# [2. PROBABILISTIC RISK MANAGEMENT IN DESIGN AND CONSTRUCTION PROJECTS (RS280-1)](https://www.construction-institute.org/probabilistic-risk-management-in-design-and-construction-projects-version-1-1)

**Report Summary:** This study identified a process that organizations can use to implement more advanced project risk management approaches, including probabilistic analysis. This process comprises three levels, each of which offers clear benefits: risk identification, deterministic analysis, and probabilistic analysis. Although more information and confidence are gained as the analysis progresses through the levels, these benefits need to be weighed against the incrementally increasing costs of successfully completing each level. Due to their extra expense, probabilistic approaches are not warranted for every project. To help organizations select the appropriate level for their projects, this study explains the benefits, results, requirements, and limitations of each level.

**Key Takeaways:**

## (1) Risk management in design and construction projects has three levels:

## Level 1. Risk identification: Identifies risks and opportunities.

## (Project Phase: Feasibility through Operate Facility)

* Conduct interviews with project stakeholders to gather information about potential risks and opportunities.
* Collect documents related to risk management and probabilistic approaches, including policies, procedures, processes, reports, and forms.
* Review case studies of previous projects to identify common risk attributes that trigger the use of different levels of risk analysis.
* Analyze data collected from interviews and document reviews to visualize the organization's risk management framework.
* Develop a project-specific risk register using probabilistic approaches, including hypothetical examples and level triggers.

## Level 2. Deterministic risk analysis: Analyzes risks through single-point estimates of potential impacts.

## (Project Phase: Concept through Operate Facility)

* Develop a comprehensive risk register using probabilistic approaches to quantify and rank project risks.
* Determine overall contingency by providing an expected value for each identified risk, considering both positive and negative outcomes.
* Calculate mean values for each risk to provide an expected value for the impact of that risk on the project.
* Use these single-point estimates to analyze the potential impacts of each identified risk on the project’s schedule, budget, and quality.

## Level 3. Probabilistic risk analysis: Analyzes risks through probability distribution estimates of potential impacts.

## (Project Phase: Concept through Operate Facility)

* Develop a comprehensive risk register using probabilistic approaches to quantify and rank project risks.
* Collaborate with stakeholders to gather data and information about each identified risk, including its likelihood and impact.
* Conduct sensitivity analysis to test the robustness of the risk assessments against changes in assumptions or inputs.
* Use Monte Carlo simulations or other probability distribution methods to estimate potential impacts and visualize risk scenarios.
* Review and refine the risk assessments regularly throughout the project’s lifecycle to ensure their ongoing accuracy and relevance.

## [(2) Tool: Applying Probabilistic Risk Management in Design and Construction Projects, Version 1.2 (IR280-2)](https://www.construction-institute.org/applying-probabilistic-risk-management-in-design-and-construction-projects-version-1-2)

## (Project Phase: Feasibility through Construction)

This tool is designed to:

* Promote a probabilistic approach: Advocates using probabilistic risk management to better anticipate project costs, schedules, and potential risks, thereby enhancing decision-making and contingency planning.
* Define a three-level framework: Establishes a three-level (identification, deterministic analysis, and probabilistic analysis) risk management model that is tailored to varying project complexities and uncertainties.
* Utilize Monte Carlo simulations: Recommends Monte Carlo simulations for complex projects to assess the probability and impact of risks, thus offering a clear range of cost and time outcomes.
* Facilitate risk communication: Emphasizes risk visualization tools, such as tornado diagrams and probability density graphs, to improve stakeholder understanding and communication.
* Provide a risk register tool: Offers a customizable Excel-based risk register to track risks and guide project teams in applying the appropriate risk management level.

## [(3) Tool: What's the Risk? (IR280-3)](https://www.construction-institute.org/what-s-the-risk)

## (Project Phase: Feasibility through Operate Facility)

This tool is designed to:

* Identify key risks: Recognizes primary risks, such as poor soil conditions and utility delays, that may impact the project’s cost and schedule.
* Estimate cost and schedule: Project costs range from $15M to $30M, with an expected mean cost of $22.5M. Schedules average 3.6 years.
* Focus the mitigation efforts: Targets risks, such as ‘Historic site’ and ‘Replaced culvert over Wandering Creek’, for significant cost impact reductions.
* Assess contingency needs: Plans contingencies to keep costs and timelines within 80% confidence levels of $26M and 3.8 years.
* Utilize sensitivity analysis: Performs analysis to understand the highest-impact risks and where to prioritize mitigation for cost efficiency.