Schedule Best Practice including Schedule Margin and Schedule Risk Analysis

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Learning Objectives

- Use Monte Carlo to model risk mitigation strategies
- Understand why traditional CPM is inherently optimistic
- How to use Schedule Margin to protect deliverables

Exercise 1

The Dice…

Each die represents a task that must be completed to deliver our project.

Tasks can be executed in parallel.

1 – 3 represents early or on-time (50% chance)

4 – 6 represents late (50% chance)

Roll the dice 10 times and count how many times all the dice you have show 1 – 3.

To be clear…

Roll the dice 10 times and count how many times ALL the dice you roll ALL show 1 to 3 dots at the SAME time.

If you have two dice and on the first roll you see a 1 and a 4, that's a fail. Do not count it.

So why did we do this?

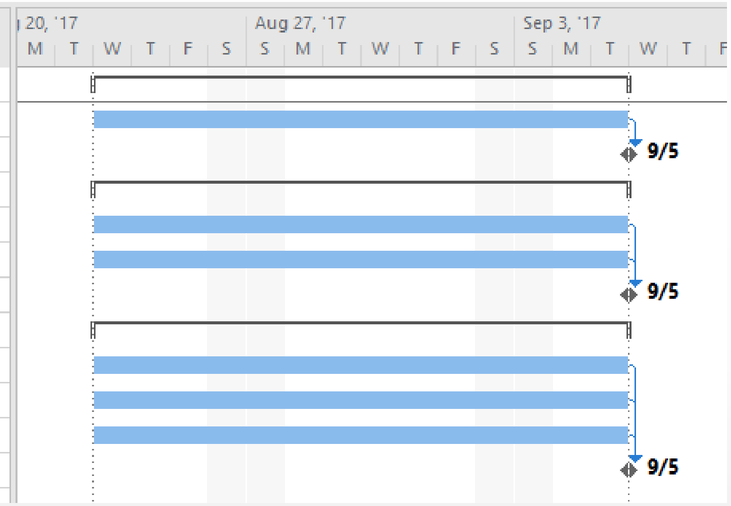
We are modelling a deliverable that is dependent on one or more assemblies.

All the assemblies have to be delivered on time for our contract to be fulfilled.

What are the chances?

Theoretical Results

	Task Name	Duration	Start	Finish	Predecessors
1	**A Single Assembly**	**10 days**	**8/23/17 8:00 AM**	**9/5/17 5:00 PM**	
2	Assembly 1	10 days	8/23/17 8:00 AM	9/5/17 5:00 PM	
3	Delivery 1	0 days	9/5/17 5:00 PM	9/5/17 5:00 PM	2
4	**Two Assemblies**	**10 days**	**8/23/17 8:00 AM**	**9/5/17 5:00 PM**	
5	Assembly 1	10 days	8/23/17 8:00 AM	9/5/17 5:00 PM	
6	Assembly 2	10 days	8/23/17 8:00 AM	9/5/17 5:00 PM	
7	Delivery 2	0 days	9/5/17 5:00 PM	9/5/17 5:00 PM	5,6
8	**Three Assemblies**	**10 days**	**8/23/17 8:00 AM**	**9/5/17 5:00 PM**	
9	Assembly 1	10 days	8/23/17 8:00 AM	9/5/17 5:00 PM	
10	Assembly 2	10 days	8/23/17 8:00 AM	9/5/17 5:00 PM	
11	Assembly 3	10 days	8/23/17 8:00 AM	9/5/17 5:00 PM	
12	Delivery 3	0 days	9/5/17 5:00 PM	9/5/17 5:00 PM	9,10,11



According to a Critical Path Method analysis, assuming all the assemblies are planned to take the same duration, then all deliveries will be on 9/5. But how realistic is that?

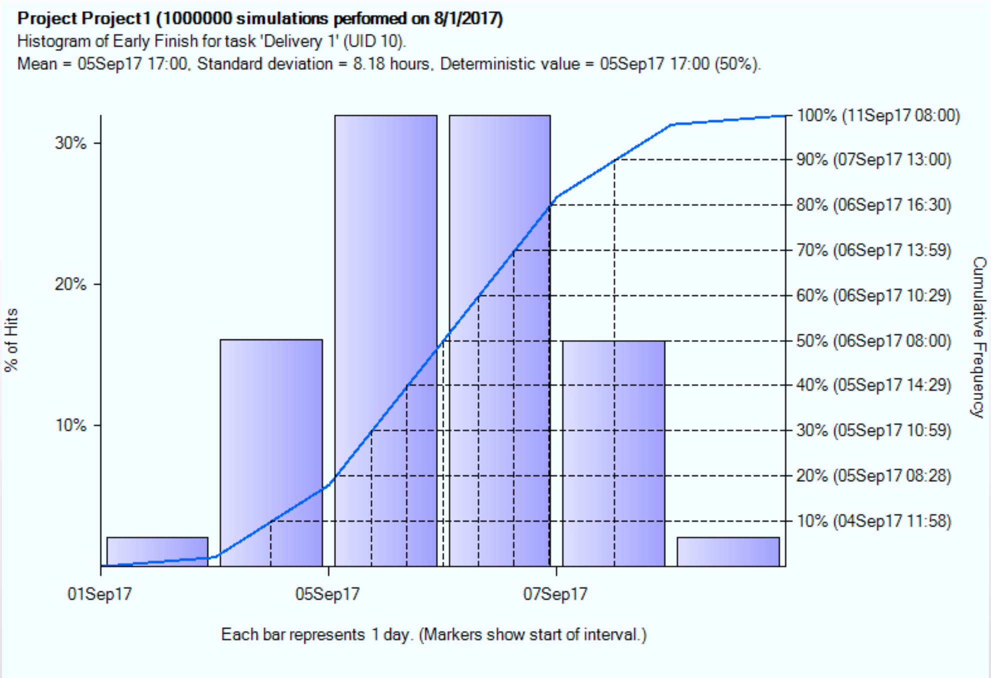
Add some symmetrical uncertainty

There is always some uncertainty associated with project tasks.

With our dice exercise we modelled symmetrical uncertainty (tasks were just as likely to finish early/on-time as they were to finish late).

