The Impact of Selected Assumptions and Core Tenets on Schedule Risk Assessment Results (A Progressive Model Comparison)

James D. Quilliam, PhD, PMP
Project Manager, Tecolote Research, Inc.

In the quest to ensure the sound representation of Schedule risk assessment (SRA) simulations this case study will provide a progressive model comparison of schedule risk assessment assumptions and core tenets. The elements of this approach will focus on the: methodology and tools; the progressive assumptions and core tenets applied; and conclusions and lessons learned for practitioners.

The effort to document the methodology, assumptions and applied core tenets for the schedule risk assessment process provides the opportunity to realize the direct impact these conditions will have on the schedule risk assessment results. This helps to establish a set of guidelines that can be followed for schedule risk assessment success. The outcome of this case study will offer new insight into the importance of selected assumptions used for schedule simulations. This will greatly enhance the understanding and confidence that leadership and project teams have in the schedule risk assessment results. It will also assure that sound decisions are being made based on the reliance of these crucial simulation factors.

Overview - Progressive Model Comparison

This case study is an effort to document and to share with other practitioners the results of a progressive schedule risk assessment model comparison. This document will provide the assumptions and core tenets that were used during a formal schedule risk assessment and share the impact these assumptions and core tenets had on the SRA results. The following SRA models provide a detailed representation of the steps that were followed and the findings, results and lessons learned for SRA practitioners to consider.

Schedule Risk Assessment Approach

As a Schedule risk assessment practitioner I was asked to conduct a formal schedule risk assessment. I was provided with a Microsoft project Integrated Master Schedule (IMS) by the Project team. This project database included the activities that were identified as risk items to be assessed in the simulation. The @Risk for project (version 4.1.4) software tool was used for the schedule risk assessment simulations. This tool was selected since it was a compatible add-in to use with the integrated master schedule which was developed in Microsoft project.

The initial goal was to conduct a schedule risk assessment with a risk assessed delivery date that was defendable and supportable. In working with the customer team, it became apparent, early on, that the methodology, assumptions, and applied core tenets would have a direct impact on the schedule risk assessment results. Here are the results of the initial progressive risk simulations with various core conditions.

Progressive Phase 1 Results

An initial SRA simulation was completed using the @risk tool with these initial assumptions and core tenets.

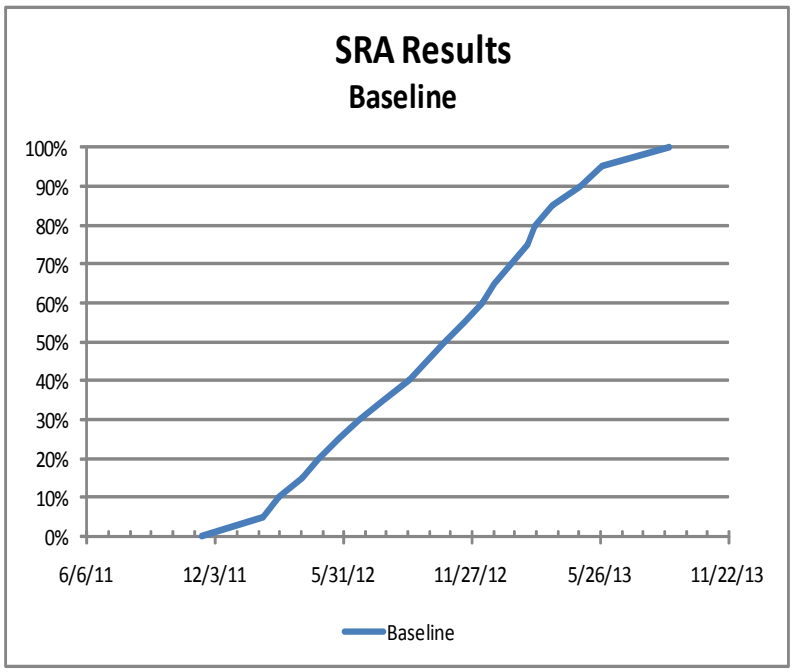
Figure 1.

