

ABOUT RMC

Briefly, Resolution Management Consultants, Inc. (“RMC”) specializes in avoiding, minimizing or resolving problems that may evolve during the design and construction process. Founded in 1993 by veterans in the construction contracting and engineering professions, RMC has assisted numerous private owners, public agencies, and contractors in either achieving project goals or resolving cost and time disputes between the contracting parties. The collective experience of our professional staff encompasses all phases of the design and construction process, including engineering, construction management and accounting.

RMC’s core business is centered on the construction industry – from inception through completion and closeout. RMC provides the unique qualifications and experience that have been accumulated through performing project management, construction management, contract compliance audit and dispute resolution services. The unique blend of qualifications and experience, provides us with a vast wealth of knowledge as to the construction processes and controls that have been successful, and those that have not been successful (or properly implemented) which has resulted in projects experiencing significant project variances and cost overruns – both in terms of time and budget.

SCHEDULE RISK ANALYSIS

The ability to deliver a project on time and on budget are the cornerstones of a successful project. Often companies develop a construction schedule only to see the project run long. Many times, this could have been avoided or reduced if the project incorporated Risk Management into their process. Risk Management identifies the potential schedule impacts to the project and how to calculate and manage those impacts. These impacts can be negative (threats) or positive (opportunities). A Risk Management Plan defines the process for both the qualitative (risk matrix / risk register) and quantitative (schedule) risk analysis to be performed on a project.

- **Qualitative:** Identify risks to a project, determine the potential impact of each risk and develop mitigation strategies.
- **Quantitative:** Evaluate the probability that the schedule deadlines will be achieved utilizing a Quantitative Schedule Risk Analysis (QSRA).

Qualitative risk analysis determines the project risks and priority of the risk identified. utilizing a Risk Register and Risk Matrix.

- **Risk Register** is where potential risks are identified, logged and tracked.
 - Document that lists/tracks project risks.
 - Used for monitoring and controls of risks and opportunities during construction.
 - Dynamic document that should be updated regularly throughout the project.
 - Probability of each risk occurring.
 - Range in time of potential impacts.

- **Risk Matrix** combines the severity, probability and priority of the risk's potential schedule and cost impact. It is usually a visual representation normally in grid form.
 - Probability of each risk occurring (Percentage or range of percentages such as 0-25%, 25-50%, etc.).
 - Range in time of potential impacts. (ex. 0-1 month, 1-2 months)

THE RESULTS – INFORMATION YOU CAN USE TO IMPROVE THE PROJECT

Quantitative risk analysis evaluates the potential time impacts of uncertainties and risks. We do this by performing Monte Carlo simulations. The Monte Carlo simulations provide multiple potential outcomes, as well as the probability of each from the risk data provided. We usually run 25,000 simulations. These simulations allow the project to see the likelihood of the project completing on time based on the risk defined. The risks and summary schedule are input into Deltek where risks and their associated impacts are mapped to schedule activities and simulations run to generate risk adjusted forecast dates for probability confidence levels, usually P20/P50/P80, for activities, milestones, and overall project completion along with a prioritized list of schedule risks.

What does this mean for you? You get information which allows you to know the completion dates at various confidence levels and the risks which could have the most impact to the project. Having this knowledge allows you to focus on a prioritized list of risks and know their potential impacts. The “Risk Exposure Histogram” tracks the frequency and cumulative frequency of the milestone activities after running a set number of simulations, usually 25,000. It provides the above mentioned risk adjusted forecast dates for set probability confidence levels (i.e. P20/P50/P80), for activities, milestones, and overall project completion. The “Risk Driver Tornado Chart” provides you the top risk events impacting the selected milestone completion date using a set percentage certainty date (i.e. P20/P50/P80) as well as their potential impact.

THE PROCESS – THE DETAILS

To accomplish the above, RMC proposes to perform the following:

1. Perform a Risk Analysis to review the design, constructability and operational functions on the project that may impact the ability to achieve success on the Project. The success factors identified should include:
 - Complete the project within the current construction budget
 - Complete construction on time
 - Meet all functional requirements for the project
2. Utilizing the Baseline Project Schedule (“Baseline”), develop a Risk Assessment Summary Schedule (“RASS”) for use in a Monte Carlo simulation. The Baseline can have 1,000+ activities which need to be reduced to below 500 activities to allow the simulation model

strategic effect of risk on the Project's finish date. The RASS will be summarized to reflect, at a minimum, the following level of detail:

- ✓ Major Construction Trades
 - ✓ Significant Dependencies
 - ✓ Anticipated Constraints (i.e., material deliveries)
3. Develop a Project Risk Register ("PRR") based on the Baseline and a review of relevant information available.
 4. Collect additional risk data by conducting separate risk interviews and/or workshops:
 - a. Owner
 - b. Design team, Contractors, Key Subcontractors

Project Risk Workshop ("PRW") will be performed to extract the necessary risk, cost, and uncertainty data available from the Owner and Contractors for the QSRA analysis. This will facilitate RMC's development of the Risk Register by identifying risks and developing a risk mitigation strategy for monitoring and controlling these risks over the remainder of the Project.

