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**Joint Confidence  
Level Analysis for  
Projects with  
Multiple Objectives**

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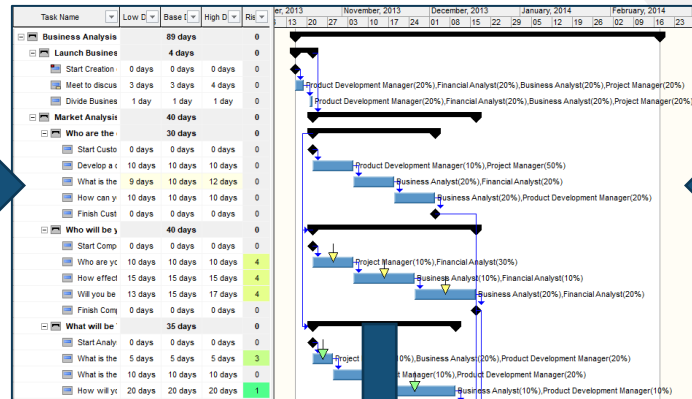


# Monte Carlo Risk Analysis: Risk Events vs. Uncertainties

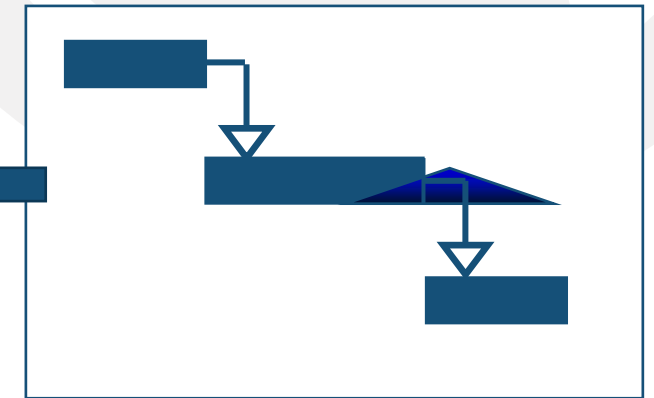
## Risk Register

Risk Name	Threat/C	Risk Assigned To	Pro	Imp	Sc	Score
Delay in Financing	Threat	Task 55: Acquisition of Finan	65.0 %	75.1 %	48.8 %	
Not enough information about competitors	Threat	Assigned to 3 tasks/resource	89.5 %	26.5 %	23.7 %	
Other risks, related to the project	Threat	All tasks (global)	20.0 %	79.5 %	15.9 %	
Selected name is taken	Threat	Task 28: Establish Name and	30.0 %	15.9 %	4.77 %	
Risks affecting whole company/division	Threat	All tasks (global)	4.00 %	36.5 %	1.46 %	
Cost information is not available	Threat	Assigned to 2 tasks/resource	9.80 %	0.00 %	0.00 %	
Delay in getting level advice	Threat	Task 29: Determine the legal t	85.0 %	0.00 %	0.00 %	
Delay in patent and trademark search	Threat	Task 28: Establish Name and	30.0 %	0.00 %	0.00 %	
Lack of knowledge of the specific area	Threat	All resources (global)	9.00 %	0.00 %	0.00 %	
Not enough data to analyze demand level	Threat	Task 21: What is the demand	75.0 %	0.00 %	0.00 %	
Not enough data to plan management of demand	Threat	Task 23: How will you manag	20.0 %	0.00 %	0.00 %	
Problem with hiring	Threat	Task 58: Hiring of key employ	15.0 %	0.00 %	0.00 %	
Resource Risks						

## Project Schedule



## Uncertainties as Duration and Cost Distributions

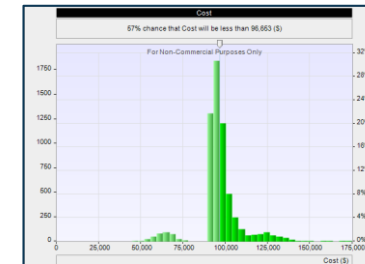
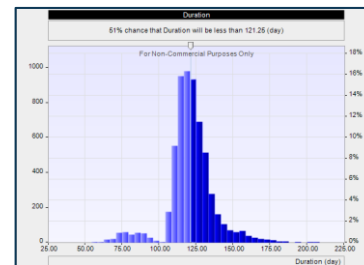