Phase 1 Assumptions and Core Tenets
Utilized integrated master schedule provided by project team
Set margin to zero duration
Set must start and must finish constraints set to as soon as possible (ASAP)
Applied expert risk ratings and their probability of occurrence on IMS risks and applied overall risk rating on remaining activities to be completed
No uncertainty applied to identified level of effort (LOE) activities

In phase 1 I utilized the integrated master schedule provided by the project team. The next step was to set all margin activities identified in the project plan to zero (duration set to zero); uncertainty was applied to all integrated master schedule remaining duration activities to be completed; all hard constraints were removed (Must finish & Must Start); all level of effort (LOE) activities were excluded from the analysis (uncertainty was not applied to any LOE activity).

It is to be noted that a team of experts were utilized to provide their inputs and these risk inputs were applied to the simulation model. The uncertainty duration ratings and probability of occurrence were applied to the expert team risks selected from the project risk list. Uncertainty duration was applied to all remaining activities. The SRA was simulated with the uncertainty and risks against the delivery date. The initial SRA results are represented below.

Figure 2.



0%	11/15/2011
5%	2/7/12
10%	3/1/12
15%	4/2/12
20%	4/25/12
25%	5/24/12
30%	6/22/12
35%	7/25/12
40%	8/30/12
45%	9/24/12
50%	**10/19/12**
55%	11/16/12
60%	12/10/12
65%	12/27/12
70%	**1/21/13**
75%	2/12/13
80%	2/22/13
85%	3/19/13
90%	4/26/13
95%	5/28/13
100%	8/29/2013

In review of the initial SRA baseline results with the current applied assumptions and core tenets, it was apparent that the baseline results were representing a delivery date substantially beyond the current planned delivery date of 10/26/2011. I collaborated with the customer project team on any additional core tenets that would be appropriate and pertinent to apply to the simulation.

Progressive Phase 2 results with additional Core Conditions

During discussions with the customer team it was decided that it would be appropriate to apply *four additional core tenets*. This would enable us to determine the impact these additional core tenets would have on the SRA results. The durations for all level of effort (LOE) activities were set to zero. A lesson learned during this process is that there was concern that many of the identified LOE activities could be considered discrete deliverable activities and may not meet the definition of being an LOE activity. An analysis was conducted with the customer and project team to review the list of LOE activities. At the completion of this analysis some of the LOE activities were converted to discrete activities.

In addition, the uncertainty formulas were applied to the remaining duration field instead of the duration field. In @Risk the analyst needs to specifically select the field value for applying the formula. The remaining duration and duration values will be very close at the beginning of a program but as the program progresses the remaining duration will vary substantially from the duration values.

Correlation was also determined to be a possible impact factor and therefore was applied to the simulation. Also we uncovered several Start no earlier than (SNET) constraints that were impacting the launch date and they were set to as soon as possible (ASAP). The following core conditions that were used for phase 2 are represented below.

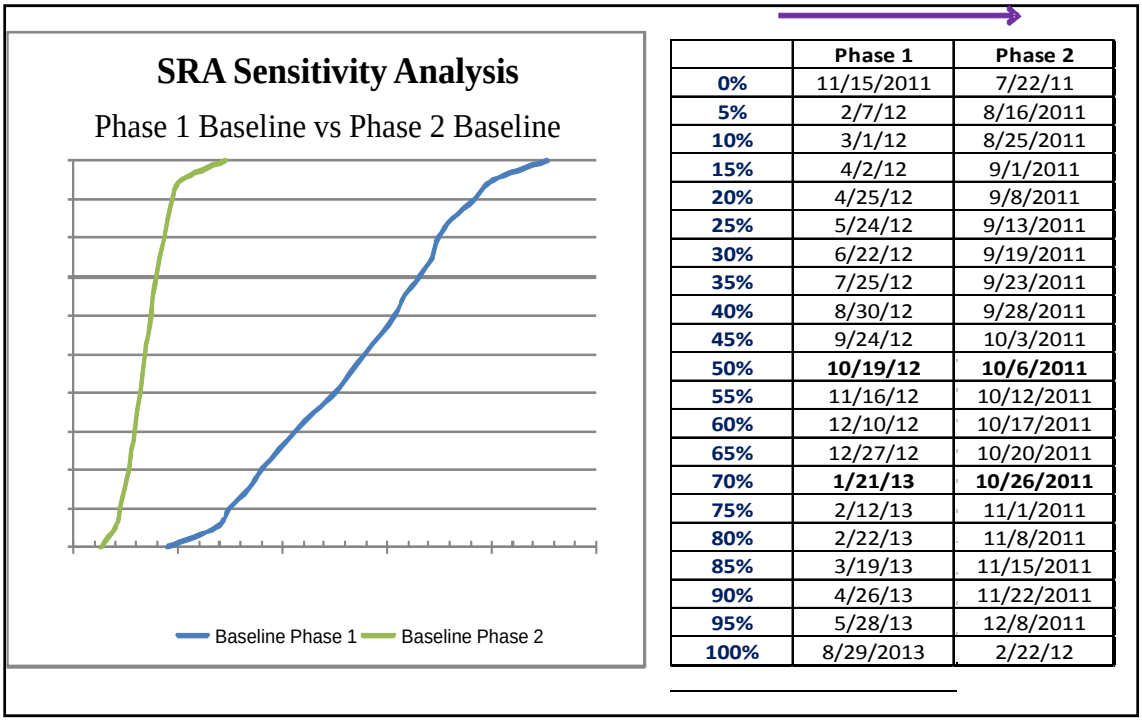
Figure 3.