5. Identify Risk Drivers – Availability of Time (i.e., Float), Labor, Material
6. Develop the Risk Model

The Risk Model is developed using a Risk Matrix and Risk Register. The Risk Matrix is developed for time impact and cost and is set for between 1 and 5 probability and impact ranges. The schedule and cost impacts are user defined and can be tailored to the specific schedule and risk. The below is a typical Risk Matrix:

The screenshot displays the 'Risk Matrix' software interface. At the top, there is a 'Template' menu and a toolbar with icons for 'Open', 'Save', 'Add', 'Delete', 'Probability Ranges', 'Impact Ranges', 'Color Thresholds', 'Auto Score', and 'Auto Range'. Below the toolbar are three configuration sections:

- Event Impact Template:** A table defining impact levels for 'Schedule' and 'Cost'.

Name	% Based	Prefix	Suffix	Very Low	Low	Medium	High	Very High
Schedule	<input type="checkbox"/>		d	<14d	<30d	<90d	<150d	<210d
Cost	<input type="checkbox"/>	\$		<\$65,000	<\$120,000	<\$333,000	<\$665,000	<\$2,500,000
- Probability / Scoring Template:** A table mapping probability ranges to impact levels and scores.

Name	Min Value	Very Low	Low	Medium	High	Very High
Very High	>85%	5	10	15	20	25
High	>60%	4	8	12	16	20
Medium	>30%	3	6	9	12	15
Low	>15%	2	4	6	8	10
Very Low	<=15%	1	2	3	4	5
- Risk Register Color Thresholds:** A table defining color codes for risk scores.

Color	Value
Green	<=8
Yellow	<=16
Red	>16
- Risk Register Custom Fields:** A table for defining custom fields in the risk register.

Name	Is Enabled
Owner Email	<input checked="" type="checkbox"/>
Custom Field 1	<input type="checkbox"/>
Custom Field 2	<input type="checkbox"/>
Custom Field 3	<input type="checkbox"/>
Custom Field 4	<input type="checkbox"/>
Custom Field 5	<input type="checkbox"/>

The Risk Register establishes user defined risks, where probability and impact factors are assigned, and risks are mapped to specific activities in the schedule.

Risk Register																			
Drag a column header here to group by that column																			
Risk		Current					Mitigation					Mitigated					Custom Fields		
Enabled	Absolu...	Mapped	ID	Type	Name	Shape	Probability	Schedule	Cost	Score	Enabled	Description	Duration	Cost	Probability	Schedule	Cost	Score	Owner Email
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5		Restrictions from landlord and ten...		Medium	Low	Very Low	5	<input type="checkbox"/>		0d	\$0	Medium	Low	Very Low	5	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7		Lack of staging area		Very Low	Very Low	Very Low	2	<input type="checkbox"/>		0d	\$0	Very Low	Very Low	Very Low	2	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8		Limited construction access throu...		Very Low	Very Low	Low	3	<input type="checkbox"/>		0d	\$0	Very Low	Very Low	Low	3	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12		Power Ventilator Procurement		Medium	Low	Low	6	<input type="checkbox"/>		0d	\$0	Medium	Low	Low	6	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20		FE Doors at Staircase		Very High	Medium	Very Low	15	<input type="checkbox"/>		0d	\$0	Very High	Medium	Very Low	15	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23		Solar Interferences of the Roof		Very Low	Very Low	Very Low	2	<input type="checkbox"/>		0d	\$0	Very Low	Very Low	Very Low	2	<input checked="" type="checkbox"/>

