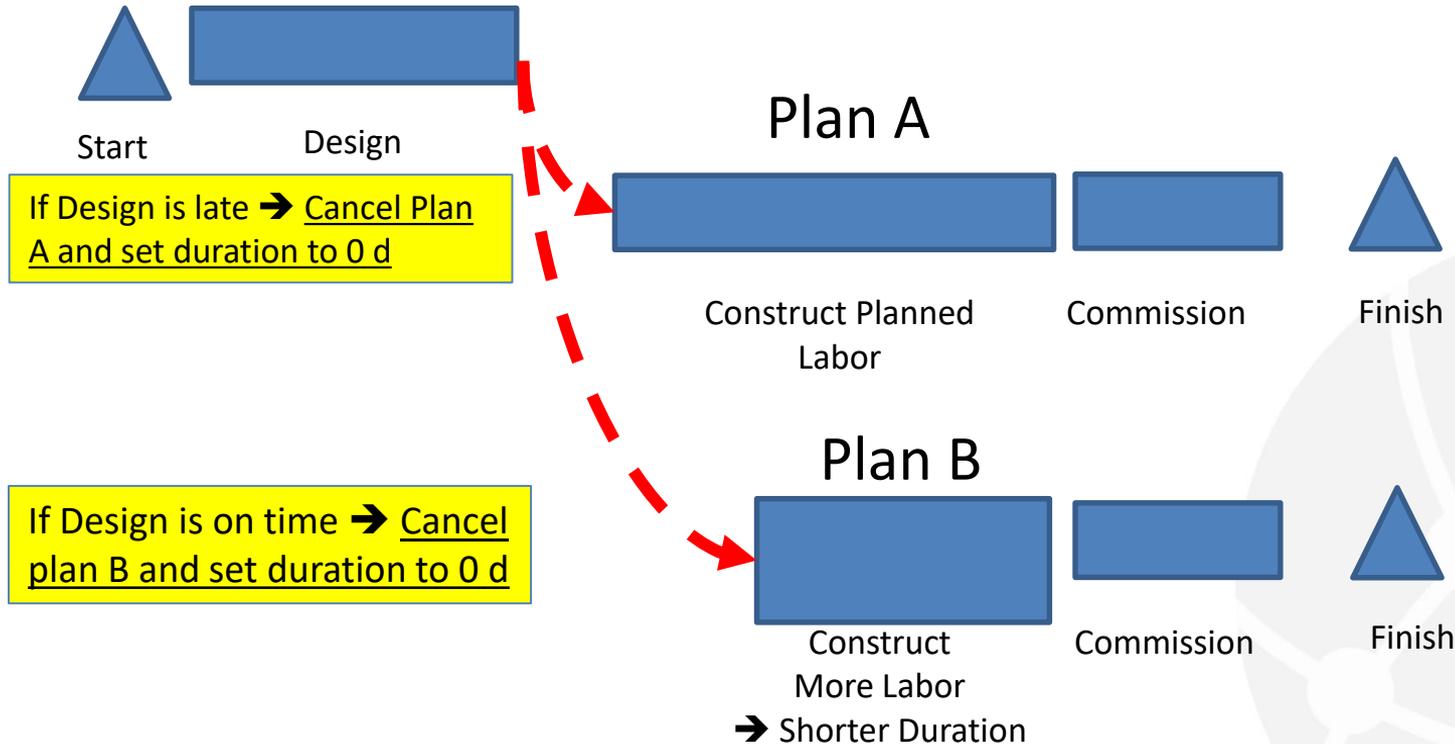


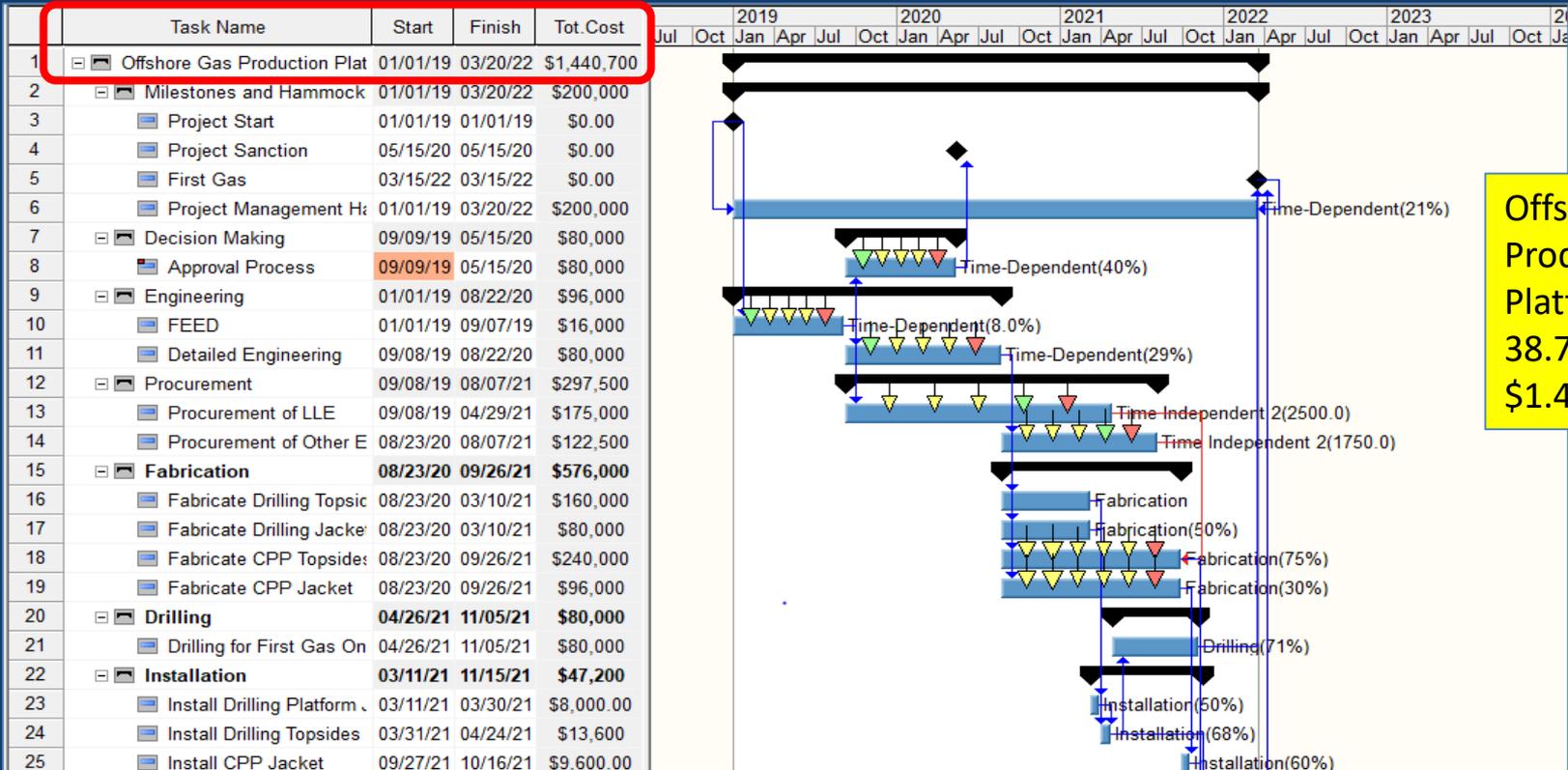
Plan B



It is a challenge to determine how much more labor and other resources would offset the delay in Design. In particular, one should not assume that the productivity of the added labor would be as high as the standard labor loaded in Plan A