Phase 2 Assumptions and Core Tenets
Utilized integrated master schedule provided by project team
Set margin to zero duration
Set must start and must finish constraints set to as soon as possible (ASAP)
Applied expert risk ratings and their probability of occurrence on IMS risks and applied overall risk rating on remaining activities to be completed
No uncertainty applied to identified level of effort (LOE) activities
Plus these additional core tenets
Level of Effort (LOE) set to zero duration
Remaining duration field used to apply uncertainty formulas
Applied correlation factors
Start no earlier than (SNET) constraints driving launch set to ASAP

The application of the original core tenets and the four additional core tenets were input to the simulation model.

In adding the four core tenets to the original model substantially shifted the Phase 1 S-curve results. The probability of making the beginning of the launch window date of 10/26/2011 was 0% for Phase 1. The probability of a launch date prior to and including 10/26/2011 was a value of 70%. A summary of the results are represented below in figure 4. Figure 4 shows the SRA sensitivity analysis s-curves and corresponding Phase 1 and Phase 2 percentile values. The overall assessment shows that in phase 1 there is a 0% chance of making a delivery on or before October 26, 2011. In phase 2 the chance of delivery on or before October 26. 2011 was seventy percent.

Figure 4.



	Phase 1	Phase 2
0%	11/15/2011	7/22/11
5%	2/7/12	8/16/2011
10%	3/1/12	8/25/2011
15%	4/2/12	9/1/2011
20%	4/25/12	9/8/2011
25%	5/24/12	9/13/2011
30%	6/22/12	9/19/2011
35%	7/25/12	9/23/2011
40%	8/30/12	9/28/2011
45%	9/24/12	10/3/2011
50%	**10/19/12**	**10/6/2011**
55%	11/16/12	10/12/2011
60%	12/10/12	10/17/2011
65%	12/27/12	10/20/2011
70%	**1/21/13**	**10/26/2011**
75%	2/12/13	11/1/2011
80%	2/22/13	11/8/2011
85%	3/19/13	11/15/2011
90%	4/26/13	11/22/2011
95%	5/28/13	12/8/2011
100%	8/29/2013	2/22/12

Phase 1 0% chance of delivery on or before 10/26/2011 Phase 2 70% chance of delivery on or before 10/26/2011

Progressive Phase 2 results with no correlation

The next progressive analysis included a trail and error effort with the removal of correlation from the model. This is depicted in Figure 5 and in table 1 below. Figure 5 depicts the three s-curves representing Phase 1, Phase 2 and Phase 2 with no correlation. Table 1 represents the corresponding percentile values (dates) for each of the three s-curves.

It was hypothesized that the application of correlation might have the effect of shifting the S-curve results substantially. The correlation from the Phase 2 baseline simulation was removed. The findings showed that there was no significant impact with or without correlation applied to the simulation model. The results of Phase 2 and Phase 2 with no correlation were essentially in family where correlated data added approximately one week duration to the percentile launch dates. The table provides a comparison of the simulation results of Phase 1, Phase 2 and Phase 2 without correlation applied.

