



Northeastern University

From Chaos to Clarity

Managing Uncertainty in Complex Project Environments

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Learning Objectives

- Distinguish risk, uncertainty, and ambiguity and explain how each affects project objectives and management decisions.
- Translate uncertain project conditions into structured risk information using evidence, assumptions, ranges, probabilities, and scenarios.
- Apply risk analytics such as sensitivity analysis, scenario analysis, expected monetary value, and Monte Carlo simulation to evaluate possible project outcomes.
- Interpret confidence levels such as P50, P80, and P90 and connect them to contingency and risk tolerance.
- Communicate uncertainty to decision makers without creating false precision or the illusion of certainty.

Monday, 8:12 AM: Your Forecast Just Became Obsolete

- You are the management accountant on a \$45 million transformation project.
- The business case was approved six months ago. The project is 30% complete. Management expects a 16% return and completion within 14 months.
- Then the environment changes.
 - A major supplier announces a 17% price increase.
 - A new tariff could affect imported components, but the final rate is still unclear.
 - Energy and transportation costs begin rising.
 - The project team requests \$2.4 million more for an AI-enabled redesign.
 - A major customer signals that demand could increase 25% but has made no commitment.
 - The CFO wants an updated forecast tomorrow morning.
 - The CEO asks one question: “Given what we know today, should we continue as planned, change course, or reconsider the investment?”

What would you take to the CFO tomorrow morning?

- A. The original forecast, with a note explaining the new uncertainties.
- B. A revised single-point forecast based on the most likely assumptions.
- C. A range of possible outcomes, with scenarios and key assumptions.
- D. A recommendation to postpone the forecast until more information becomes available.

The problem is not that management lacks a number. The problem is that one number may create an illusion of certainty.

Uncertainty Changes the Question

■ Traditional management question

- What will the project cost and how long will it take?
 - Give me the forecast.
 - Give me the completion date.
 - Give me the expected return.
 - Tell me whether we are on budget.

■ Decision question under uncertainty

- What could happen, and what should we do about it?
 - What outcomes are reasonably possible?
 - What assumptions are driving the forecast?
 - Which uncertainties could materially change the result?
 - What is within our control?
 - What decision must management make now?
 - What would cause us to change course?

- A forecast is not the future. It is an estimate based on assumptions about the future.
- When the assumptions change, the decision model must change too.

Risk Management Domains

- Enterprise Risk Management establishes the organization's overall risk appetite, governance structure, and strategic risk priorities.
- Portfolio Risk Management aligns collections of programs and projects with strategic objectives and balances aggregate risk exposure.
- Program Risk Management coordinates interrelated project risks and manages dependencies to achieve broader benefits.
- Project Risk Management addresses uncertainties that affect scope, schedule, cost, quality, and stakeholder expectations at the initiative level.
- Operational Risk Management focuses on ongoing processes, systems, compliance, and day to day performance stability.
- Strategic direction flows from enterprise to portfolio, program, and project levels, while risk information and performance data flow upward for oversight and decision making.
- Effective integration across domains supports alignment between strategy, execution, and operational sustainability.



Source: *Risk management and analytics: A case-based approach* (1st ed.). Cognella Academic Publishing.

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What is Risk Management?

- “The process through which organizations plan, identify, assess, and prioritize risks to minimize, monitor, and control the impact of unforeseen events, as well as to maximize opportunities” (Alexis, 2026, p. 2).
- “Coordinated activities to direct and control a [project] with regard to risk” (ISO 31000:2018, p. 1).
- “Activities used to identify, analyze, respond to, and monitor risks related to work objectives” (PMI, 2024, p. 137).



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Why Risk Management?

- Effective risk management enables the project team to:
 - Increase the probability of achieving project objectives related to scope, schedule, cost, and quality.
 - Promote a proactive mindset that anticipates uncertainty rather than reacting to issues.
 - Strengthen the identification and evaluation of both opportunities and threats.
 - Maintain alignment with legal, regulatory, and contractual requirements.
 - Allocate resources strategically based on risk exposure and priority.
 - Improve operational performance through structured analysis and informed decision making.
 - Reduce the financial and operational impact of adverse events.
 - Capture lessons learned to support continuous organizational improvement



Source: *Risk management and analytics: A case-based approach* (1st ed.). Cognella Academic Publishing.