Offshore Gas
Production
Platform. Base:
38.7 months
\$1.44 billion

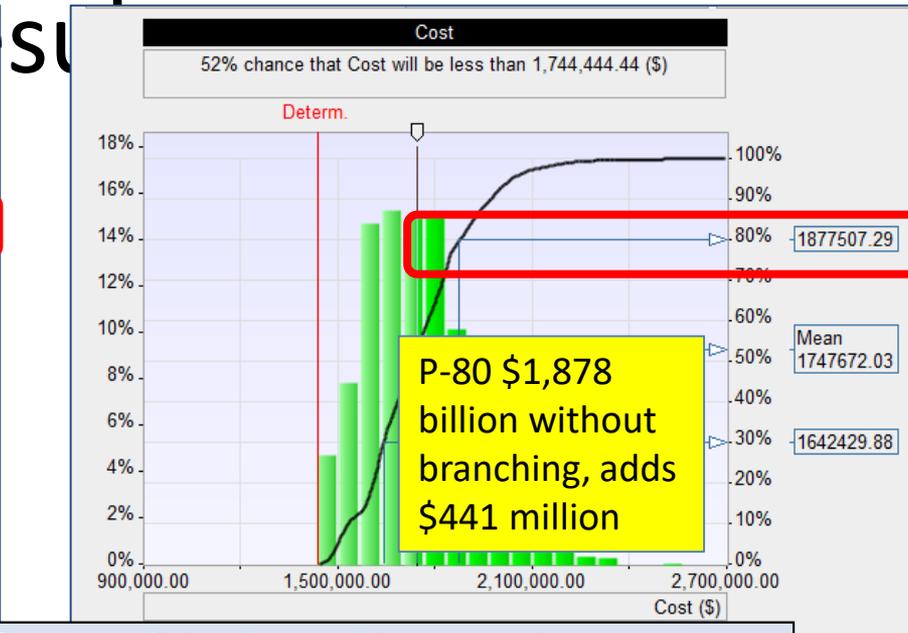
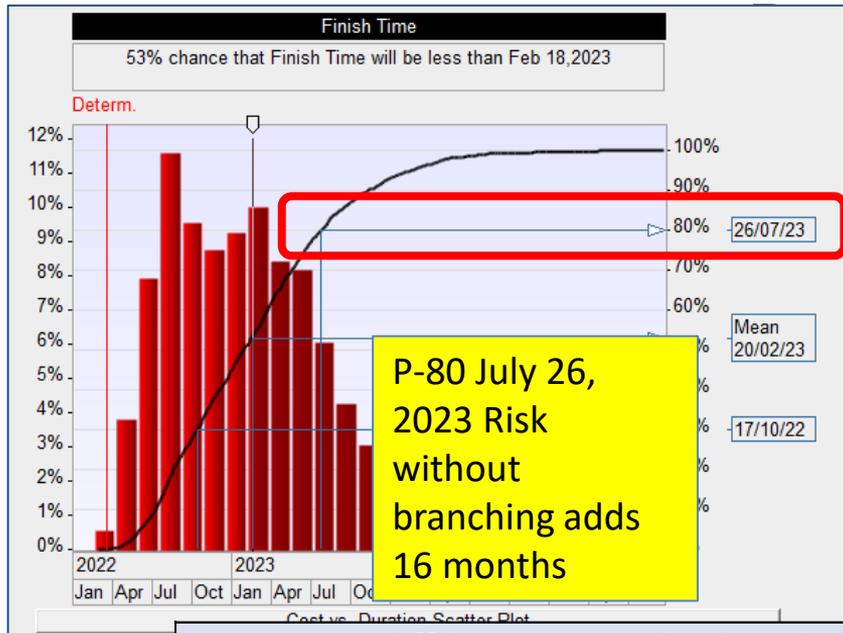
Offshore Gas Production Platform Conditional Branching Scenarios

	Scheduled Finish Date	Scheduled Total Cost (M)
Base Case, Deterministic	20-Mar-22	\$1,441