Figure 5.

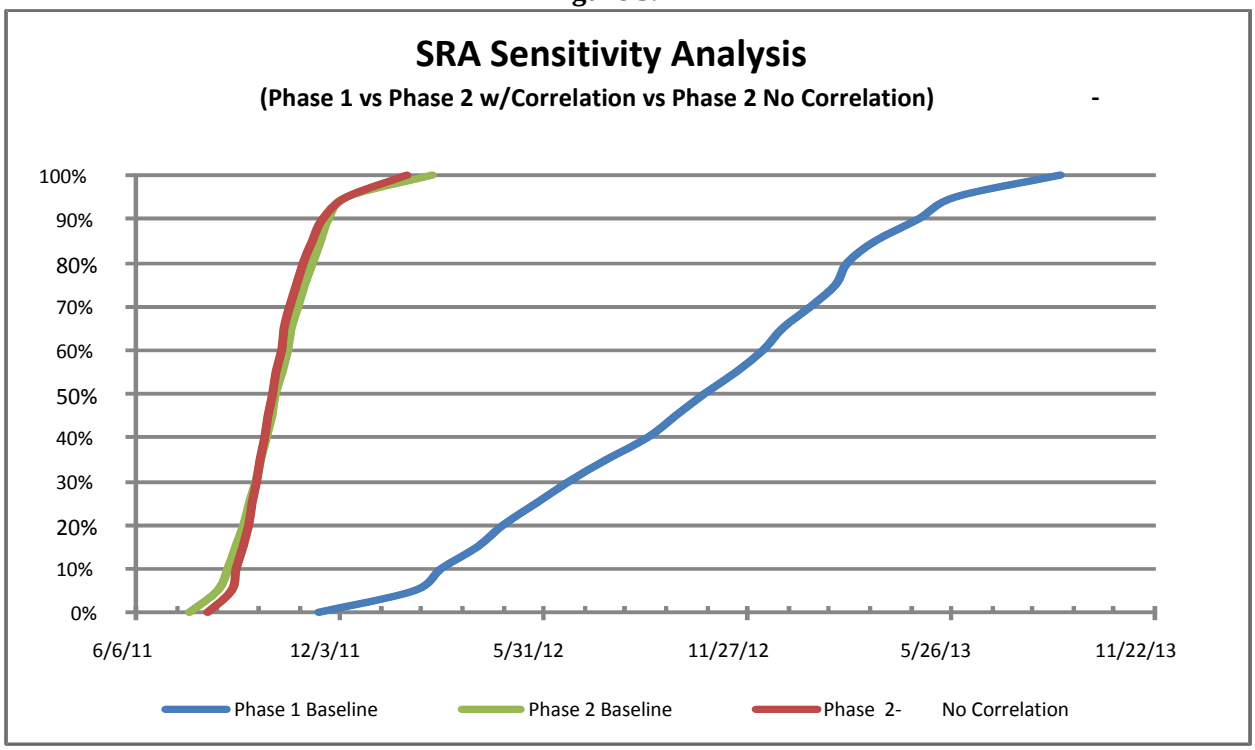


Table 1.

	Phase 1	Phase 2 with Correlation	Phase 2 No Correlation
0%	11/15/2011	7/22/11	8/8/11
5%	2/7/12	8/16/2011	8/29/2011
10%	3/1/12	8/25/2011	9/2/2011
15%	4/2/12	9/1/2011	9/8/2011
20%	4/25/12	9/8/2011	9/13/2011
25%	5/24/12	9/13/2011	9/16/2011
30%	6/22/12	9/19/2011	9/20/2011
35%	7/25/12	9/23/2011	9/23/2011
40%	8/30/12	9/28/2011	9/27/2011
45%	9/24/12	10/3/2011	9/30/2011
50%	**10/19/12**	**10/6/2011**	**10/4/2011**
55%	11/16/12	10/12/2011	10/7/2011
60%	12/10/12	10/17/2011	10/12/2011
65%	12/27/12	10/20/2011	10/14/2011
70%	**1/21/13**	**10/26/2011**	**10/19/2011**
75%	2/12/13	11/1/2011	10/25/2011
80%	2/22/13	11/8/2011	10/31/2011
85%	3/19/13	11/15/2011	11/8/2011
90%	4/26/13	11/22/2011	11/17/2011
95%	5/28/13	12/8/2011	12/8/2011
100%	8/29/2013	2/22/12	1/30/12