Assign risks to project activities

## Monte Carlo Simulations:



## Results of Analysis:



- Statistical distribution of cost, finish time and duration
- Ranked risks in Risk Register

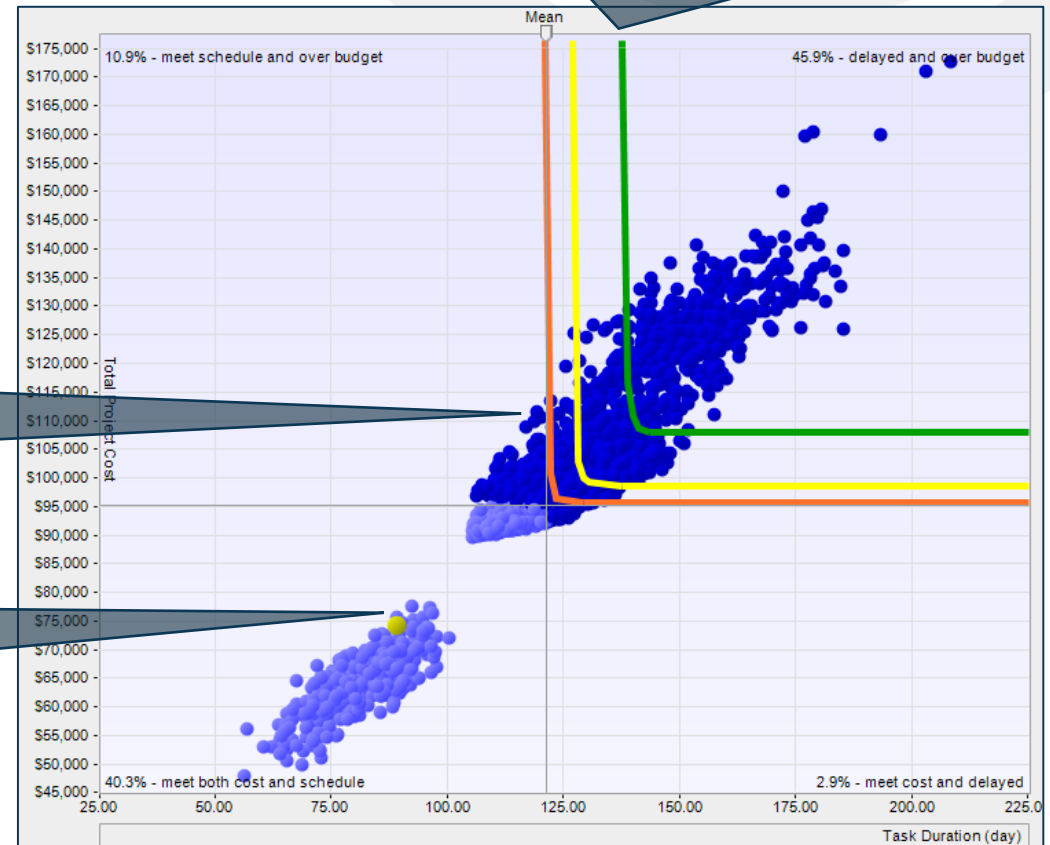
# Joint Confidence Level Analysis

The result of a Joint Confidence Analysis shows the probability that a project's cost will be less than the targeted cost and the finish time or duration will be less than the targeted finish time or duration.