To save time let’s run 1,000,000 simulations using a computer…

Dependent on one assembly



CPM = 9/5 5pm

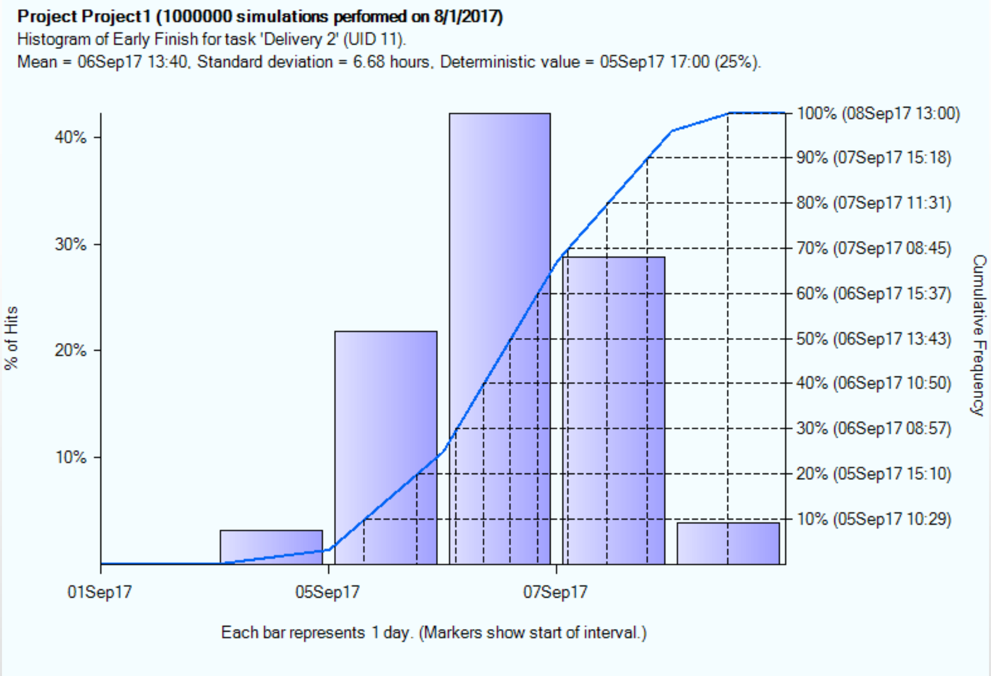
Mean Finish = 9/5 5pm

Mean Duration = 10d

50% chance of on-time

P80 = 9/6 4:30pm

Dependent on two assemblies



CPM = 9/5 5pm

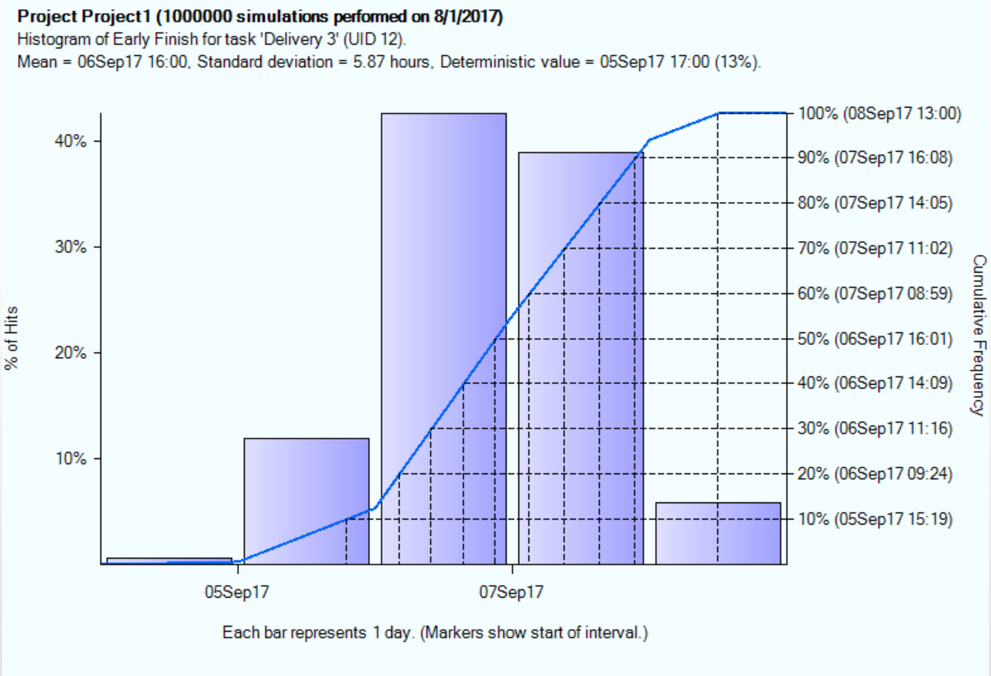
Mean Finish = 9/6 1:40pm

Mean Duration = 10.6d

25% of on-time

P80 = 9/7 11:31am

Dependent on three assemblies



CPM = 9/5

Mean Finish = 9/6 4:00pm

Mean Duration = 10.9d

13% chance of on-time

P80 = 9/7 2:05pm

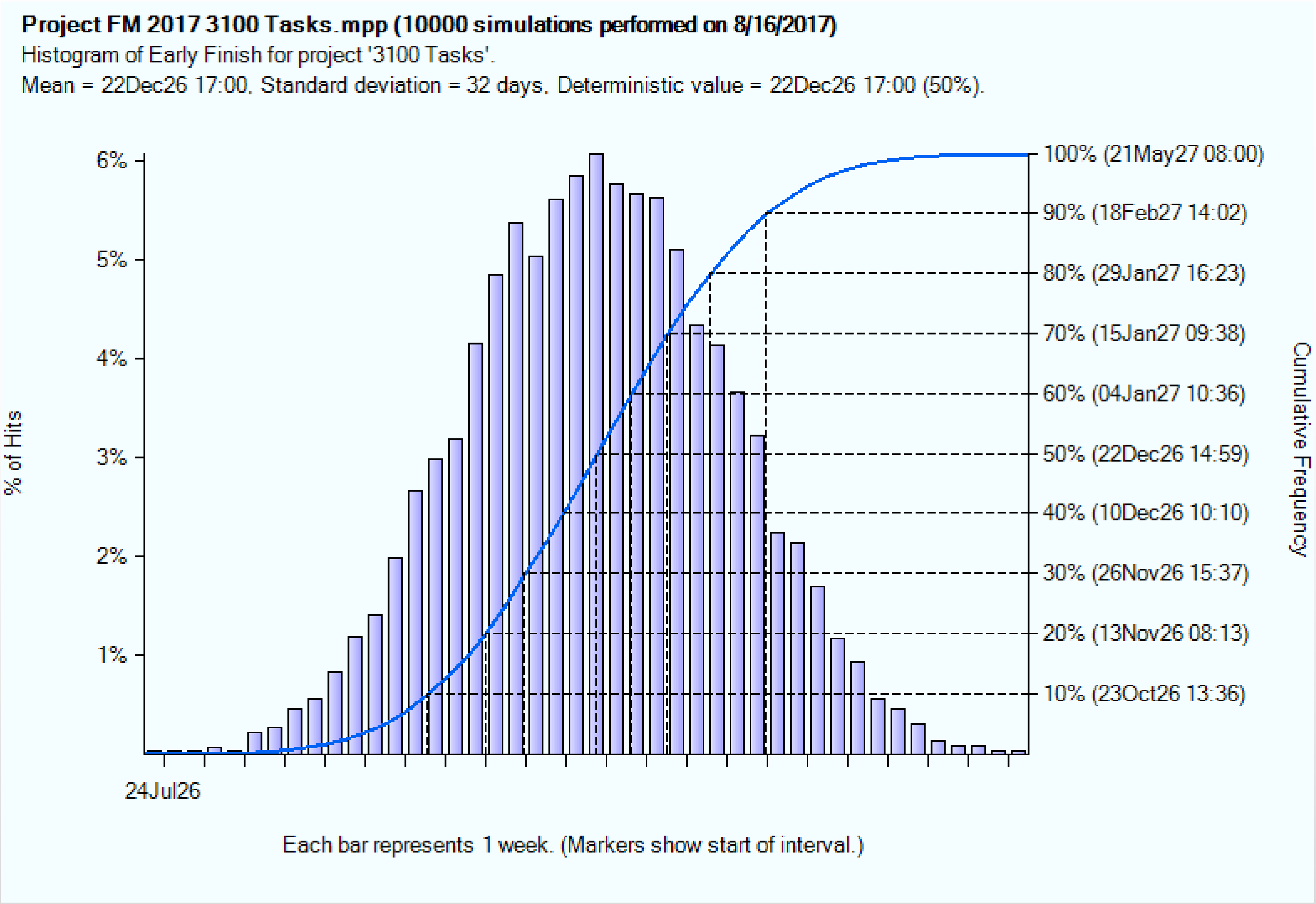
So…

As the number of predecessors for any given task or milestone increase, the chance of it starting/delivering on time decreases.

Our example was a worst case scenario since we had identical parallel predecessors but this effect is the primary reason that dates predicted by Critical Path Method (CPM) models are often overly optimistic.

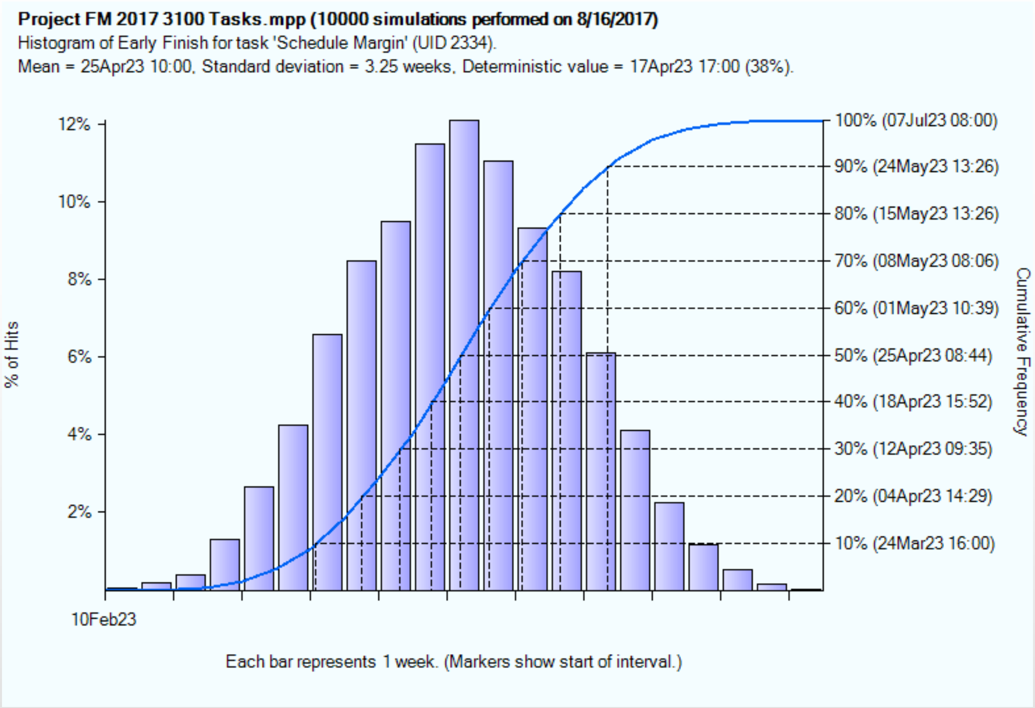
This effect is called **Merge Bias**.