Progressive Case Analysis (Progressive Comparison with Cases 1-4)

With the Phase 1 and 2 and Phase 2 with no correlation models completed and results analyzed, the next evolution of our progressive comparison was to go back to the original assumptions and core tenets applied in phase 1. All of the same Phase 1 core tenets were used for this subsequent analysis. This allowed for the testing of various cases with specific core tenets applied. This provided a database of new simulation results with these specific case-by-case progressive comparisons. The goal was to determine or pinpoint the primary driver/s that were impacting and had the greatest influence on the SRA results. The methodology that was used is represented below for the four (4) cases that were simulated.

The assumptions/core tenets that were applied were used as the baseline model to initiate the analysis. The case attributes are represented below.

Core Tenets

- Utilized integrated master schedule provided by project team
- Set margin to zero duration
- Set must start and must finish constraints set to as soon as possible (ASAP)
- Applied expert risk ratings and their probability of occurrence on IMS risks and applied overall risk rating on remaining activities to be completed
- No uncertainty applied to identified level of effort (LOE) activities

Case 1: Core tenets above plus SNET constraints driving launch set to ASAP
Case 2: Core tenets plus case 1 and remaining duration value versus duration value used to apply uncertainty formulas
Case 3: Core tenets plus case 1 & 2 and correlation applied
Case 4: Core tenets plus case 1, 2 & 3 and LOE set to zero duration

In each of the case excursions the various core tenets were applied and then each progressive case attribute was applied to establish s-curve results for comparison among all the cases. A representation and explanation of the case results are summarized below.

Case 1

As you can see Case 1 applied the original core tenets while also setting the start no earlier than (SNET) constraints driving the launch date to be set to as soon as possible (ASAP). This would allow for the activities surrounding launch to be as free as possible (free flowing) from constraints among the integrated master plan activities.

Case 2

After Case 1 was completed Case 2 attributes were implemented. Case 2 included the combination of the core tenets plus Case 1 SNET constraints set to ASAP and then all of the uncertainty formulas were formulated using the remaining duration and not duration. This allowed the model to simulate each of the activities remaining duration for the project effort.

Case 3

Once Case 2 was accomplished, Case 3 was implemented. Case 3 included the core tenets plus Cases 1 and 2 attributes with the added correlation factors. A correlation factor was applied to the activities in the overall simulation model.

Case 4

Case 4 included the core tenets plus the attributes of Cases 1, 2, & 3 plus level of effort (LOE) activities set to zero duration. This insured that LOE activities would not have a factor on influencing simulated launch dates.

The results of the s-curve percentiles for each of the first 3 phases and the 4 cases can be found in table 2.

Table 2.

