

Sensitivity and Risk Path Analysis

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Sensitivity Analysis

Sensitivity Analysis shows us which tasks are creating uncertainty in a selected outcome. The outcome might be the entire project or an interim deliverable. Understanding the potential impact of each task on the outcome helps us focus management effort and perhaps identify opportunities for schedule compression.

Consider the schedule shown in Figure 1.

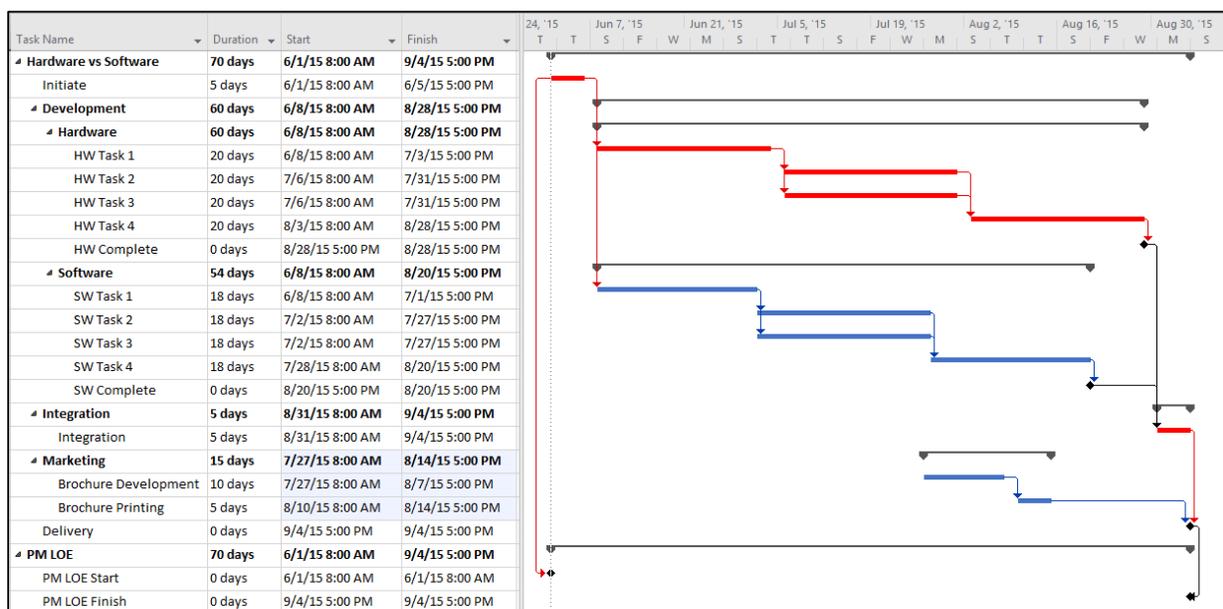


Figure 1

The scheduling tool has calculated that the critical/longest path runs through Initiate, the Hardware tasks, and finally Integration.

But, on the assumption that everything is subject to some uncertainty, are there other tasks we should consider as potentially have an impact on the outcome?

Let's apply some uncertainty to all tasks. For simplicity, in this example we will apply symmetrical uncertainty of $\pm 25\%$ to each task. This means that each task is just as likely to finish early as late, meaning that on average each task should be completed in the duration originally estimated. The likely impact of each task on the outcome can be depicted using a Tornado chart. This shows the sensitivity of the outcome to each task in the schedule as seen in Figure 2.