A real schedule – Hmmm…



End of discrete work

- 3100 Tasks
- All tasks +/- 10%
- 10,000 Simulations (3 mins)
- 38% Chance of deterministic finish



Merge Delay (Bias)

FM 2017 3100 Tasks.mpp - Full Monte View: JO Date Diagnostics (Help Understand Results)

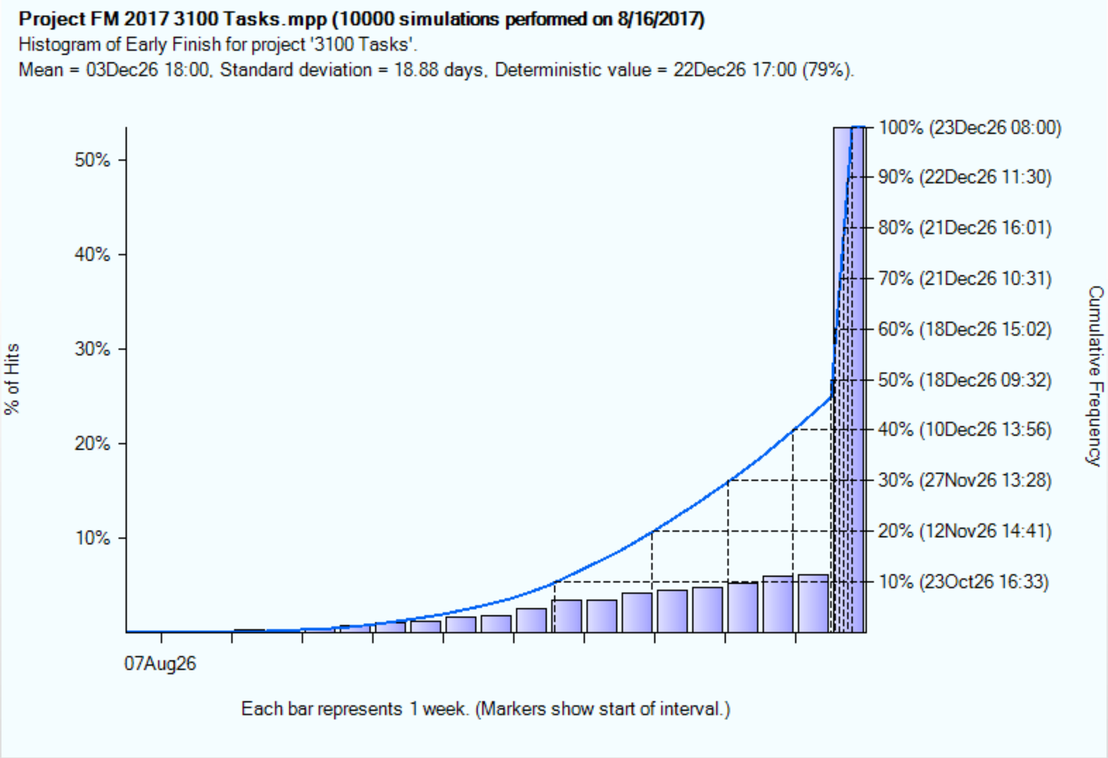
File View Help Risk Analysis Search for Name or ID <<

ID	Task Name	Merge Delay	Remaining Duration	Early Start (MSP)	Early Finish (MSP)	Chance of Achieving MSP Early Finish	Early Start Expected Value	Early Finish Expected Value	Early Start Basis	Early Finish Basis
1329	1329	12.27 days	1365 days	1/1/18 8:00AM	3/24/23 5:00PM	40%	1/1/18 8:00AM	4/10/23 10:03AM	Task 1328	Tasks 1332 (58%), 1333 (42%)
1017	1017	10.6 days	1236.1 days	1/1/18 8:00AM	9/27/22 8:47AM	22%	1/1/18 8:00AM	10/14/22 3:41PM	Task 571	Tasks 1055 (56%), 1044 (44%)
1308	1308	8.72 days	1016 days	1/1/18 8:00AM	11/22/21 5:00PM	46%	1/1/18 8:00AM	11/26/21 2:37PM	Task 1250	Tasks 1309 (70%), 1322 (30%)
2133	2133	6.24 days	1057 days	1/1/18 8:00AM	1/18/22 5:00PM	39%	1/1/18 8:00AM	1/27/22 10:12AM	Task 1389	Tasks 2134 (66%), 2163 (23%), 2146 (10%)
486	486	4.77 days	1357 days	1/1/18 8:00AM	3/14/23 5:00PM	38%	1/1/18 8:00AM	3/22/23 11:39AM	Task 176	Tasks 548 (53%), 538 (48%)
585	585	4.38 days	73 days	5/12/21 8:47AM	8/23/21 8:47AM	44%	5/19/21 11:49...	8/30/21 11:02AM	Task 584 (28%), Early Finish (72%)	Task 2769 [FF-60 days] (72%), Early Start (28%)
1666	1666	3.97 days	555 days	1/1/18 8:00AM	2/14/20 5:00PM	34%	1/1/18 8:00AM	2/21/20 9:13AM	Task 1665	Tasks 1688 (69%), 1695 (31%)
1198	1198	3.66 days	161 days	12/20/19 8:00AM	7/31/20 5:00PM	34%	12/25/19 4:54...	8/6/20 2:18PM	Task 226 [-80 days] (48%), Early Finish (52%)	Task 1194 [FF] (52%), Early Start (48%)
997	997	3.6 days	1073 days	1/1/18 8:00AM	2/9/22 5:00PM	29%	1/1/18 8:00AM	2/15/22 11:46AM	Task 571	Tasks 1006 (54%), 1000 (46%)
1402	1402	2.64 days	758 days	1/1/18 8:00AM	11/25/20 5:00PM	36%	1/1/18 8:00AM	11/30/20 2:30PM	Task 1389	Tasks 1546 (71%), 1506 (30%)
2745	2745	2.42 days	20 days	3/15/21 2:52PM	4/12/21 2:52PM	46%	3/18/21 10:28...	4/15/21 10:28AM	Tasks 2741 [SS] (70%), 2742 [SS] (30%)	Early Start
3015	3015	1.86 days	300 days	1/1/18 8:00AM	2/22/19 5:00PM	36%	1/1/18 8:00AM	2/26/19 4:09PM	Task 23	Tasks 3032 (68%), 3137 (32%)
1364	1364	1.8 days	709 days	1/1/18 8:00AM	9/17/20 5:00PM	46%	1/1/18 8:00AM	9/21/20 4:41PM	Task 571	Tasks 1383 (88%), 1384 (12%)
1067	1067	1.61 days	38 days	2/15/19 8:00AM	4/9/19 5:00PM	41%	2/18/19 3:01PM	4/11/19 2:33PM	Tasks 1065 (63%), 1064 (37%)	Early Start
433	433	1.53 days	5 days	3/22/23 8:00AM	3/28/23 5:00PM	36%	3/29/23 1:24PM	4/5/23 1:26PM	Tasks 402 (67%), 549 (18%), 539 (15%)	Early Start
675	675	1.5 days	909 days	1/1/18 8:00AM	6/24/21 5:00PM	46%	1/1/18 8:00AM	6/28/21 2:47PM	Task 674	Tasks 695 (69%), 694 (31%)
3069	3069	1.25 days	68 days	1/1/18 8:00AM	4/4/18 5:00PM	26%	1/1/18 8:00AM	4/6/18 10:19AM	Task 3015	Tasks 3070 (52%), 3074 (52%), 3080 (48%)

72 rows | Filter: Merge Bias (72 rows) | Highlight: EF <> EFX (72 rows) | Sorted on Merge Delay | Simulations: 1000, Sensitivity Targets: 2815 (schedule), 0 (cost)

72 tasks out of 3100 had merge delay

Beware 'odd' results…



The project clearly has a 'hard' constraint (FNLT, FON etc.)

These need to be removed or ignored

Schedule Quality affects SRA

Schedule Inspector(tm) C:\Users\jowen\Documents\Barbecana\Demo Data\Full Monte\FM 2017\FM 2017 31...