Frontier lines show the combination of cost and duration that meets certain predefined targets: 70% chance that project will be on time and on budget at the same time (30% of dots are above this line)

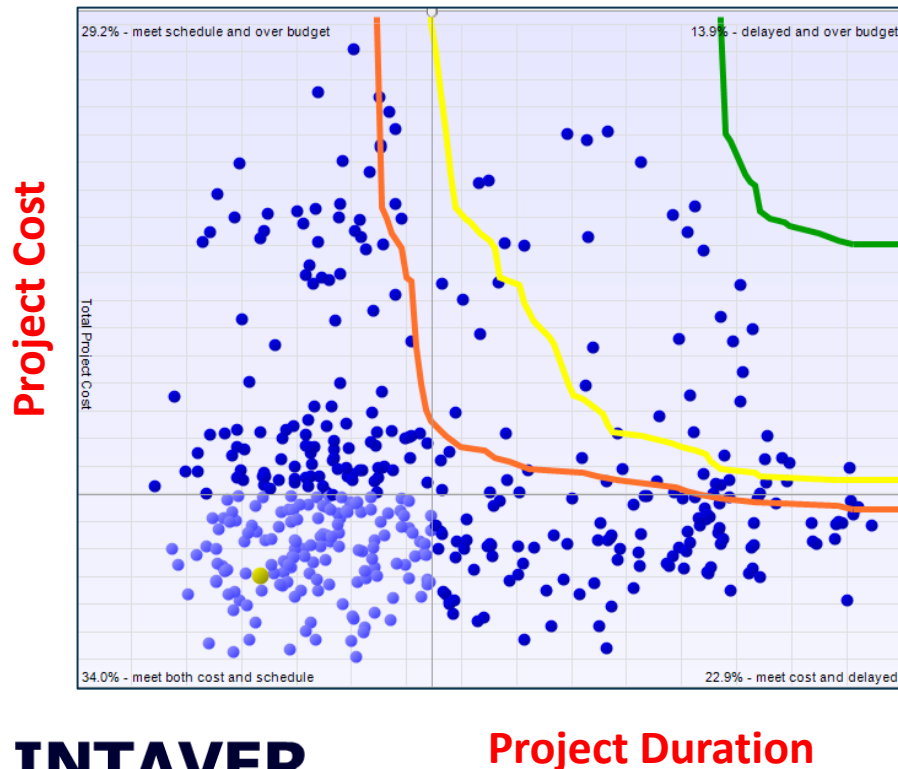
Each dot is a result of one Monte Carlo simulation (cost and schedule)

Deterministic project cost and schedule



# Limitation of Traditional Joint Confidence Analysis

- Traditional methodology is performed only for project cost and schedule.
- In reality, most projects have multiple objectives



Aerospace mission may not be successful if most objectives are not met due to some risks.

## Objectives

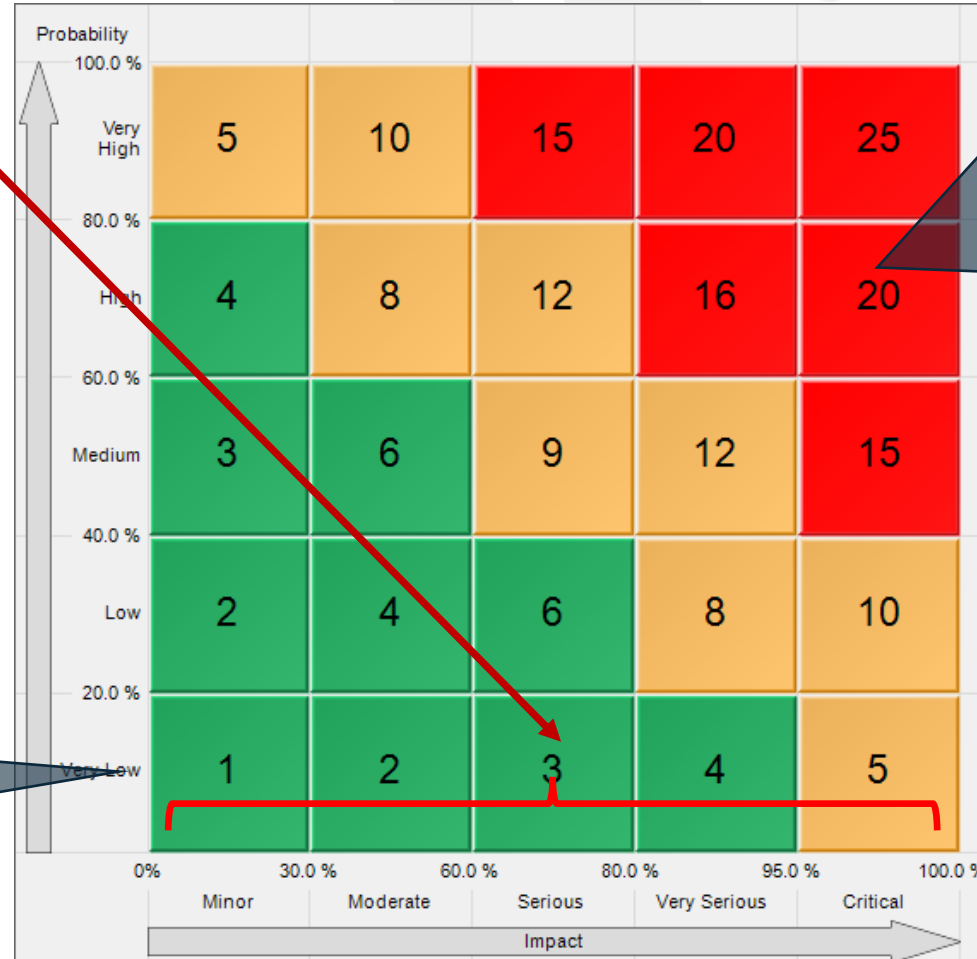
- Cost
- Schedule
- Technical Performance
- Quality/Reliability
- Environment
- Safety
- Security
- Litigation
- Public Relations