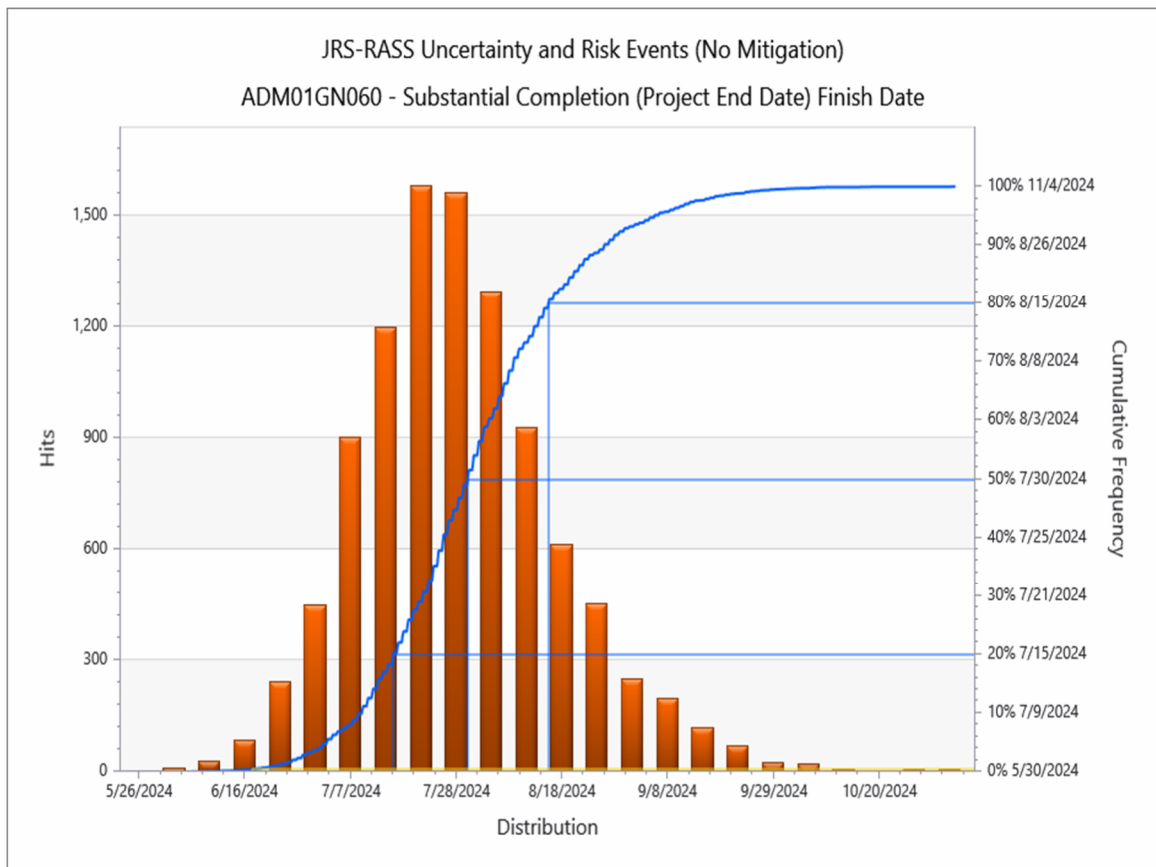
7. Perform Monte Carlo Simulation utilizing Deltek - Acumen Risk

The PRR and RASS are input into Deltek where risks and their associated costs are mapped to schedule activities and simulations run to generate risk adjusted forecast dates for different probability confidence levels, most commonly P20/P50/P80, activities, milestones and overall project completion along with a prioritized list of schedule risks. Similarly, the Deltek Cost Estimate Risk Model generates risk adjusted costs and