File Options Run Tests DCMA View Help Status Date:

Condition	Select	Threshold	Exclude*	Goal	Result	
Baseline duration exceeds threshold (DCMA metric # 8)	☑	22 days	LSP	< 5%	41.80% (1098 out of 2627 tasks)	Detail ...
Duplicate task names	☑			= 0%	0.00% (0 out of 3145 tasks)	Help
Finish-Start relationships (DCMA metric # 4)	☑			> 90%	93.81% (3516 out of 3748 relati...	Detail ...
Hard constraints (DCMA metric # 5)	☑			< 5%	0.00% (0 out of 3145 tasks)	Help
Inactive tasks	☑			= 0%	0.00% (0 out of 3145 tasks)	Help
Lags bigger than threshold (DCMA metric # 3)	☑	0		< 5%	1.65% (62 out of 3748 relations...	Detail ...
Leads bigger than threshold (DCMA metric # 2)	☑	0		= 0%	1.79% (67 out of 3748 relations...	Detail ...
Manually scheduled tasks	☑			= 0%	0.00% (0 out of 3145 tasks)	Help
Milestones with resources	☑			= 0%	0.00% (0 out of 261 tasks)	Help
More than threshold number of predecessors (Preambl...	☑	10		= 0%	0.64% (20 out of 3145 tasks)	Detail ...
More than threshold number of successors (Preamble t...	☑	10		= 0%	0.29% (9 out of 3145 tasks)	Detail ...
Negative slack exceeds threshold (DCMA metric # 7)	☑	0		= 0%	63.56% (1999 out of 3145 tasks)	Detail ...
No baseline start or finish date (Excluded by most DCM...	☑			= 0%	0.03% (1 out of 3145 tasks)	Detail ...
No predecessors (DCMA metric # 1 Part 1)	☑		S	< 5%	12.33% (324 out of 2627 tasks)	Detail ...
No resources (DCMA metric # 10)	☑		SM	= 0%	80.35% (1910 out of 2377 tasks)	Detail ...
No successors (DCMA metric # 1 Part 2)	☑		S	< 5%	2.82% (74 out of 2627 tasks)	Detail ...
Summary tasks with relationships (Preamble to DCMA ...	☑			= 0%	0.00% (0 out of 518 tasks)	Help
Summary tasks with resources	☑			= 0%	0.00% (0 out of 518 tasks)	Help

*** Exclusions Codes: Complete, LoE, Milestone, No dependencies, Planning package, Summary. (PP limit is Monday, October 16, 2017)**

Simulation – is that the best we can do?

- The simple answer is yes
- Modelling the interaction of multiple random variables can only be performed by simulation
- There are no analytical solutions for even three related random variables (although there are numerical solutions which basically break the problem down into many small steps and make some assumptions). These become unworkable for larger numbers of variables (thousands of tasks in a schedule!)

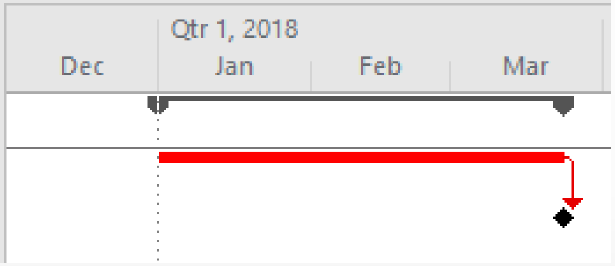
Key Takeaways

- CPM schedules are inherently optimistic because they do not take into account Merge Bias.
- Bias gets worse the more parallel tasks there are.
- All tasks are subject to some uncertainty
- Even using ‘unrealistic’ symmetrical uncertainty has value (identifying merge bias and improving predictions)
- Realistic uncertainty is rarely symmetrical

Planning Packages

… and their impact on risk analysis

Task Name	Duration	Start	Finish
High Level Task	**60 days**	**1/1/18 8:00 AM**	**3/23/18 5:00 PM**
Planning Package	60 days	1/1/18 8:00 AM	3/23/18 5:00 PM
Delivery	0 days	3/23/18 5:00 PM	3/23/18 5:00 PM

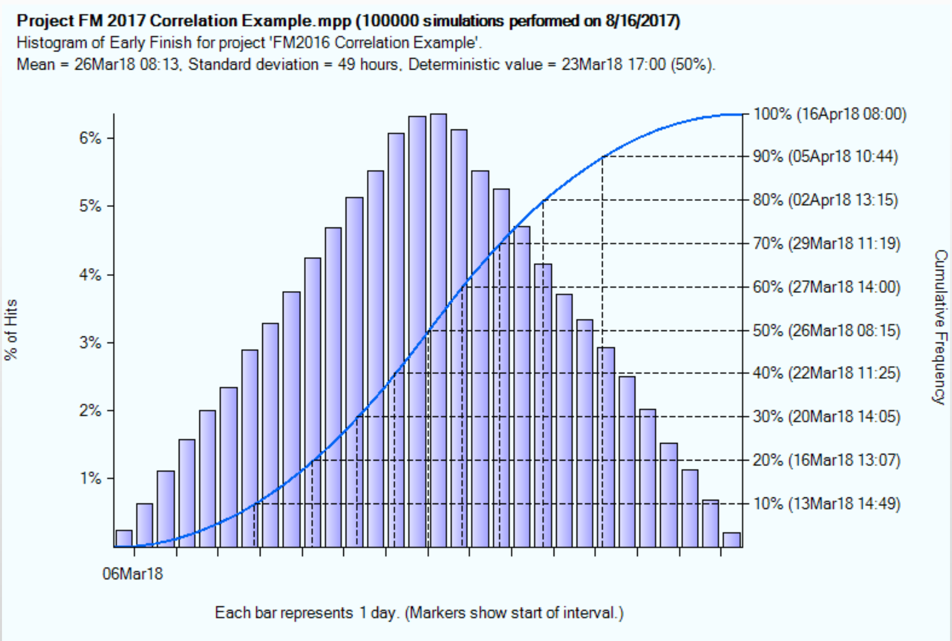


A single 60 day task.

CPM Finish is 23Mar18

Apply some uncertainty

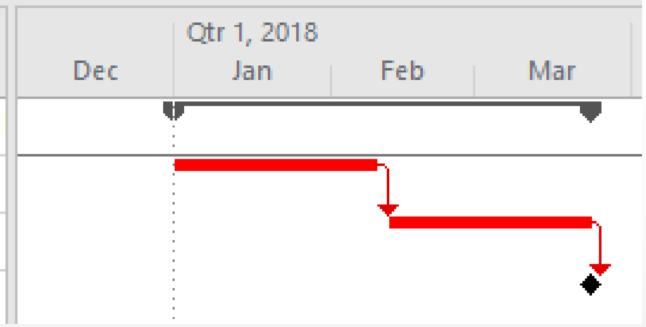
ID	Task Name	Remaining Duration	Duration Distribution Type	Duration Optimistic	Duration Most Likely	Duration Pessimistic	Duration Confidence Interval (%)	Early Finish Histogram
0	⊟ FM2016 Correlation Example	60 days	(None)					NA
1	⊟ High Level Task	60 days	(None)					NA
2	Planning Package	60 days	Triangular	45 days	60 days	75 days	100%	NA
3	Delivery	0	(None)					NA



- +/- 25%
- 50% Chance of achieving deterministic 23Mar18
- P80 = 2Apr18
- SD = 49 Hours
- Range = 36 Days

Break into more detail

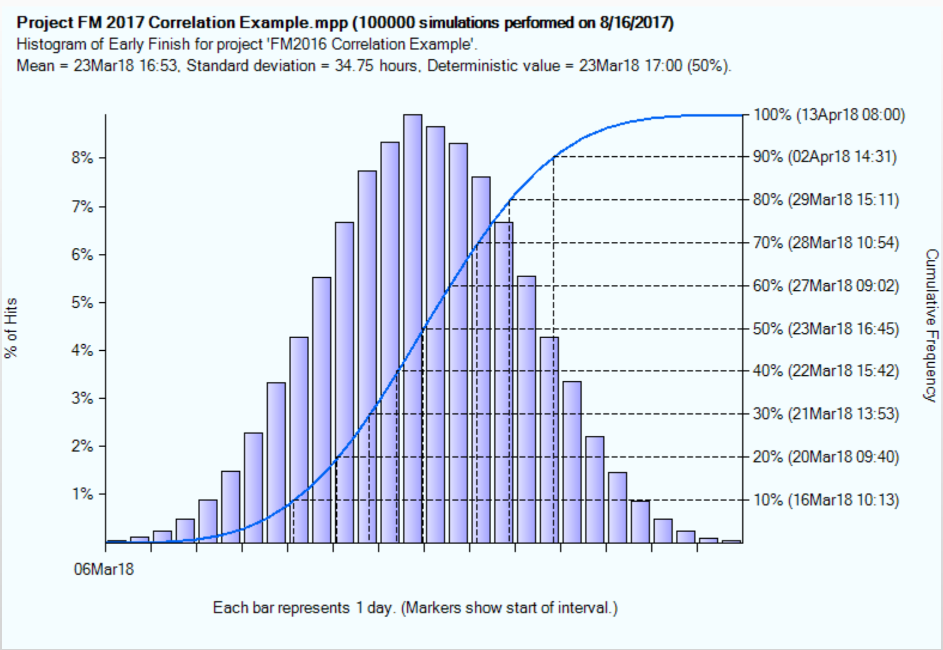
Task Name	Duration	Start	Finish
Detailed Tasks	**60 days**	**1/1/18 8:00 AM**	**3/23/18 5:00 PM**
Task A	30 days	1/1/18 8:00 AM	2/9/18 5:00 PM
Task B	30 days	2/12/18 8:00 AM	3/23/18 5:00 PM
Delivery	0 days	3/23/18 5:00 PM	3/23/18 5:00 PM



- Original 60 day task split into two 30 day tasks
- CPM Finish is still 23Mar18

Apply Uncertainty

ID	Task Name	Remaining Duration	Duration Distribution Type	Duration Optimistic	Duration Most Likely	Duration Pessimistic	Duration Confidence Interval (%)	Early Finish Histogram
0	⊟ FM2016 Correlation Example	60 days	(None)					NA
1	⊟ Detailed Tasks	60 days	(None)					NA
2	Task A	30 days	Triangular	75%	100%	125%	100%	NA
3	Task B	30 days	Triangular	75%	100%	125%	100%	NA
4	Delivery	0	(None)					NA



- +/- 25%
- 50% Chance of achieving deterministic 23Mar18
- P80 = 29Mar18 (2Apr18)
- SD = 34.75 Hours (49h)
- Range = 26 Days (36d)
- Central Limit Theorem

Long Duration Tasks

- A single long task does not give the same results as many smaller tasks with the same overall duration.
- Uncertainty tends to ‘cancel out’ when there are multiple serial tasks (reduces standard deviation)
- High level tasks also mask Merge Bias

- SRA should be run on schedules with as much detail as possible. Avoid summary schedules.