S-Curves with individual cases applied

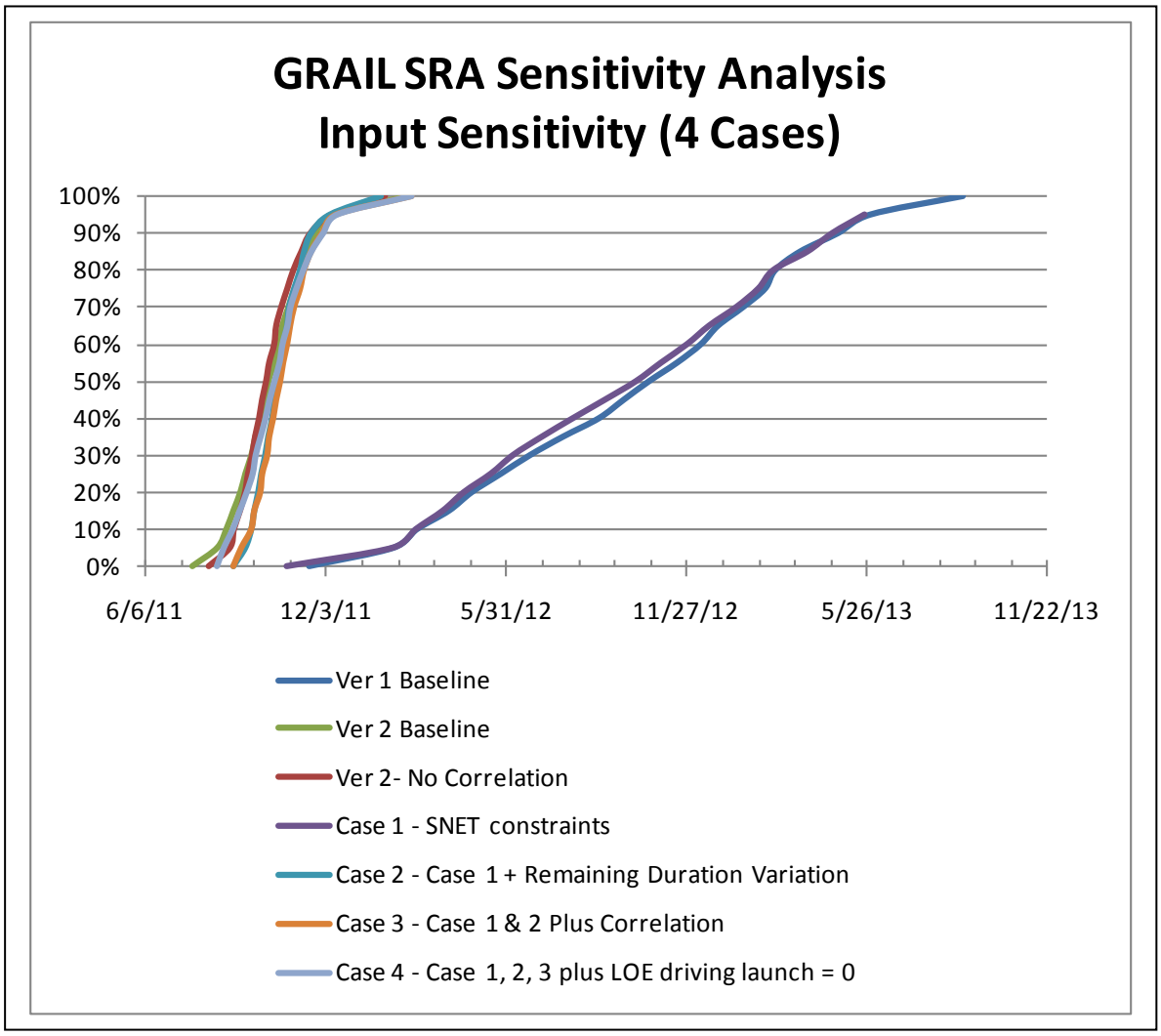
	Phase 1 Baseline Ver 1 Baseline	Phase 2 Baseline Ver 2- Baseline	Phase 2 No Correlation Ver 2- No Correlation	Case 1 - SNET constraints	Case 2 - Case 1 + Remaining Duration Variation	Case 3 - Case 1 & 2 Plus Correlation	Case 4 - Case 1, 2, 3 plus LOE driving launch = 0
0%	11/15/2011	7/22/11	8/8/11	10/25/2011	9/1/2011	9/1/2011	8/15/2011
5%	2/7/12	8/16/2011	8/29/2011	2/8/2012	9/13/2011	9/9/2011	8/22/2011
10%	3/1/12	8/25/2011	9/2/2011	3/2/2012	9/19/2011	9/19/2011	8/31/2011
15%	4/2/12	9/1/2011	9/8/2011	3/29/2012	9/22/2011	9/22/2011	9/7/2011
20%	4/25/12	9/8/2011	9/13/2011	4/19/2012	9/26/2011	9/28/2011	9/14/2011
25%	5/24/12	9/13/2011	9/16/2011	5/16/2012	9/29/2011	9/30/2011	9/20/2011
30%	6/22/12	9/19/2011	9/20/2011	6/7/2012	10/3/2011	10/5/2011	9/23/2011
35%	7/25/12	9/23/2011	9/23/2011	7/6/2012	10/6/2011	10/7/2011	9/28/2011
40%	8/30/12	9/28/2011	9/27/2011	8/6/2012	10/10/2011	10/11/2011	10/3/2011
45%	9/24/12	10/3/2011	9/30/2011	9/7/2012	10/12/2011	10/14/2011	10/7/2011
50%	**10/19/12**	**10/6/2011**	**10/4/2011**	**10/8/2012**	**10/17/2011**	**10/18/2011**	**10/12/2011**
55%	11/16/12	10/12/2011	10/7/2011	11/2/2012	10/19/2011	10/21/2011	10/17/2011
60%	12/10/12	10/17/2011	10/12/2011	11/28/2012	10/21/2011	10/25/2011	10/20/2011
65%	12/27/12	10/20/2011	10/14/2011	12/20/2012	10/25/2011	10/28/2011	10/25/2011
70%	**1/21/13**	**10/26/2011**	**10/19/2011**	**1/16/2013**	**10/27/2011**	**11/1/2011**	**10/28/2011**
75%	2/12/13	11/1/2011	10/25/2011	2/7/2013	11/1/2011	11/7/2011	11/3/2011
80%	2/22/13	11/8/2011	10/31/2011	2/22/2013	11/7/2011	11/11/2011	11/10/2011
85%	3/19/13	11/15/2011	11/8/2011	3/28/2013	11/11/2011	11/18/2011	11/18/2011
90%	4/26/13	11/22/2011	11/17/2011	4/22/2013	11/18/2011	11/29/2011	11/30/2011
95%	5/28/13	12/8/2011	12/8/2011	5/24/2013	12/7/2011	12/13/2011	12/14/2011
100%	8/29/2013	2/22/12	1/30/12	10/10/2013	1/27/2012	2/27/2012	2/27/2012