# Step 1. Define and Quantify Objectives

Example of the objective: Quality

Meaning	Range
Minor Quality Issues	0 – 30%
Moderate Quality Issues	30 – 60%
Serious, Very Serious, Critical	> 60%
....	....

Risk Matrix settings for Quality Risk



Number are used to calculate scores

Define scales for selected objective

Numerical value for each range

The scales are visualized on the risk matrix

# Step 2. Prioritize Objectives

All objectives

	Risk Category and Outcome Type	Importance	Schedule	Cost and	Safety	Environment	Quality	Legal	Performance	Technology
1	+ 🏠 Schedule and Scope	11.2%	1.00	1.00	1.00	1.00	0.33	1.00	1.00	1.00
8	+ 🏠 Cost and Income	12.3%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	+ 🏠 Safety	12.3%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	+ 🏠 Environment	12.3%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	+ 🏠 Quality	14.8%	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	+ 🏠 Legal	12.3%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
22	+ 🏠 Performance	12.3%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
24	+ 🏠 Technology	12.3%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Quality is 3 times more important than schedule

All objectives

Calculated priorities for each objective

# Step 3. Assign Risks to Tasks and Monte Carlo Analysis of Project Schedule

## A. Define Probabilities and Impacts:

Risk: Potential issues with supplier

The risk will be assigned to the following tasks or resources:

	Name	ID	Action
1	Task: Mechanical assembly	62	Add new risk or update existing risks

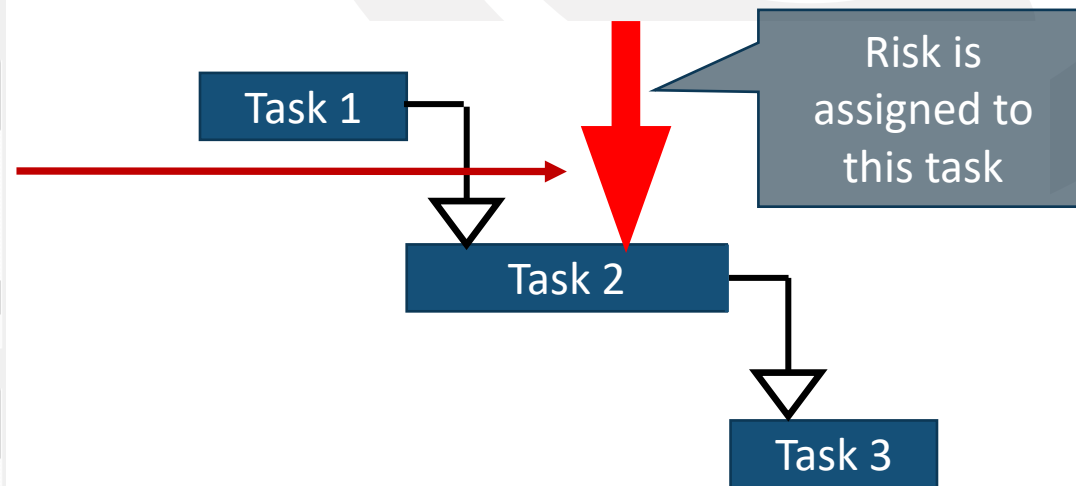
For quality and safety outcomes impact is defined based on scales