But we need Planning Packages..

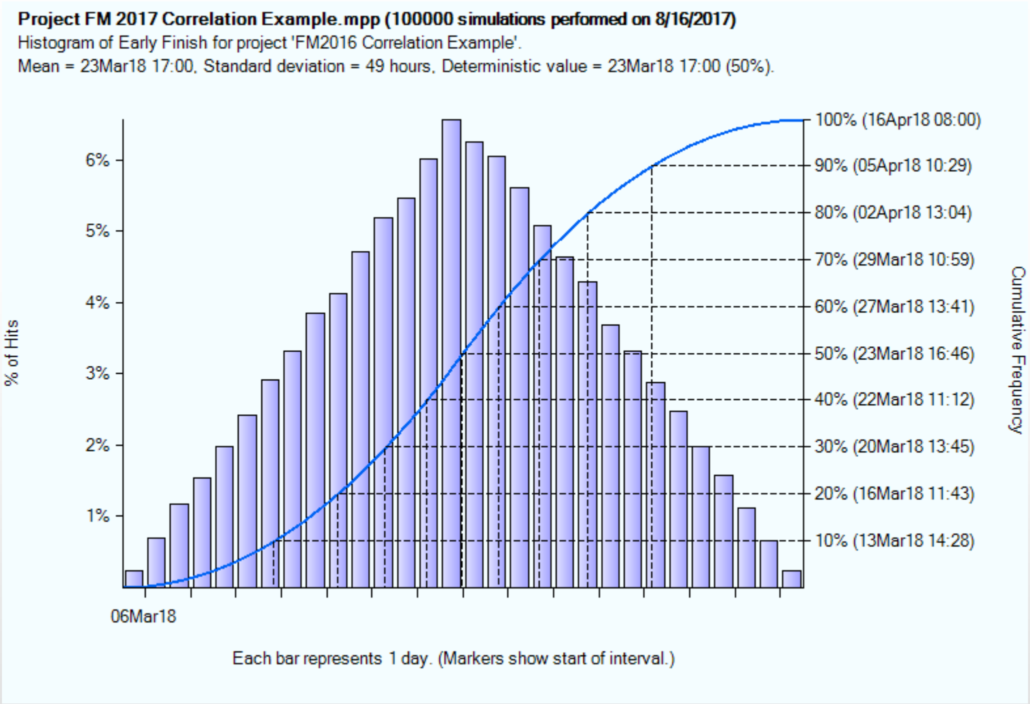
- Planning Packages (placeholders for future work that has yet to be defined in detail) are necessary for longer programs.
- When you break Planning Packages into more detail expect the SD to decrease but see an increased impact from Merge Bias
- Correlation can solve the reducing Standard Deviation

Correlation

- Correlation allows us to model shared influencing factors – like detail tasks all belonging to the same planning package.

ID	Task Name	Remaining Duration	Duration Distribution Type	Duration Optimistic	Duration Most Likely	Duration Pessimistic	Duration Confidence Interval (%)	Duration Correlations	Early Finish Histogram
0	⊟ FM2016 Correlation Example	60 days	(None)						Graph
1	⊟ Detailed Tasks	60 days	(None)						Graph
2	Task A	30 days	Triangular	75%	100%	125%	100%	PP (100%)	Graph
3	Task B	30 days	Triangular	75%	100%	125%	100%	PP (100%)	Graph
4	Delivery	0	(None)						Graph

Correlation Results

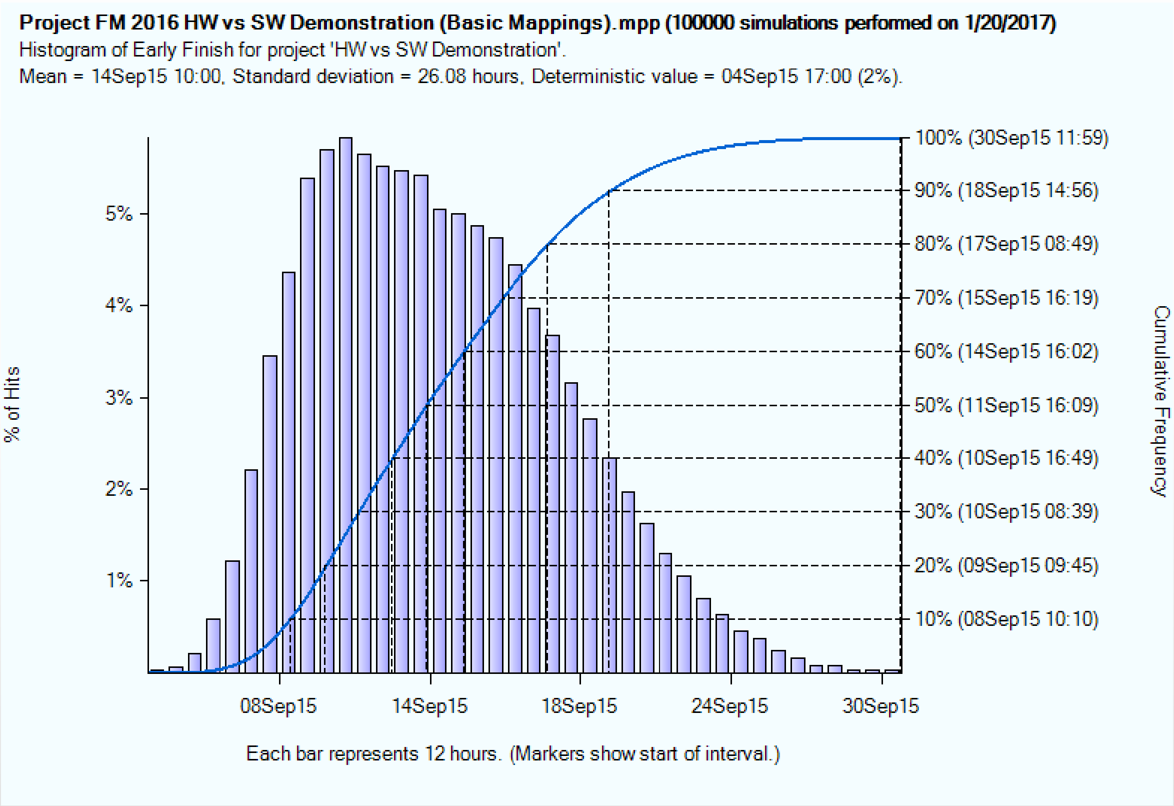


- +/- 25%
- 50% Chance of achieving deterministic 23Mar18
- P80 = 2Apr18 (2Apr18)
- SD = 49 Hours (49h)
- Range = 36 Days (36d)

Key Takeaways

- Correlation can help reduce changes to the results of Schedule Risk Analysis caused by breaking Planning Packages into more detail.
- Schedule Risk Analysis works best when applied to as much detail as possible.
- Avoid the use of summary schedules – they mask the impact of merge bias

Schedule Risk Analysis Outputs



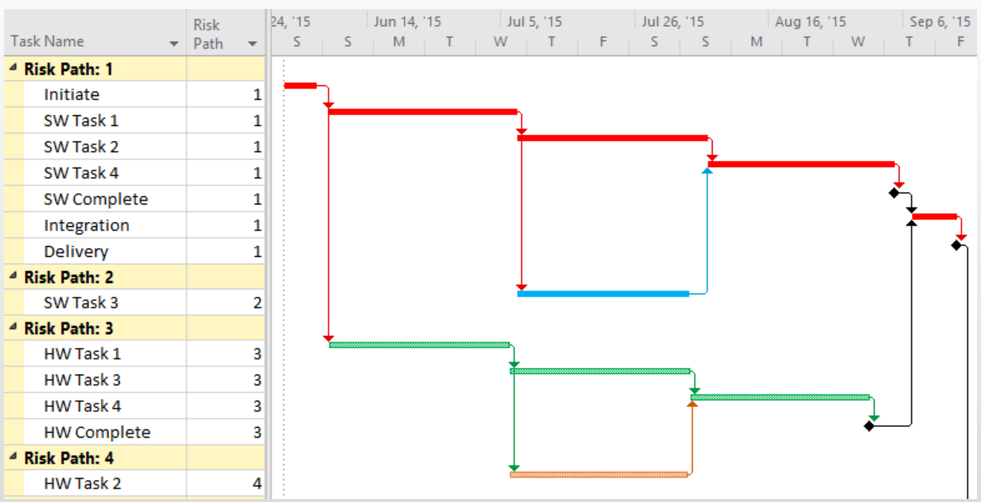
Histograms plot the chance of finishing **on** a specific date/cost while the S-Curve is the probability of completion **by** a date/cost.