Using Risky Project software from Intaver Institute

Risk Name
⚠ Bids may be abusive leading to delayed approval
⚠ Engineering may be complicated by using offshore design firm
⚠ Fabrication and installation problems may be revealed during HUC
⚠ Fabrication yards may experience different productivity than planned_1
⚠ Installation is complex and maybe challenging to the shipyard
⚠ Megaproject may have coordination problems with offshore sourcing
⚠ Megaproject may have excessive schedule pressure
⚠ Megaproject may have interdependency problems
⚠ Suppliers of installed equipment may be busy
⚠ The organization has other priority projects so personnel and funding may be unavailable
⚠ The subsea geological conditions may be different than expected

Stay with Plan A. No Branching, Risk



Offshore Gas Production Platform Conditional Branching Scenarios

	Scheduled Finish Date	Scheduled Total Cost (M)	
Base Case, Deterministic	20-Mar-22	\$1,441	
Branching Scenarios	P-80 Finish Date	P-80 Total Cost (M)	% Plan B
Base Case Base Plan A Only, No Plan B			
Stay with Base Plan A throughout	26-Jul-23	\$1,878	0 %

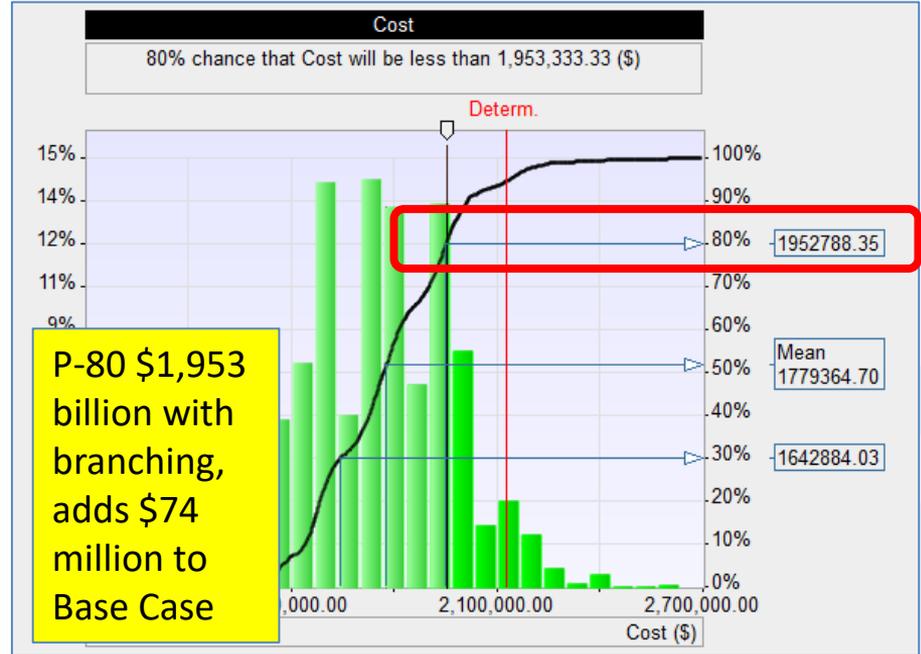
- Focus on Detailed Engineering since it is always critical and is a predecessor of Fabrication of Jackets and Topsides and of some Procurement (but not Long Lead Procurement), the Execution phase
- This may be the bell-weather of the project's success
 - Detailed Engineering finish date is determined by the risk of decision-making and FEED as well as Detailed Engineering
 - What is left is Fabrication (11 months) and Installation and Hook-up and Commissioning (about 7 months of this 38-month project). Catch it at Fabrication or lose the opportunity
- The status of the program at Detailed Engineering may be a good time to determine if we use Plan B on Execution to try to claw back some schedule

- Plan B involves the Fabrication phase
 - Fabricate Drilling Platform Jacket and Topsides
 - Fabricate Central Processing Plant (CPP) Jacket and Topsides
- Implement Plan B at the end of Detailed Engineering / beginning of Fabrication
- Take a bold step to change directions
 - Do not wait until the 1-year Fabrication phase starts, it will be too late to negotiate, for a price, accelerated fabrication with suppliers
 - It is too late to make up a lot of time during Installation and HUC

