PO.ID 221

Quantitative Risk Assessment and Contingency Sizing

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Abstract

Understanding the risks associated with multi-million Euro projects is crucial for the successful development of renewable energy projects. Several different methodologies are currently used within the industry.

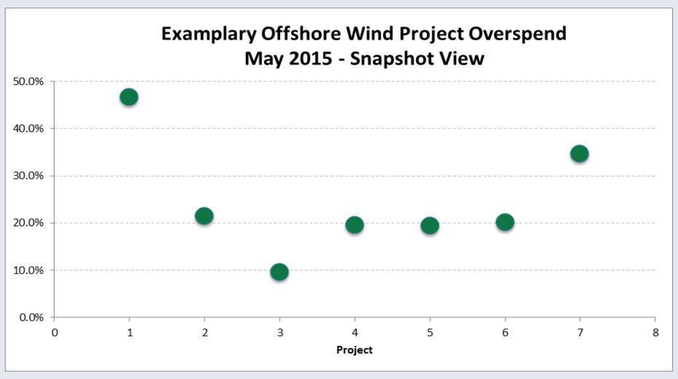
Probabilistic quantitative risk assessment using Monte Carlo simulation techniques is considered best practise to quantify and display the cost exposure associated with a project's risk profile.

This technique can be used to quantify the combined effects of all risks and uncertainties, both negative and positive, on the different project objectives. As such, this approach can for example be used to calculate the risks of cost or schedule overruns at different confidence levels. Depending on the desired certainty different contingency levels can thus be added to the project budget or milestone dates.

Project Experience (budget overrun)

Some reasons:

- Weather risk
- Production delays
- Insolvency
- Grid delay
- Serial defects
- Poor contractors execution

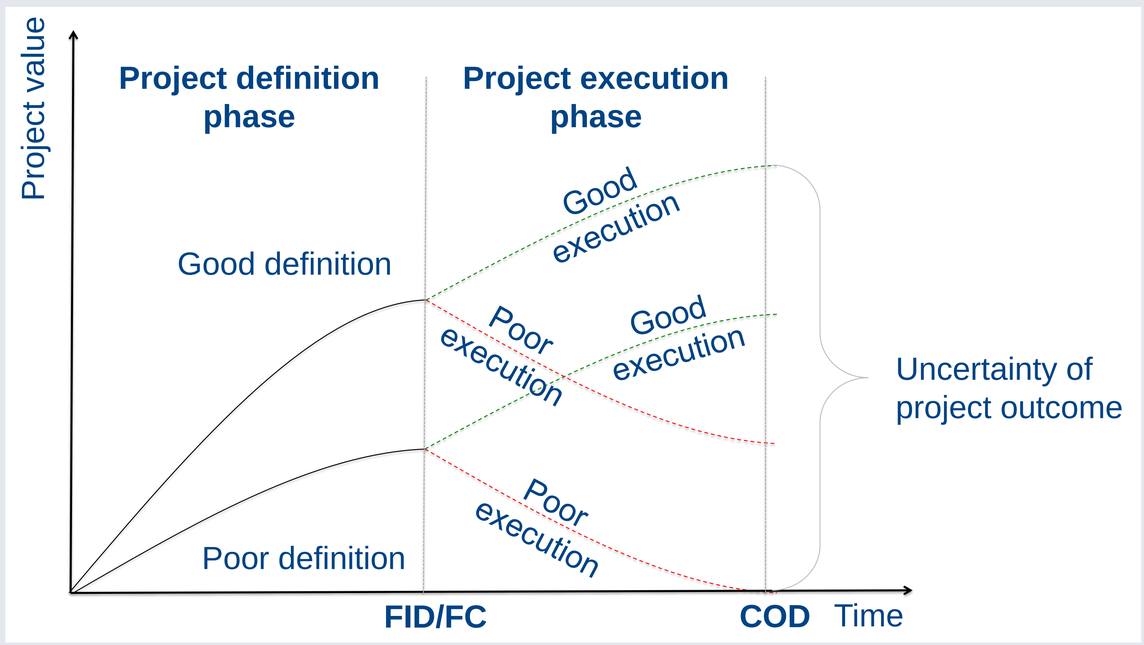


Conclusion:

- Cost and schedule variations have varied significantly.
- They do not necessarily correlate with the pre-FC risk profile of the project.
- The capability of the project's execution team and risk management has a direct influence on the end results.

Uncertainty of the Project Outcome

What influences the project outcome?