Reports produced using Barbecana's Full Monte for Microsoft Project

Schedule Risk Analysis Outputs

ID	Task Name	Percent Critical	Sensitivity Index	Sensitivity Index 50.0	Optimistic Finish of Project	Pessimistic Finish of Project	2015 Sep 06 13 20
14	SW Task 4	84%	57%		9/9/15 4:10PM	9/21/15 2:08PM	
11	SW Task 1	84%	57%		9/9/15 4:10PM	9/21/15 2:08PM	
12	SW Task 2	76%	51%		9/10/15 11:46AM	9/21/15 1:06PM	
7	HW Task 3	13%	4%		9/14/15 9:32AM	9/16/15 9:56AM	
13	SW Task 3	8%	2%		9/14/15 9:44AM	9/15/15 3:35PM	
8	HW Task 4	16%	3%		9/14/15 9:36AM	9/15/15 1:18PM	
5	HW Task 1	16%	3%		9/14/15 9:36AM	9/15/15 1:18PM	
6	HW Task 2	3%	1%		9/14/15 9:54AM	9/15/15 8:06AM	

Sensitivity Tornado charts identify the tasks creating the most uncertainty in the target delivery date



Risk Path analysis groups tasks by their criticality to the target delivery date

Reports produced using Barbecana's Full Monte for Microsoft Project

Key Takeaways

- Histograms have little value
- S-Curves are far more important.
- Sensitivity Analysis helps identify tasks creating uncertainty and opportunities for schedule compression but does not include tasks with no uncertainty.
- Risk Path analysis adds value to sensitivity analysis because it includes tasks with no uncertainty. It helps focus management effort.

Contingency

Nearly every project includes some contingency to handle cost variations.

In fact, many projects have two kinds of cost contingency:-

Contingency – for known-unknowns. For identified risks like rate variations. Often calculated using risk analysis.

Management Reserve – for unknown-unknowns. For unknown issues like missed scope. Often this is a percentage of the project value.

Cost contingency usually exists even if buried in rates etc.

…and yet schedulers are expected to come up with a date - and stick to it!

Schedule Margin

a.k.a. Schedule Contingency, Schedule Buffer, Delay Allowance, Risk Allowance, Risk Buffer…

Schedule Margin is best defined as:

‘The amount of additional time needed to achieve a significant event with an acceptable probability of success’

Significant events are major contract milestones or deliverables.

Do not confuse Schedule Margin with the ‘buffers’ defined by techniques such as ‘Critical Chain’. While there are similarities (protecting deliverables), Schedule Margin is purely focused on Schedule.

Padded Durations

These are BAD BAD BAD! Don't do it!

Recognizing there is uncertainty in our task duration estimates, it can be tempting to pad or add time to individual duration estimates to increase the chance they will be completed in the budgeted time.

This never works!

Work expands to fill the time available (variously known as Parkinson's Law or Student Syndrome). Also see Procrastination…

Keep task estimates as realistic as possible. Task Durations should represent the most likely time the task should take.

Contingency belongs to the project, not the task.

Govt' Accountability Office (GAO)

GAO Best Practices

Schedule Assessment Guide

Most likely conditions for estimated durations imply that duration estimates do not contain padding or margin for risk. Rather, risk margin should be introduced as separate schedule contingency activities to facilitate proper monitoring by management…

Who ‘Owns’ Schedule Margin?

The **Project Manager** owns the Schedule Margin.

It does not belong to the client and it should not be negotiated away by the sales team.

This is one reason to CLEARLY identify the Schedule Margin in the schedule. It is there to protect the project deliverable(s). That’s good for contractor and client alike.

Unlike cost contingency, schedule margin is not typically allocated to over-running tasks, but remains as a buffer (which may change in size if the project slips) to protect the project deliverable.

Where to add Schedule Margin

Going back to our definition for Schedule Margin.

‘The amount of additional time needed to achieve a significant event with an acceptable probability of success’

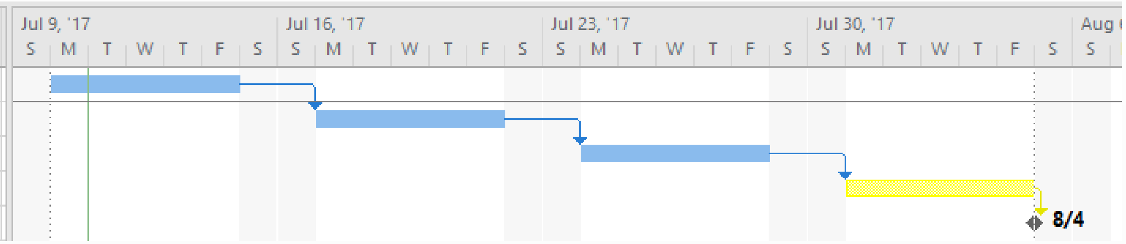
We can/should add Schedule Margin to our schedule before any major contract event/deliverable. The aim is to protect that deliverable.

Schedule margin must be clearly identified!

Schedule margin tasks **must not** represent any work!

How to ‘size’ Schedule Margin

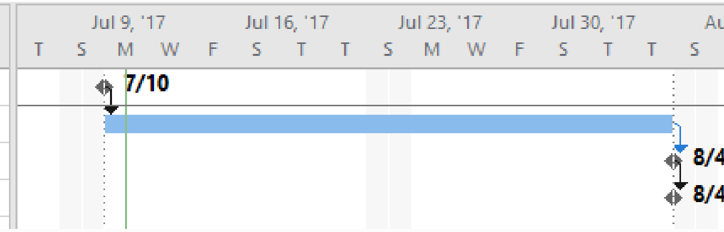
Task Name	Duration	Start	Finish
Task A	5 days	7/10/17 8:00	7/14/17 5:00
Task B	5 days	7/17/17 8:00	7/21/17 5:00
Task C	5 days	7/24/17 8:00	7/28/17 5:00
Schedule Margin	5 days	7/31/17 8:00	8/4/17 5:00 F
Delivery	0 days	8/4/17 5:00 F	8/4/17 5:00 F



- Experience based on past project history
- Some percentage of the project duration
- Based on project complexity/risk
- **Use Schedule Risk Analysis!**

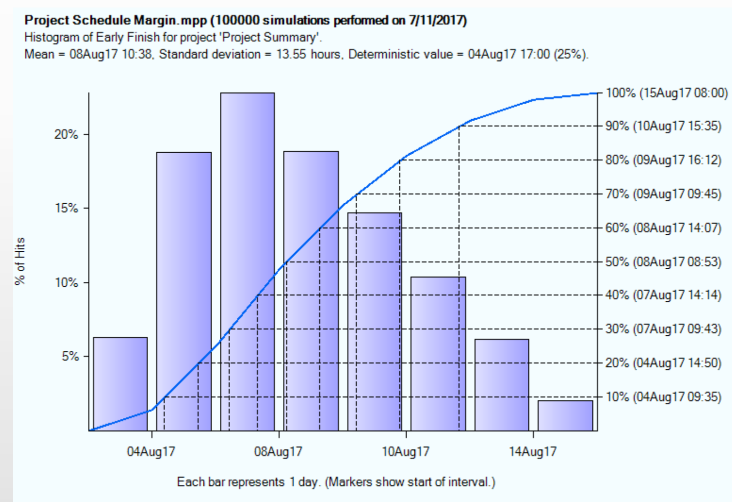
Perform a Schedule Risk Analysis

	Task Name	Duration	Start	Finish	Schedule Margin	Predecessors
1	Start	0 days	7/10/17 8:00 AM	7/10/17 8:00 AM	No	
2	Work	20 days	7/10/17 8:00 AM	8/4/17 5:00 PM	No	1
3	Schedule Margin	0 days	8/4/17 5:00 PM	8/4/17 5:00 PM	Yes	2
4	Delivery	0 days	8/4/17 5:00 PM	8/4/17 5:00 PM	No	3