Define chances and outcomes for this risk assignments:

	Alternati	Chance	Outcome Type	Outcome	Start	Most Like
1		15.0 %	Relative delay	20.0 %	0.00 %	
2		15.0 %	Safety Risk	50.0 %	0.00 %	
3		15.0 %	Quality Risk	30.0 %	0.00 %	

Example: this risk reduce quality of 30% with probability 15%

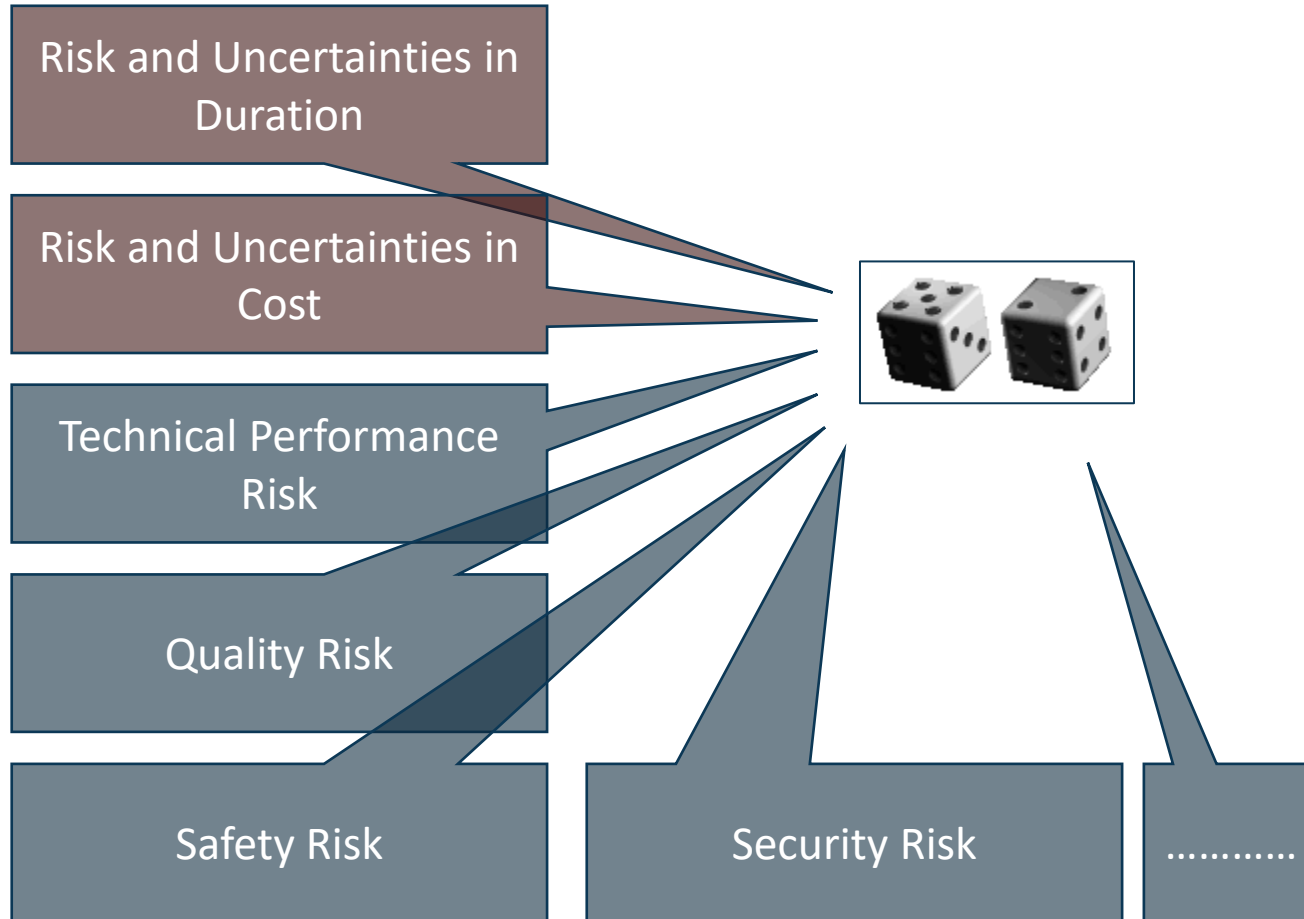
## B. Assign Risks to Project Schedule:



## C. Run Monte Carlo simulations:



# Monte Carlo Simulation



- The analysis was performed using RiskyProject Project Risk Analysis and Risk Management software by Intaver Institute Inc.
- Additional data analysis and visualization was performed using Microsoft Excel and OriginPro software.



# Step 4. Rank Risks for All Objectives

	Risk Name	Oper	Risk	Threat/C	Pre-Mitigation				Post-Mitigation		
					Pro	Impi	Sco	Score	Pro	Impi	Sco
1	Delay in Financing	Open	Risk	Threat	65.0 %	65.2 %	42.4 %		30.0 %	30.0 %	9.00 %
2	Delay of critical component delivery	Open	Risk	Threat	96.9 %	23.7 %	22.9 %		96.9 %	23.7 %	22.9 %
3	Failure of critical assembly	Open	Risk	Threat	20.0 %	72.9 %	14.6 %		20.0 %	72.9 %	14.6 %
4	Potential issues with supplier	Open	Risk	Threat	15.0 %	80.0 %	12.0 %		15.0 %	80.0 %	12.0 %
5	Software failure	Open	Risk	Threat	4.00 %	36.2 %	1.45 %		4.00 %	36.2 %	1.45 %
6	Cost information is not available	Open	Risk	Threat	55.3 %	0.00 %	0.00 %		55.3 %	0.00 %	0.00 %
7	Delay in transportation	Open	Risk	Threat	85.0 %	0.00 %	0.00 %		85.0 %	0.00 %	0.00 %
8	Critical test failed	Open	Risk	Threat	37.9 %	0.00 %	0.00 %		37.9 %	0.00 %	0.00 %