Steps of Quantitative Risk Assessment (QRA)

Step 1 Risk Identification

- Identification of **all risks** affecting the project objectives
- Risk **workshops,** interviews, review meetings and lessons learnt
- Risks are recorded in the **risk register**

Step 2 Risk Analysis

- Definition of **distributions**
- Estimation of **probabilities**
- Estimation of **impacts** (Three-point estimates)
- Correlations / **Knock on effects**

Step 3 Risk Modelling

- **Monte Carlo simulation** using specialized software

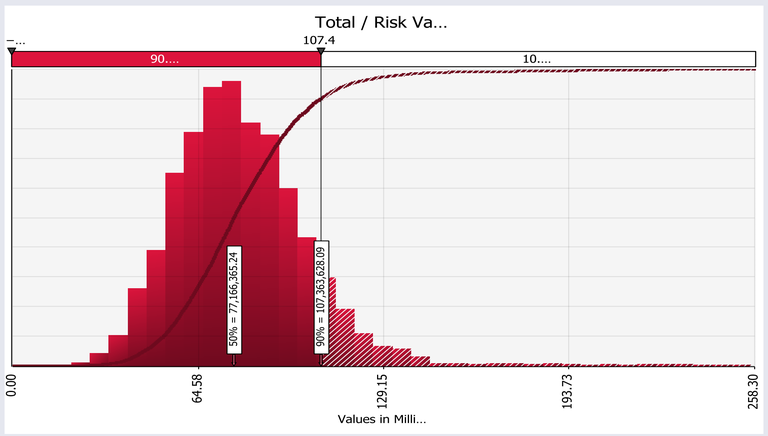
Result Contingency Estimate

- **Required contingencies** for different confidence levels
- **Connects the risk register** with the contingency needs for the project

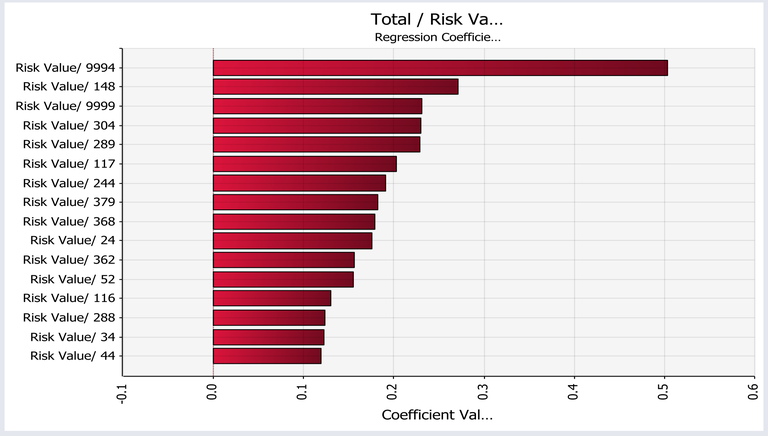
- Sensitivity analysis
- Risk mitigation strategy
- Stress testing
- Repeat analysis

- Multiple outcomes are then used to generate a single probabilistic function
- From this output the relevant probabilities relating to exceedance (i.e. P(50), P(10)) can be determined

Results of the QRA



Frequency distribution / Cumulative distribution



Tornado charts for sensitivity analysis

Findings

1. QRA is an established approach and considered the best practice method for sizing cost and schedule contingencies for mega-projects.
2. QRA is increasingly being used to estimate contingency requirements for offshore wind farms.
3. A further value add is the ability to continuously monitor and forecast cost and time to completion during the project execution.
4. However, our experience is that the quality of the quantitative risk assessments deviates significantly.
5. Integrity and success of the technique depends heavily on the experience of the user, company culture, the integrity of the risk register and assumptions made during the simulation.

Common Pitfalls

1. The execution efficiency of the planned risk response at FID/FC is overestimated.
2. Schedule driven cost risks (e.g. PM costs, construction monitoring, support vessels, etc.) are overlooked.
3. Inadequate modelling of correlation / knock on effects
4. Neglecting allowances for unknown unknowns
5. Inadequate understanding and assessment of weather risk.

   Experience has shown that transferring the entire weather risk to the contractor may not always be the most cost effective approach. Independent weather analysis and a detailed understanding by the Project are essential.

1. Stress tests are recommended to examine consequential impacts on both the individual work packages and the overall project under specific scenarios. Examples:
   - Major supply chain disruption occurs just after commencement of monopile manufacturing which leads to a six month delay of monopile delivery.
   - Significant issue (e.g. insolvency, poor performance, etc.) leads to the requirement to re-contract the cable installation package.

Conclusions

Unexpected things will happen, don't neglect this. Take risk management seriously and include unknown unknowns allowances during the QRA in a systematic manner. It is recommended to conduct regular health checks and stress tests to verify the QRA results.

QRA provides a better informed assessment of cost risk exposure, cost impacts, and sensitivities for different probability ranges. This results in a higher confidence in any revisions to time and cost estimations for completion. Following that the contingency requirements can also be determined in a better informed manner. Offshore wind projects with low risk profiles can benefit from this approach.