ID	Task Name	Remaining Duration	Percent Critical	Percent Critical (Sensitivity)	Sensitivity Index	Sensitivity Index	Optimistic Finish of Project	Pessimistic Finish of Project	2015		
						50.0			Aug	Sep	
5	HW Task 1	4 wks	91%	91%	58%		9/3/15 11:25AM	9/15/15 10:08...	30	06	13
8	HW Task 4	4 wks	91%	91%	58%		9/3/15 11:25AM	9/15/15 10:08...			
7	HW Task 3	4 wks	45%	45%	29%		9/7/15 2:03PM	9/14/15 11:13...			
6	HW Task 2	4 wks	45%	45%	29%		9/7/15 2:06PM	9/14/15 11:08...			
17	Integration	1 wk	100%	100%	16%		9/7/15 8:16AM	9/9/15 1:08PM			
2	Initiate	1 wk	100%	100%	16%		9/7/15 8:16AM	9/9/15 1:08PM			
14	SW Task 4	18 days	9%	9%	5%		9/8/15 9:42AM	9/10/15 9:17AM			
11	SW Task 1	18 days	9%	9%	5%		9/8/15 9:42AM	9/10/15 9:17AM			
13	SW Task 3	18 days	5%	5%	3%		9/8/15 9:59AM	9/9/15 2:03PM			
12	SW Task 2	18 days	5%	5%	3%		9/8/15 9:59AM	9/9/15 1:58PM			

Figure 2

The Sensitivity Index ranks the tasks in order of their likely impact on the outcome and clearly shows that HW Task 1 and 4 are having the greatest effect. The split between green and red areas in the time scaled bar chart shows the potential impact versus the mean finish for the outcome. This highlights that when tasks HW Task 1 and 4 finished early then the finish date for the outcome also tended to finish earlier than its expected mean. Conversely, if the tasks finished late then the outcome moved later. By managing these tasks well during execution, the chance of an on-time delivery increases.

However, the symmetrical uncertainty we applied to all tasks was not very realistic.

Fortunately, the sensitivity analysis can be considered a 'hit' list of tasks that affected the outcome during the simulations. This list can be used for targeted estimate refinement. An example assessment of confidence in the estimated durations for tasks with a high sensitivity index is shown in Figure 3. Such assessments can use any terms or numbering schemes that meet the needs of the organization. For example 'High Confidence' could equally be described as 'Low Risk'.

Task Name	Duration	Assessment 2
Hardware vs Software	70 days	
Initiate	5 days	
Development	60 days	
Hardware	60 days	
HW Task 1	20 days	HW High Confidence
HW Task 2	20 days	HW High Confidence
HW Task 3	20 days	HW Medium Confidence
HW Task 4	20 days	HW High Confidence
HW Complete	0 days	
Software	54 days	
SW Task 1	18 days	SW Low Confidence
SW Task 2	18 days	SW Low Confidence
SW Task 3	18 days	SW Medium Confidence
SW Task 4	18 days	SW Low Confidence
SW Complete	0 days	
Integration	5 days	
Integration	5 days	
Marketing	15 days	
Brochure Development	10 days	
Brochure Printing	5 days	

Figure 3

We have indicated that we generally have higher confidence in the estimated durations for the hardware tasks and lower confidence in the estimates for the Software tasks.

The assessments might translate into the uncertainty data shown in Figure 4.

ID	Task Name	Remaining Duration	Early Start (MSP)	Duration Distribution Type	Duration Optimistic	Duration Most Likely	Duration Pessimistic	Duration Confidence Interval (%)
0	HW vs SW Demonstration	14 wks	01Jun15 08:00	(None)				
1	Hardware vs Software	14 wks	01Jun15 08:00	(None)				
2	Initiate	1 wk	01Jun15 08:00	(None)				
3	Development	12 wks	08Jun15 08:00	(None)				
4	Hardware	12 wks	08Jun15 08:00	(None)				
5	HW Task 1	4 wks	08Jun15 08:00	Normal	90%	100%	110%	100%
6	HW Task 2	4 wks	06Jul15 08:00	Normal	90%	100%	110%	100%
7	HW Task 3	4 wks	06Jul15 08:00	LogNormal	90%	103.68%	120%	100%
8	HW Task 4	4 wks	03Aug15 08:00	Normal	90%	100%	110%	100%
9	HW Complete	0	28Aug15 17:00	(None)				
10	Software	54 days	08Jun15 08:00	(None)				
11	SW Task 1	18 days	08Jun15 08:00	Triangular	90%	120%	150%	100%
12	SW Task 2	18 days	02Jul15 08:00	Triangular	90%	120%	150%	100%
13	SW Task 3	18 days	02Jul15 08:00	Beta	90%	110%	130%	100%
14	SW Task 4	18 days	28Jul15 08:00	Triangular	90%	120%	150%	100%
15	SW Complete	0	20Aug15 17:00	(None)				
16	Integration	1 wk	31Aug15 08:00	(None)				
17	Integration	1 wk	31Aug15 08:00	(None)				
18	Marketing	3 wks	27Jul15 08:00	(None)				
19	Brochure Development	2 wks	27Jul15 08:00	(None)				
20	Brochure Printing	1 wk	10Aug15 08:00	(None)				
21	Delivery	0	04Sep15 17:00	(None)				