From the data results in table 2 it became apparent that with the progressive core tenets applied that two of the simulation results fell out of family and the other five (5) were in family. Another way to state this is that the applied core tenets did not have a substantial impact on the overall Phase 2 results as 5 of the simulation results had similar s-curve steepness and similar simulation percentile results and they were all essentially adjoined.

It is also interesting that the findings from the progressive Case 1-4 analysis that the distributions that were simulated using the remaining duration and not duration seemed to have the greatest influence on the SRA results among the 4 cases. It is to be noted that this program was at a maturity level where the remaining duration values were substantially less than the original duration value of the prospective tasks.

Figure 6.

S-Curves with individual cases applied



It was also uncovered during this analysis that with all the SNET constraints set to ASAP the model was able to achieve near parity with the phase 1 results. Essentially Case 1 was in family with phase 1 results and these two s-curves were the flattest of the s-curve results. The Phase 2 and Phase 2 with correlation and cases 2-4 were all in family with steep s-curve results. Please reference Figure 6. The take away from this analysis is the understanding the importance that selecting core tenets or assumptions can have on your SRA results and the possibility of unintended consequences from application of certain core tenets upon the simulation model. This research is very beneficial for SRA practitioners to better understand the impact these selected assumptions and core tenets can have on the simulated SRA results. It is also important for senior leadership teams to be plugged from the onset on these developed models so they can better understand and agree with the assumptions and core tenets applied. This will insure that they can be confident on a sound agreed to model so they can place a high level of confidence on SRA results and rely on these results to implement key program decisions.

Biography

James D. Quilliam, PhD, PMP

James is currently a Principal Analyst in the Los Angeles Division of Tecolote Research, Inc. a privately-held company that provides high quality, integrated services that rely on an empowered and experienced professional staff, proven business and analytical processes, and automated tools that are based on a strong knowledge of customer requirements and leading edge technology. He has supported multiple federal and military mission-driven organizations. James has successfully assisted and consulted with a myriad of organizations to help them foster and implement initiatives to produce intelligent, fact-based decisions to improve mission effectiveness, resource efficiency, and resource savings. His educational background includes a Bachelor of Science degree in Business Administration, a Masters of Business Administration, and Ph.D. in Industrial and Organizational Psychology.
Address: 2120 East Grand Avenue, Suite 200, El Segundo, CA 90245 E-Mail: JQuilliam@tecolote.com
Telephone: (310) 640-4700, Ext. 52861.