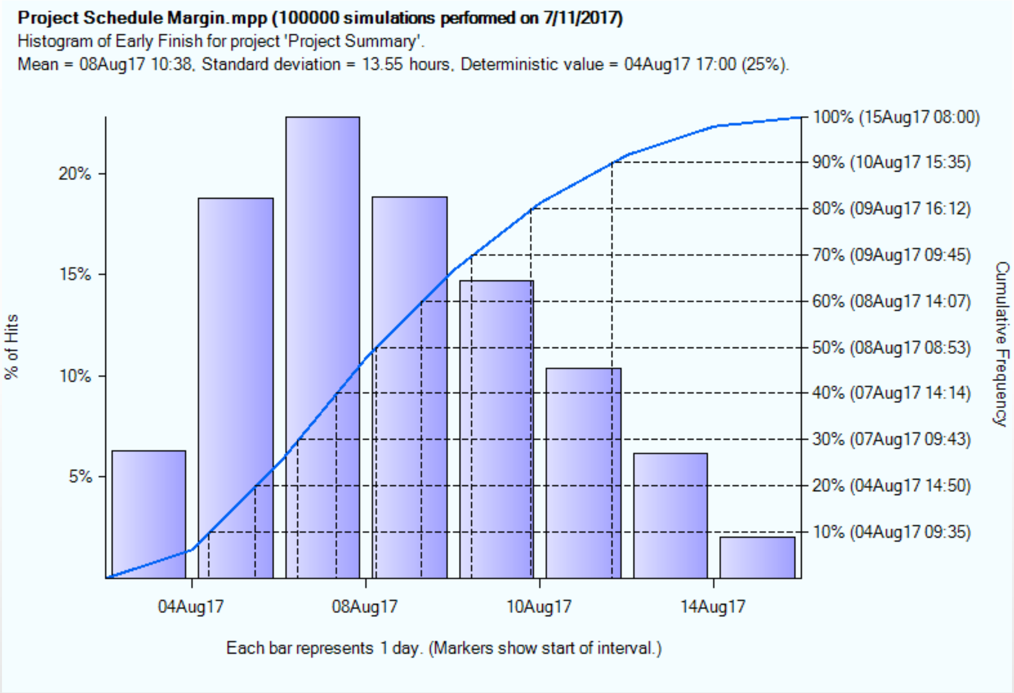


ID	Task Name	Original Duration (MSP)	Remaining Duration	Duration Distribution Type	Duration Optimistic	Duration Most Likely	Duration Pessimistic	Duration Confidence Interval (%)	Early Finish Histogram
0	⊟ Project Summary	4 wks	4 wks	Triangular	90%	100%	130%	100%	Graph
1	Start	0	0	Triangular					10Jul17 08:00
2	Work	4 wks	4 wks	Triangular	90%	100%	130%	100%	Graph
3	Schedule Margin	0	0	(None)					Graph
4	Delivery	0	0	Triangular					Graph

Based on the uncertainty in the schedule, risk analysis will predict a range of dates for project delivery.



A more detailed look



The Deterministic finish calculated by CPM was 04Aug17 at 5pm.

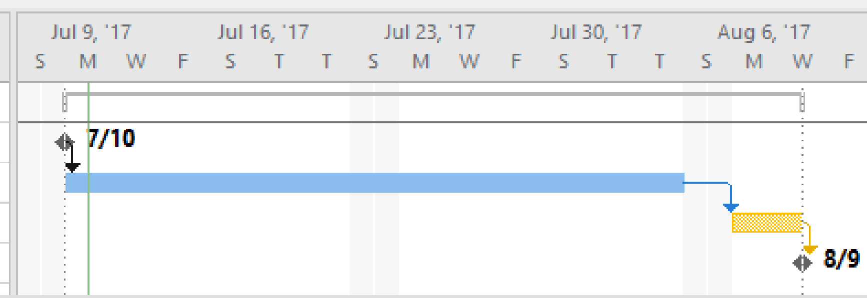
Based on the specified uncertainty, the simulation is predicting only a 25% chance of achieving that date,

However, a more realistic 80% confident date would be 9Aug17 at 4:12pm.

Sizing the Schedule Margin

- The difference between the Deterministic Finish and the finish date at the required level of confidence is a good value for the Schedule Margin.
- Deterministic Finish 4Aug17 at 5pm
- 80% (80th Percentile) Finish Date 9Aug17 at 4:12pm
- Schedule Margin suggested value 3 days (5 day calendar)

Task Name	Duration	Start	Finish	Schedule Margin
Project Summary	**23 days**	**7/10/17 8:00 AM**	**8/9/17 5:00 PM**	**No**
Start	0 days	7/10/17 8:00 AM	7/10/17 8:00 AM	No
Work	20 days	7/10/17 8:00 AM	8/4/17 5:00 PM	No
Schedule Margin	3 days	8/7/17 8:00 AM	8/9/17 5:00 PM	Yes
Delivery	0 days	8/9/17 5:00 PM	8/9/17 5:00 PM	No



We need to deliver on 4Aug17…

The most common concern with techniques like Schedule Risk Analysis (SRA) and Schedule Margin is that the revised delivery dates are beyond commitments already made/required.

This in no way invalidates the techniques.

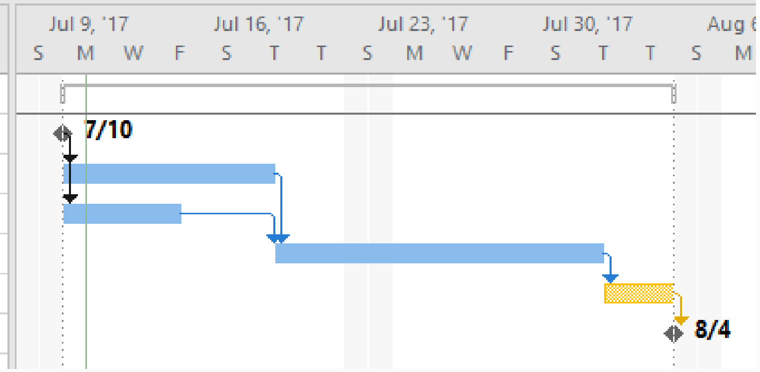
What the SRA tells us in our example is that, based on our estimates of uncertainty, we only have a 25% chance of delivering by 4Aug17.

This should concern us. The time to take action is NOW.

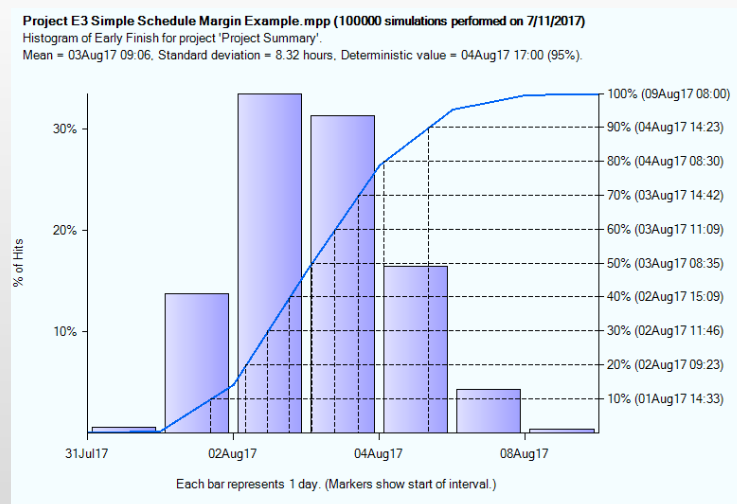
Revise the scope, revise the schedule, or reduce the uncertainty, to bring in the delivery date of the schedule so that the 80% confidence date moves to 4Aug17.

The revised schedule

Task Name	Duration	Start	Finish	Schedule Margin
Project Summary	**20 days**	**7/10/17 8:00 AM**	**8/4/17 5:00 PM**	**No**
Start	0 days	7/10/17 8:00 AM	7/10/17 8:00 AM	No
Work Team 1	7 days	7/10/17 8:00 AM	7/18/17 5:00 PM	No
Work Team 2	5 days	7/10/17 8:00 AM	7/14/17 5:00 PM	No
Integration	10 days	7/19/17 8:00 AM	8/1/17 5:00 PM	No
Schedule Margin	3 days	8/2/17 8:00 AM	8/4/17 5:00 PM	Yes
Delivery	0 days	8/4/17 5:00 PM	8/4/17 5:00 PM	No



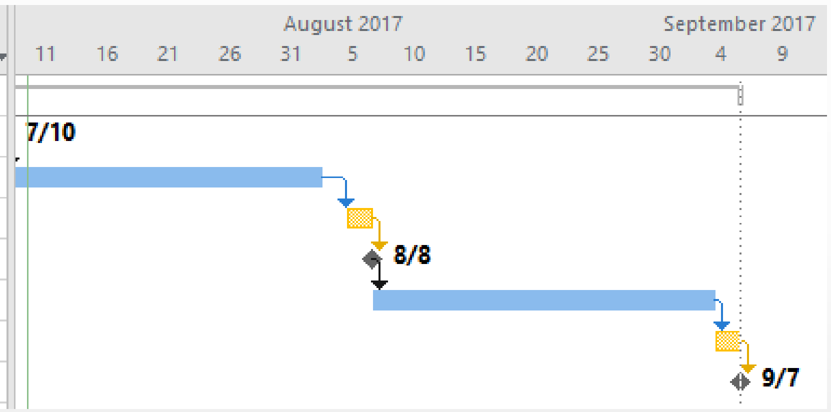
After revising the schedule (working in parallel), which while increasing the total work, reduces the total duration, the Deterministic Finish is now 1Aug17 giving us an 80% chance of finishing by the originally agreed date of 4Aug17.