Figure 4

If we now re-run the analysis, the Sensitivity Tornado chart shown in Figure 5 is produced.

ID	Task Name	Remaining Duration	Percent Critical	Percent Critical (Sensitivity)	Sensitivity Index	Sensitivity Index		Optimistic Finish of Project	Pessimistic Finish of Project	2015		
						50.0				Sep		
14	SW Task 4	18 days	86%	86%	59%			9/9/15 3:43PM	9/21/15 3:13PM	06	13	20
11	SW Task 1	18 days	86%	86%	59%			9/9/15 3:43PM	9/21/15 3:13PM			
12	SW Task 2	18 days	67%	67%	45%			9/11/15 8:26AM	9/21/15 11:35...			
13	SW Task 3	18 days	19%	19%	7%			9/14/15 10:14AM	9/16/15 3:09PM			
7	HW Task 3	4 wks	11%	11%	3%			9/14/15 10:40AM	9/16/15 10:25...			
8	HW Task 4	4 wks	14%	14%	3%			9/14/15 10:43AM	9/15/15 1:59PM			
5	HW Task 1	4 wks	14%	14%	3%			9/14/15 10:43AM	9/15/15 1:59PM			
6	HW Task 2	4 wks	3%	3%	1%			9/14/15 10:58AM	9/15/15 8:50AM			

Figure 5

We can clearly see that, due to the lower confidence in the Software duration estimates, the Software tasks are creating more uncertainty in the finish date. It is important to note that not only has the order of tasks likely to affect the outcome changed, but the range of likely values has also changed and moved further into the future (because we moved away from the unrealistic symmetrical uncertainty).

But what happened to the Initiate and Integration tasks? These were show in Figure 2 but do not appear in Figure 5.

Since our risk assessment/estimate refinement exercise focused on the Hardware and Software tasks, our revised model did not include any uncertainty for Initiate and Integration. Since they now have no uncertainty they do not create any variability in the outcome and therefore do not appear in the sensitivity analysis.

Risk Path Analysis

Another technique to view tasks responsible for the dates of the outcome is a Risk Path report shown in Figure 6 available in Full Monte 2017. This groups tasks based on their probability of affecting the outcome. Unlike the Sensitivity Tornado chart, the Risk Path report includes any task driving the outcome even if they have no uncertainty and do not appear on the sensitivity report.