- Deterministic effect on Fabrication activities:
 - Plan B cuts 20 days off of the Fabrication duration 285 wd vs 265 wd for a 7% duration savings
 - Plan B adds \$114 million to the Fabrication activities, \$690 million vs \$576 million for a 20% cost increase
- It is normal that an accelerated plan will cost more than proportionate to the duration savings compared to the base plan
 - More labor is involved but added labor is not expected to be as productive as planned labor, cost is not linear with time savings
- Typical extra costs
 - Added labor hours, more days or shifts to accommodate these
 - Expedited material and equipment delivery
 - Premium paid to suppliers to “jump the line” to get higher priority

- Detailed Engineering is planned to finish August 22, 2020
- Conditional Branch: Give Detailed engineering another 2 months to finish.
- If Detailed Engineering is finished on or before October 22, 2020 then continue with Plan A
- Otherwise, pull the trigger, adopt Plan B

Name:		Detailed Engineering			
	ID	Successor name	Condition	Value	Action
1	14	Procurement of Other Equipment			
2	16	Start Plan A	If Finish Time >	10/22/20 00:00	Cancel and set duration to zero
3	22	Start Plan b	If Finish Time <=	10/22/20 00:00	Cancel and set duration to zero



Offshore Gas Production Platform Conditional Branching Scenarios			
	Scheduled Finish Date	Scheduled Total Cost (M)	
Base Case, Deterministic	20-Mar-22	\$1,444	
Branching Scenarios	P-80 Finish Date	P-80 Total Cost (M)	% Plan B
Base Case Base Plan A Only, No Plan B			
Stay with Basel Plan A throughout	26-Jul-23	\$1,878	0%
Trigger Date for Conditional Branch if Detailed Engineering finishes > 10/22/20			
If Detailed Engineering > 2 months late	15-May-23	\$1953	73%

Plan B saves 2 ½ months

- Detailed Engineering finished beyond October 22, 2020 in 73% of the iterations
- The project was able to stick to the base Plan A 27% of the iterations
- This project will need to change directions whenever the schedule is delayed at the early phase, Plan B is 73% likely to occur
- Is it worth \$74 million to save 2 ½ months?
- Given this information the project management might want to re-think their Base Plan