Interim Deliverables

Schedule Margin can protect interim deliverables as well as project completion.

Task Name	Duration	Start	Finish	Schedule Margin
Project Summary	**44 days**	**7/10/17 8:00 AM**	**9/7/17 5:00 PM**	**No**
Start	0 days	7/10/17 8:00 AM	7/10/17 8:00 AM	No
Phase 1	20 days	7/10/17 8:00 AM	8/4/17 5:00 PM	No
Schedule Margin	2 days	8/7/17 8:00 AM	8/8/17 5:00 PM	Yes
Phase 1 Complete	0 days	8/8/17 5:00 PM	8/8/17 5:00 PM	No
Phase 2	20 days	8/9/17 8:00 AM	9/5/17 5:00 PM	No
Schedule Margin	2 days	9/6/17 8:00 AM	9/7/17 5:00 PM	Yes
Delivery	0 days	9/7/17 5:00 PM	9/7/17 5:00 PM	No



Note: Some agencies (DCMA) may prefer interim milestones to have no tasks representing work following any margin. Use a constraint to resume work after the deliverable. Check with your compliance officer.

Key Takeaways

Schedule Margin is used to protect deliverables from delays. It allows an allowance for ‘risk’ to be **clearly identified** in the schedule.

It doesn’t affect float or techniques like Earned Value.

It belongs to the Project Manager/Contractor

It protects both contractor and client.

It should be zeroed out during risk analysis

Modelling Risk Mitigation

Estimate and Threat modelling can highlight that project deliverables may not be achievable.

It might be possible to reduce durations (more/better resources), reduce uncertainty (re-estimate), change logic to achieve a required delivery date at the required level of confidence.

But what if you would rather only change the logic if necessary…

Alternate Points of Incorporation…

- Presentation by Rick Price (LMCO) at EVM World 2016.
- Mr. Price suggested using Monte Carlo simulation to model risk mitigation to protect key deliverables that require a high level of confidence.
- Rather than create two models we can use Conditional Branching in a single model.

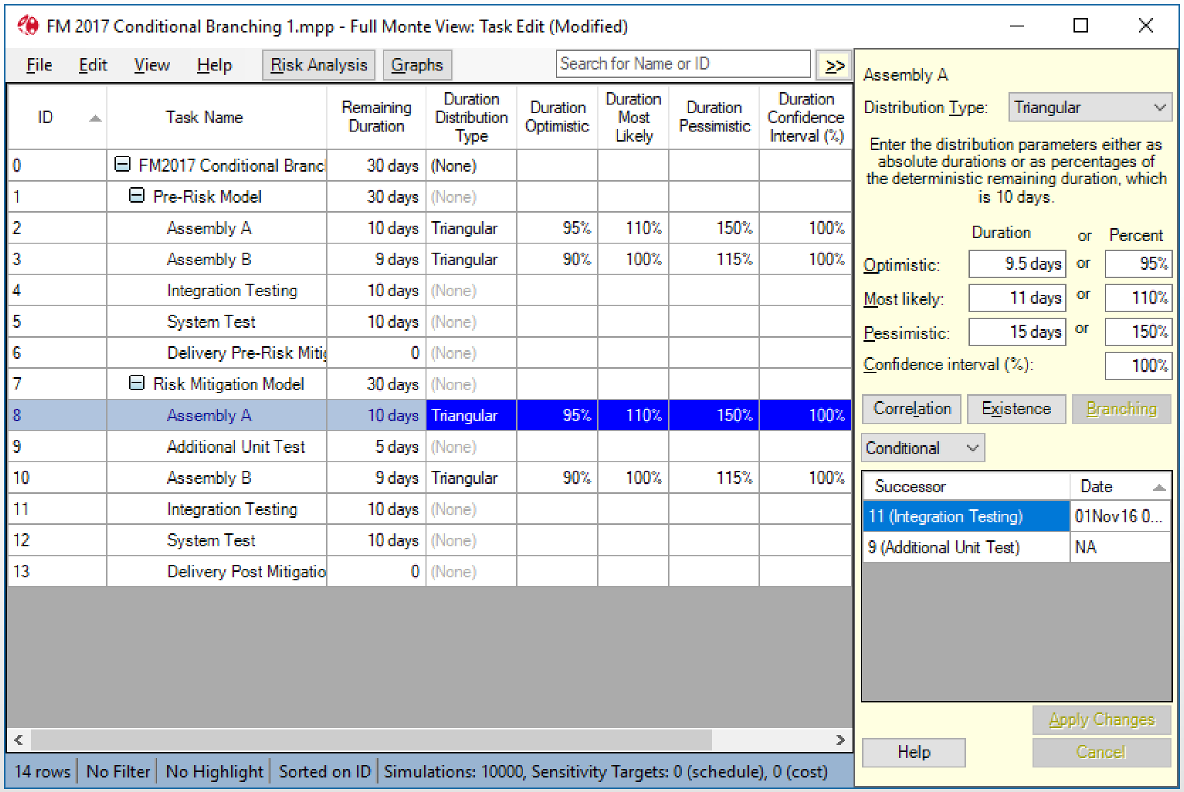
Conditional Branching

Conditional branching allows the model to include alternate logic based on the date a predecessor finishes.

A good use for conditional branching is to model alternate points of incorporation if key work items are delivered late (as a risk mitigation).

For example, if integration testing requires two sub-assemblies, one of which has a high risk of being delivered late, then conditional logic could be used to model additional unit testing before integration later in the test program in order to avoid a project delay.

Conditional Branching Data



Click Branching and then choose ‘Conditional’.

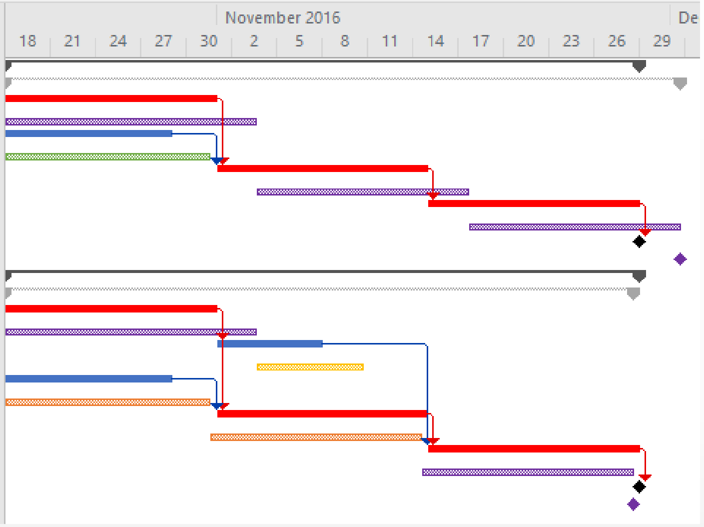
Enter the date(s) the task must complete for successors to be included.

One successor must have no date (NA).

In this example, the successor will be Integration Testing if Assembly A completes on or before 1Nov16.

Conditional Branching Example

Task Name	Duration	Predecessors	Risk Assessment	Percent Critical	Percent Active (branching)	Chance of Achieving MSP Early Finish
Pre-Risk Model	**30 days**			**100**	**100**	**2.87**
Assembly A	10 days		High Risk	100	100	3
Assembly B	9 days		Low Risk	0	100	39.95
Integration Testing	10 days	2,3		100	100	2.87
System Test	10 days	4		100	100	2.87
Delivery Pre-Risk Mitigation	0 days	5		100	100	2.87
Risk Mitigation Model	**30 days**			**100**	**100**	**95.82**
Assembly A	10 days		High Risk	100	100	3.21
Additional Unit Test	5 days	8		4	97	0
Assembly B	9 days		Low Risk	93	100	39.84
Integration Testing	10 days	8,10		96	100	95.82
System Test	10 days	11,9		100	100	95.82
Delivery Post Mitigation	0 days	12		100	100	95.82



The conditional logic increases our chance of achieving the required end date from under 2% to over 95%.

Key Takeaways

- Conditional Branching allows risk mitigation logic to be incorporated into the schedule to protect key deliverables
- This is especially useful where schedule parameters do not allow sufficient margin to be used to achieve a required level of confidence.

Thank you.

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Questions about the presentation or Schedule Risk Analysis

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