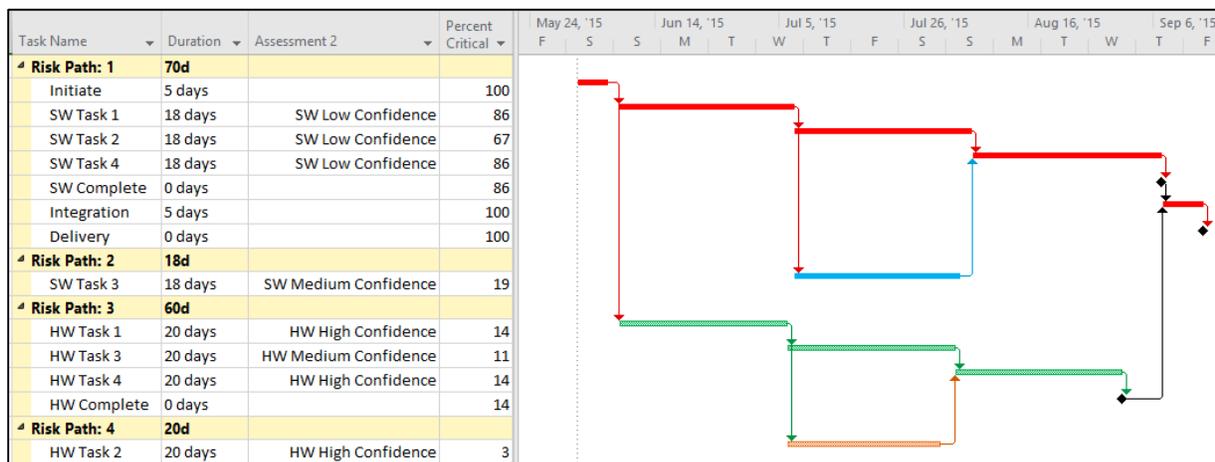


Figure 6

The Risk Path report can make it easier to understand the most likely critical path to any outcome and hence identify opportunities for schedule compression or risk reduction by changing logic between the tasks.

Full Monte 2017 allows both Sensitivity and Risk Path analysis to be focused either on the entire project or a selected interim deliverable. Figures 7 and 8 show the Sensitivity and Risk Path analysis focused on the SW Complete milestone.

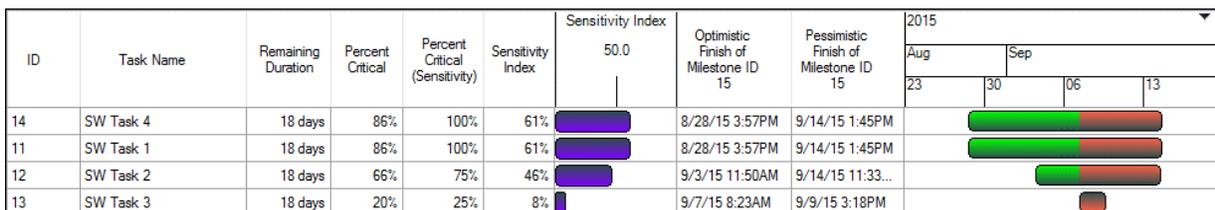


Figure 7

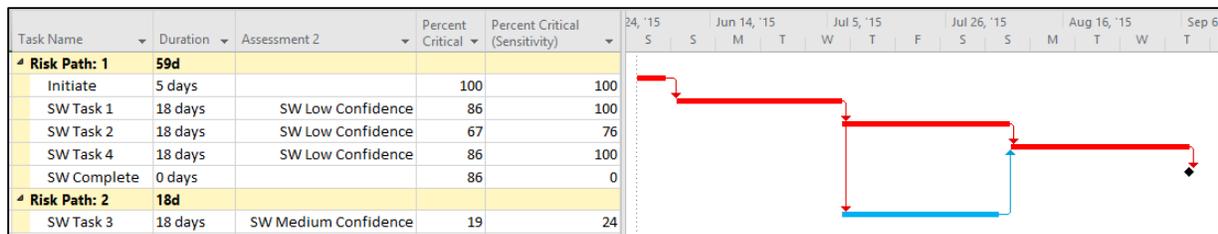


Figure 8

Note in Figure 7 that Full Monte calculates a Percentage Critical both to the Project Completion and the Selected Sensitivity target. In figure 8 we can see that task SW Task 1 is 100% on the critical path for SW Complete while only on the critical path to project completion 86% of the time.

Conclusion

While Sensitivity Analysis is a very powerful tool for understanding the effect of task duration uncertainty on specific outcomes, it does have two shortcomings:

1. Tasks with no uncertainty will not appear in a sensitivity report as they do not cause uncertainty in the outcome.
2. It is not easy to understand how any task featured on the sensitivity report logically fits in to create uncertainty in the outcome.

The Risk Path report in Barbecana’s Full Monte 2017 addresses both issues and highlights how other non-critical paths may ultimately affect the outcome.

Projects can realize significant cost savings and a greater chance of meeting commitments by understanding and managing the potential critical paths based on schedule risk analysis.