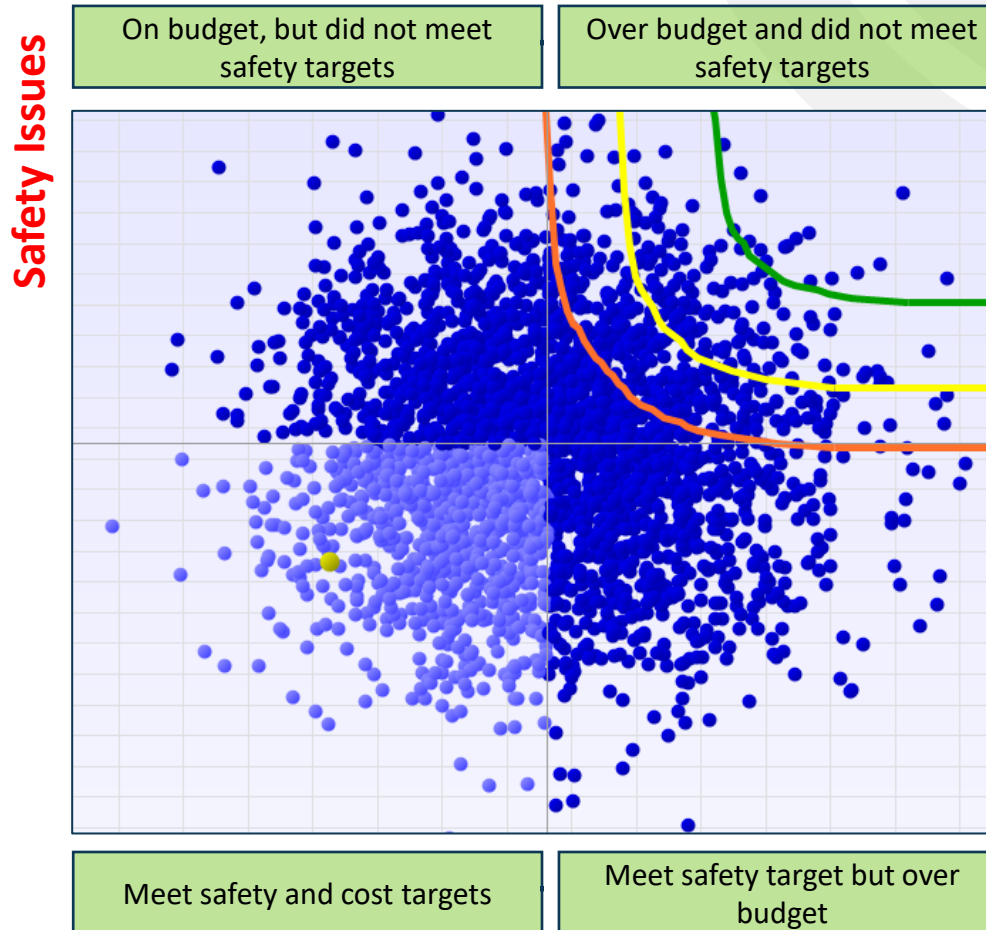
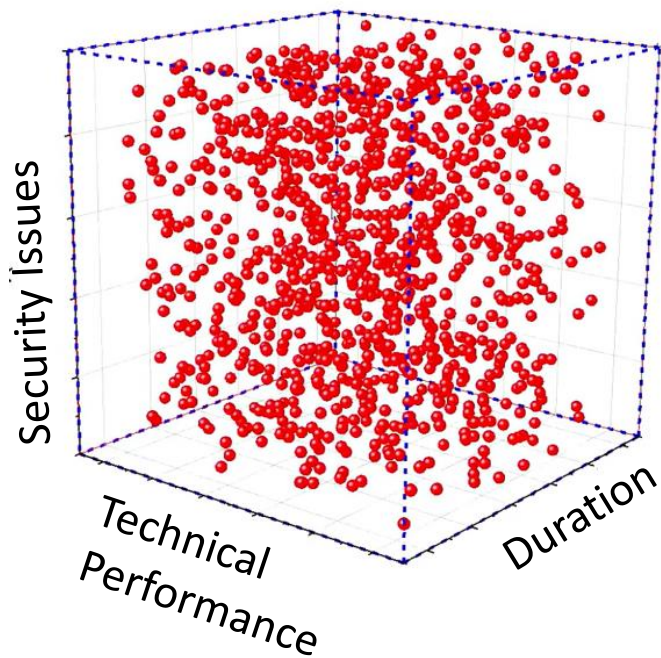
Critical risks for all objectives must be mitigated first

Risk Register is sorted based on score for all objectives together.

Risk Register can be sorted for individual objective: quality, safety, etc.

# Step 5. Analysis using Joint Confidence Level Scatter Plot

Example of 3D Plot



Frontier lines show the combination of cost and safety that meets certain predefined targets: e.g. 70%,80% and 90% chance that project will be on time and meet safety targets.