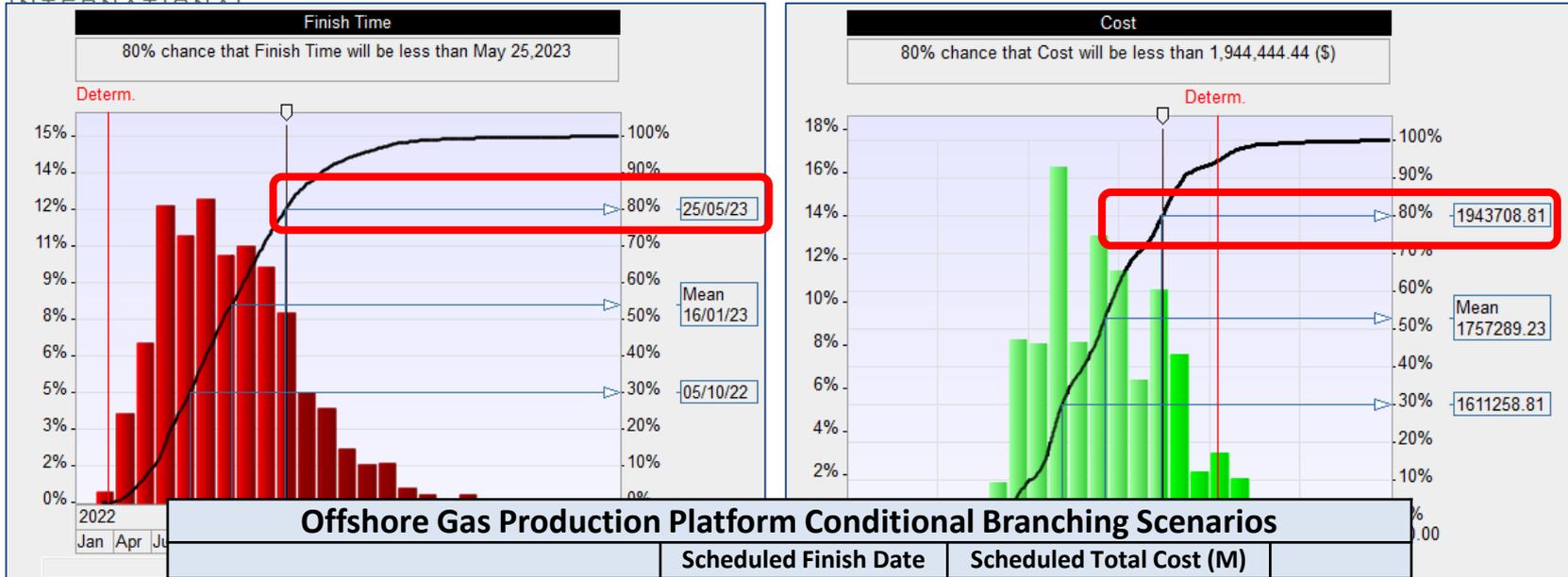
Task Name	Success	
1	Offshore Gas Production Platform	
2	Milestones and Hammocks	
3	Project Start	100.0%
4	Project Sanction	100.0%
5	First Gas	100.0%
6	Project Management Hammock	100.0%
7	Decision Making	
8	Approval Process	100.0%
9	Engineering	
10	FEED	100.0%
11	Detailed Engineering	100.0%
12	Procurement	
13	Procurement of LLE	100.0%
14	Procurement of Other Equipment	100.0%
15	Fabrication Plan A	
16	Start Plan A	27.0%
17	Fabricate Drilling Topsides	27.0%
18	Fabricate Drilling Jacket	27.0%
19	Fabricate CPP Topsides	27.0%
20	Fabricate CPP Jacket	27.0%
21	Fabrication Plan B	
22	Start Plan b	73.0%
23	Fabricate Drilling Topsides	73.0%
24	Fabricate Drilling Jacket	73.0%
25	Fabricate CPP Topsides	73.0%
26	Fabricate CPP Jacket	73.0%
27	Drilling	
28	Drilling for First Gas Only	100.0%
29	Installation	
30	Install Drilling Platform Jacket	100.0%
31	Install Drilling Topsides	100.0%
32	Install CPP Jacket	100.0%
33	Install CPP Topsides	100.0%
34	HUC	
35	Hook UP and Commissioning for Fi	100.0%

- The Plan B trigger date for Detailed Engineering finish is January 13, 2021 vs October 22, 2020, adding 2 ¾ months to the trigger
- That occurs only 50% of the time vs. 73% of the time

ID	Successor name	Condition	Value	Action
14	Procurement of Other Equipment			
16	Start Plan A	If Finish Time >	01/13/21 00:00	Cancel and set duration to zero
22	Start Plan b	If Finish Time <=	01/13/21 00:00	Cancel and set duration to zero

	Task Name	Success
1	Offshore Gas Production Platform	
2	Milestones and Hammocks	
3	Project Start	100.0%
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5	First Gas	100.0%
6	Project Management Hammock	100.0%
7	Decision Making	
8	Approval Process	100.0%
9	Engineering	
10	FEED	100.0%
11	Detailed Engineering	100.0%
12	Procurement	
13	Procurement of LLE	100.0%
14	Procurement of Other Equipment	100.0%
15	Fabrication Plan A	
16	Start Plan A	50.0%
17	Fabricate Drilling Topsides	50.0%
18	Fabricate Drilling Jacket	50.0%
19	Fabricate CPP Topsides	50.0%
20	Fabricate CPP Jacket	50.0%
21	Fabrication Plan B	
22	Start Plan b	49.0%
23	Fabricate Drilling Topsides	49.0%
24	Fabricate Drilling Jacket	49.0%
25	Fabricate CPP Topsides	49.0%
26	Fabricate CPP Jacket	49.0%
27	Drilling	
28	Drilling for First Gas Only	100.0%
29	Installation	
30	Install Drilling Platform Jacket	100.0%
31	Install Drilling Topsides	100.0%
32	Install CPP Jacket	100.0%
33	Install CPP Topsides	100.0%
34	HUC	
35	Hook UP and Commissioning for Fi	100.0%