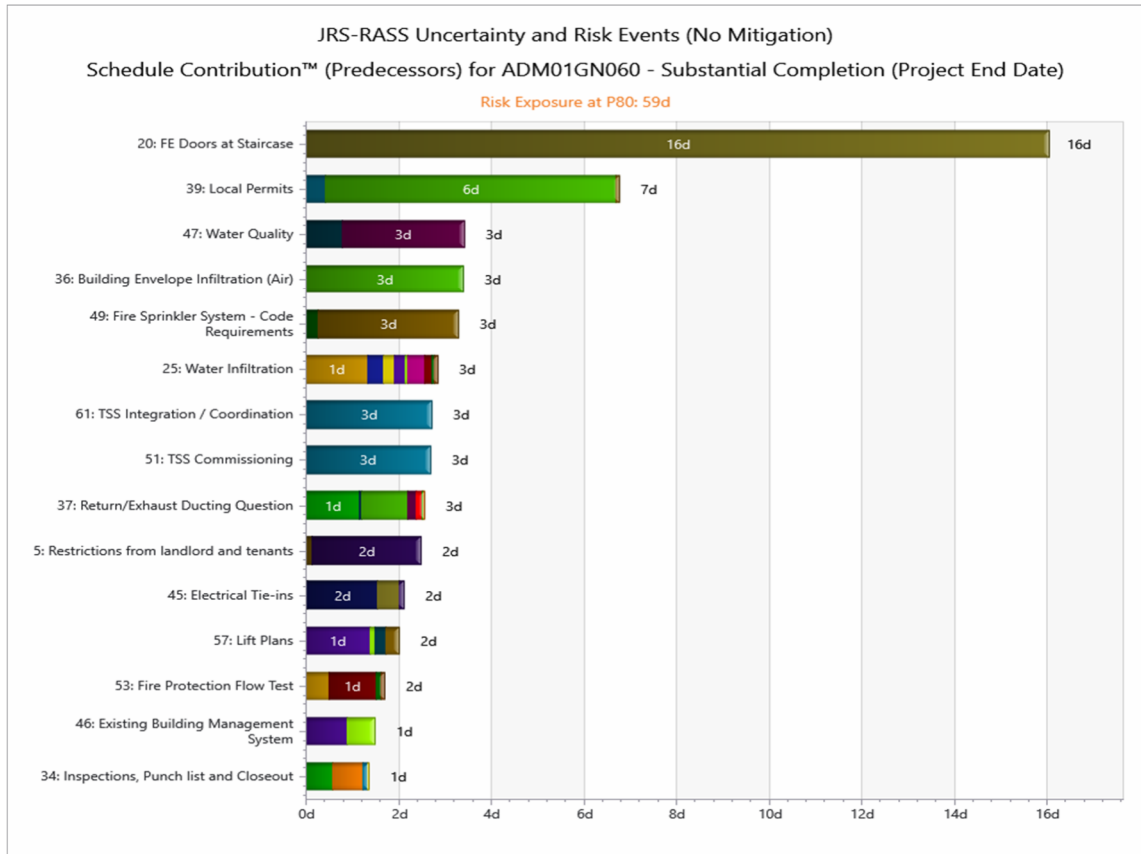
confidence levels P20/P50/P80, for all cost loaded activities, construction phase or type of work costs, and total project costs.

8. Issue the Report – interim Project milestone dates and key construction phase costs at a P-80 confidence level and substantial completion and overall project costs at P-20, P-50 and P-80 confidence levels, along with a prioritized list of risks to interim milestone dates, construction activity costs, and the overall critical path of the project.

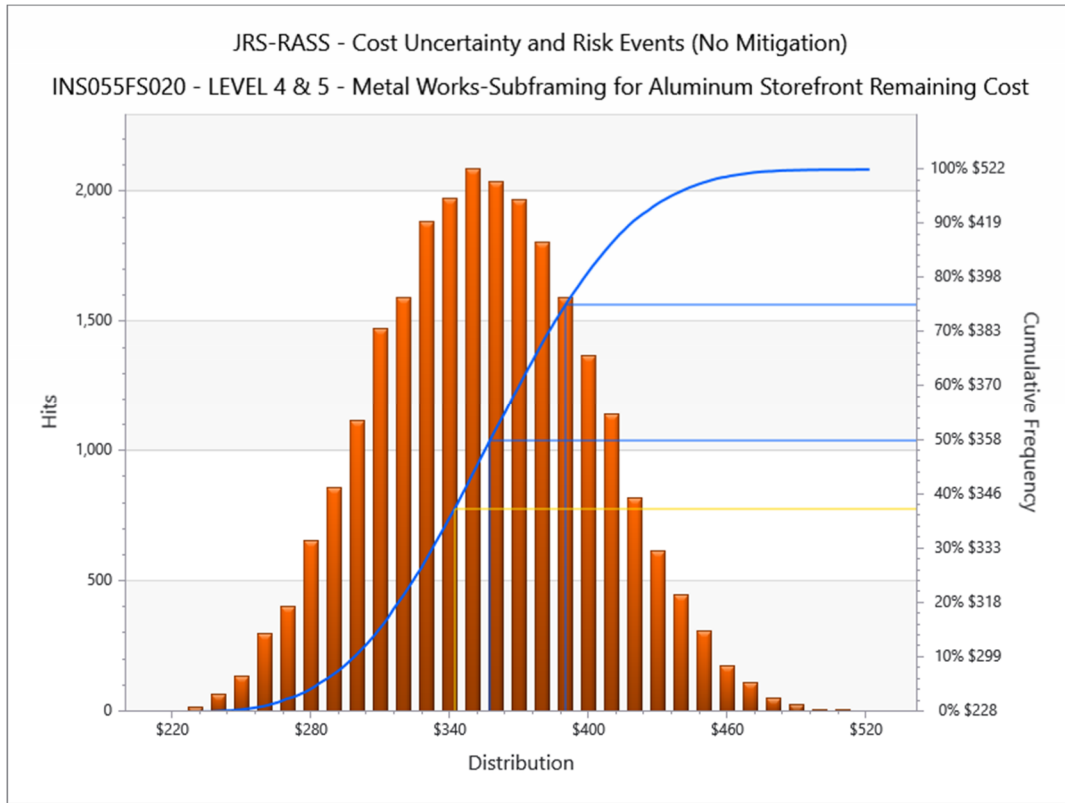
The report includes charts tracking the frequency and cumulative frequency of the milestone activities after running 25,000 simulations:



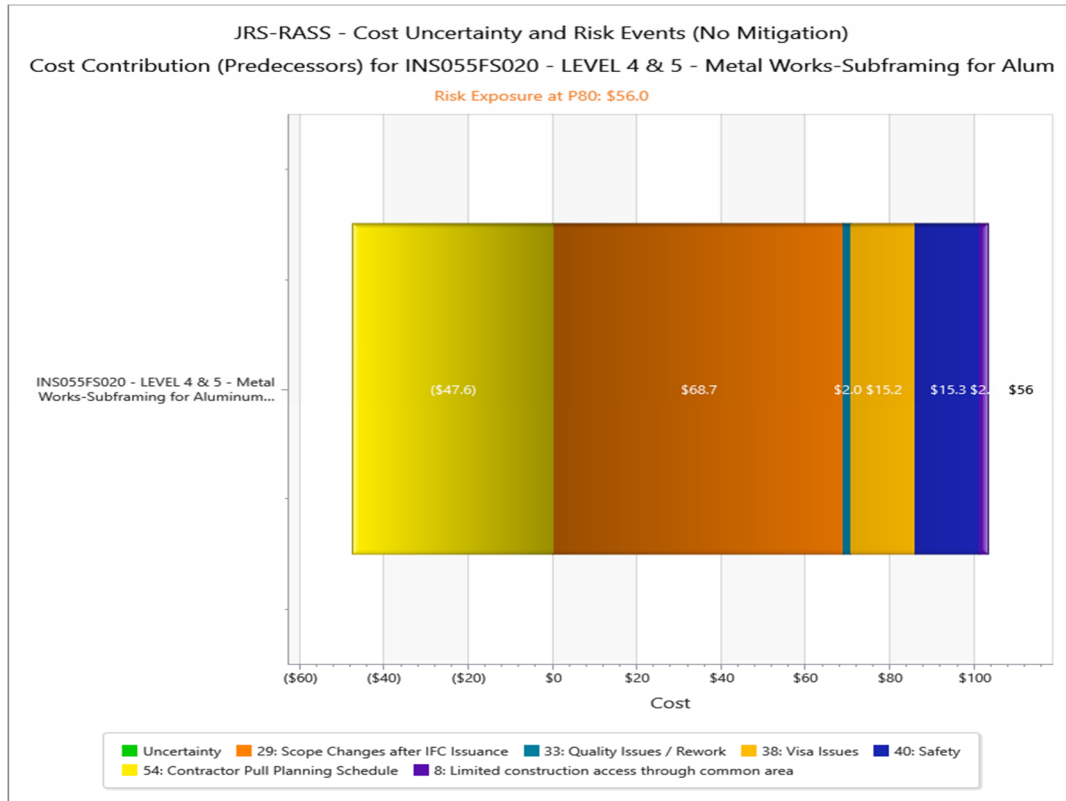
As well as the following “Risk Driver Tornado Chart” providing the top 15 risk events impacting the selected milestone completion date at 80% (P80) certainty, with 25,000 simulations run:



For associated costs, the report includes charts tracking the frequency and cumulative frequency of specific cost loaded activities after running 25,000 simulations:



As well as charts detailing the top 10 contributing activities based on a P80 analysis:



9. Discuss with you whether further actions are warranted to mitigate risks

Following the issuance of the QSRA Report, RMC will monitor Project performance to identify when QSRA updates should be performed. As a general guideline the QSRA should be updated at the following key milestone points during construction:

- When construction is approximately 20% completed, or at a point when construction has made progress that early project risks can be updated
- When approximately 40% to 60% of construction is completed
- At a point when approximately 80% of the construction is complete, or at a point potential risks impacting project completion can be updated.

Additional QSRA updates may be required should any of the following occur:

- A Revision Schedule is required
- A Recovery Schedule is required
- A major contract modification in which the contract completion date or overall scope of the Project is substantially modified