# Step 6. Risk Mitigation Based on JCL Analysis

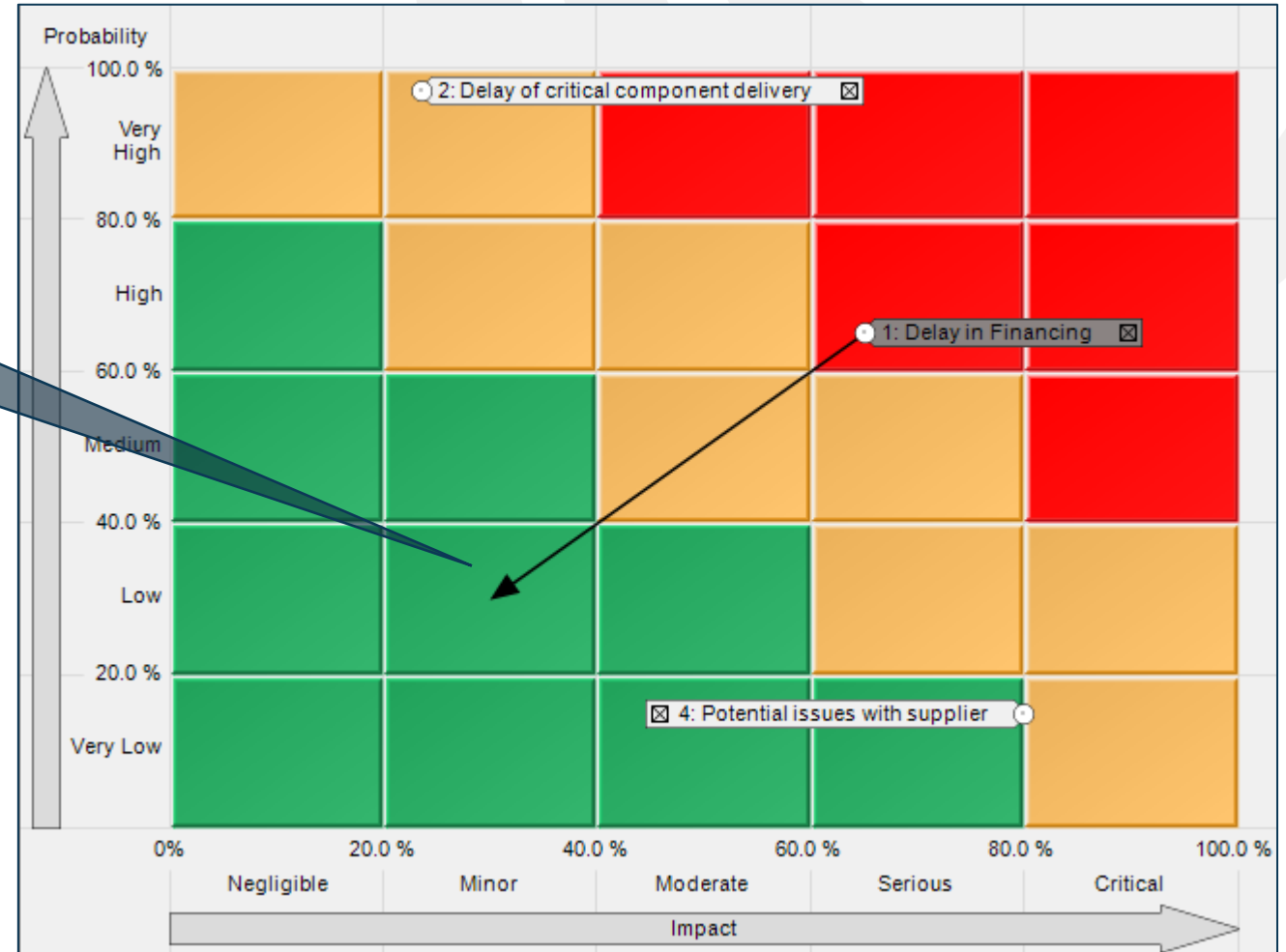
The risk must be mitigated so probability of the objectives could meeting predefined target will be reduced

New Joint Confidence Level analysis will be performed

Risk can be:

- **Mitigated**
- **Accepted**
- **Transferred**
- **Avoided**

JCL analysis can be used to make a decision



# CONCLUSIONS

- Projects in aerospace and defense industry have multiple conflicting objectives, which cannot be achieved at the same time on 100% due to multiple risks.
- Joint Confidence Level is a proven methodology of integrated cost and schedule risk analysis.
- The joint confidence level methodology was expanded to allow analysis with multiple objectives
- Project risk analysis with multiple objectives allows to rank project risk based on integrated score for all objectives
- Joint confidence level analysis can be used to assess efficiency of risk mitigation measures