AACE Plan A /Plan B can be 50% - 50%



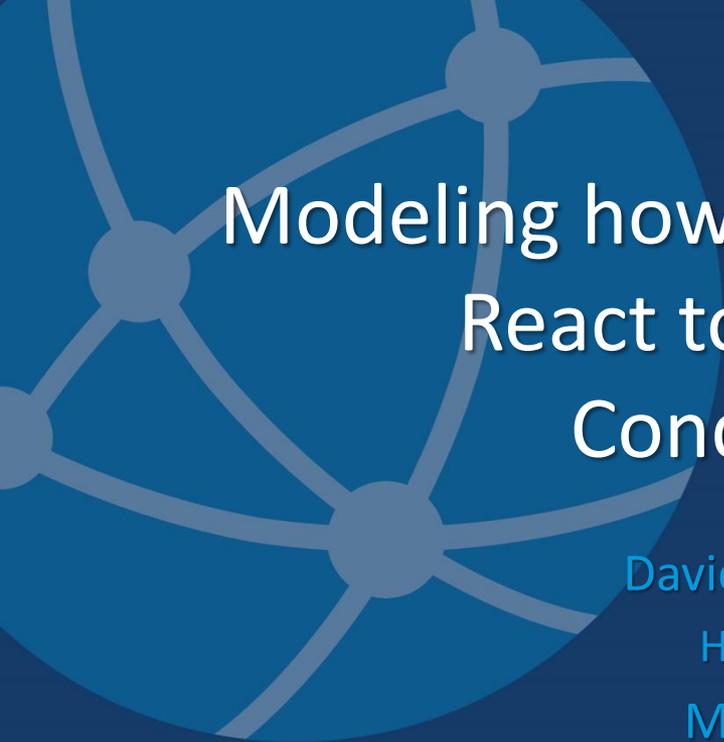
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Trigger Date for Detailed Engineering set at January 13, 2023			
Cause Plan A 50%, Plan B 50%	25-may-23	\$1,944	50%

- Monte Carlo typically risks only the baseline plan as shown in the project schedule and budget – Stick to the Base Plan. This is a valid criticism of Monte Carlo without conditional branching
- Project Managers typically respond to a signal that the project will be late by adjusting the plan => more budget, shorter execution time, need to claw back schedule with recovery plan
- Conditional branching models this adaptive behavior by allowing a switch to “Plan B” if the project is “off the rails” in any iteration
- Plan B costs more because of added resources (and other expenditures) but results in shorter duration of Execution Phase.
 - Added labor may not be as productive as planned labor

- Three scenarios are analyzed:
 - Plan A, No Plan B
 - Plan B is activated if Detailed Engineering is more than 2 months late
 - Plan B is activated only 50% of the time
- Findings
 - Conditional Branching allows the Monte Carlo-based risk analysis to model adaptive behavior other than just staying with the plan
 - Plan B helps claw back some of the schedule to the extent of its selection, that is by being used more frequently
 - Plan B costs more so increases the cost overrun. This models historical findings that projects use resources to achieve better schedule results so the percentage cost overruns are greater % of base than are schedule overruns

- Conditional branching can recognize more schedule conditions than just an activity being late
 - An activity taking longer than planned
 - An activity starting later or earlier than planned
 - An activity costing more than planned
- Conditional branching can have consequences more than just activity / path existence



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