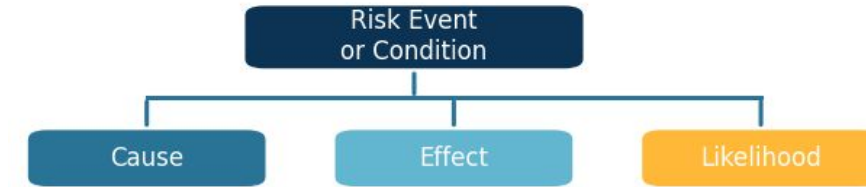
What is Risk?

- The probability and magnitude of potential deviations from intended objectives arising from uncertain future events or conditions, with implications for value creation and performance (Alexis, 2026).
- “Effect of uncertainty on objectives” (ISO 31000:2018, p. 1).
- “A future event with a measurable probability” (Knight, 1921, p. 231)
- “An uncertain event or condition that, if it occurs, has a positive or negative effect on one or more portfolio, program, or project objectives” (PMI, 2024, p. 136).



Source: *Risk management and analytics: A case-based approach* (1st ed.). Cognella Academic Publishing.

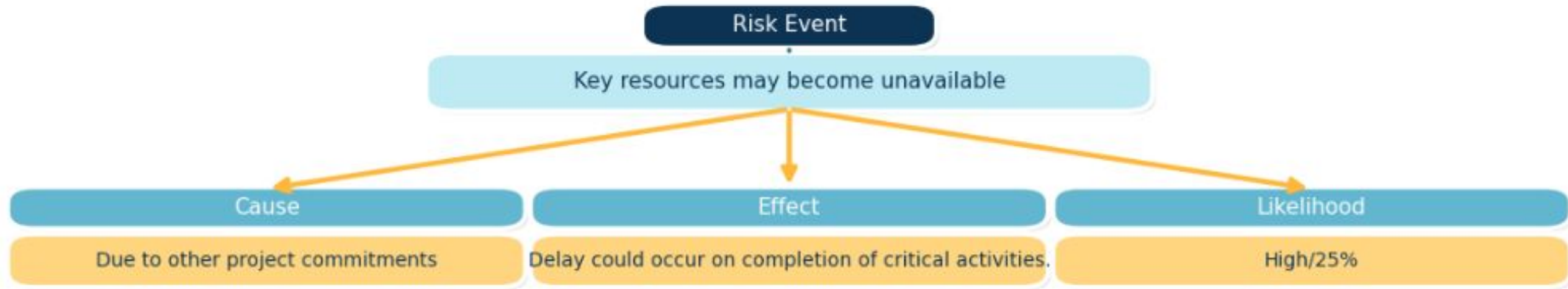
Components of a Risk Event/Condition



- **Cause:**
 - The source or trigger that gives rise to uncertainty.
 - A condition, action, decision, or external factor that may generate a risk event.
 - Can originate from technical, financial, operational, regulatory, environmental, or strategic drivers.
 - Often framed as the “if” portion of a well-written risk statement
- **Effect:**
 - The potential consequence if the risk event occurs.
 - The impact on objectives such as scope, schedule, cost, quality, performance, reputation, or compliance.
 - May produce negative outcomes such as loss or disruption, or positive outcomes such as gain or competitive advantage.
 - Often framed as the “then” portion of a risk statement.
- **Likelihood:**
 - The probability that the risk event will occur within a defined time frame.
 - Expressed qualitatively such as low, medium, high, or quantitatively as a percentage.
 - Influenced by historical data, expert judgment, and environmental conditions.
 - Supports prioritization and response planning decisions.

Source: *Risk management and analytics: A case-based approach* (1st ed.). Cognella Academic Publishing.

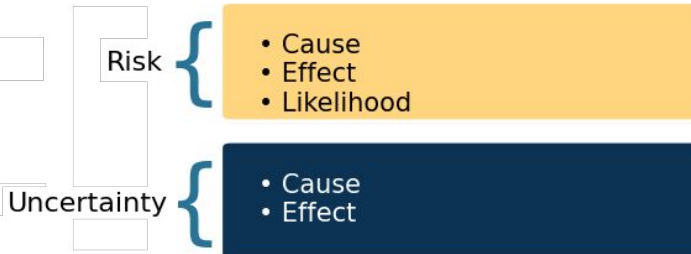
A Risk Event and Components



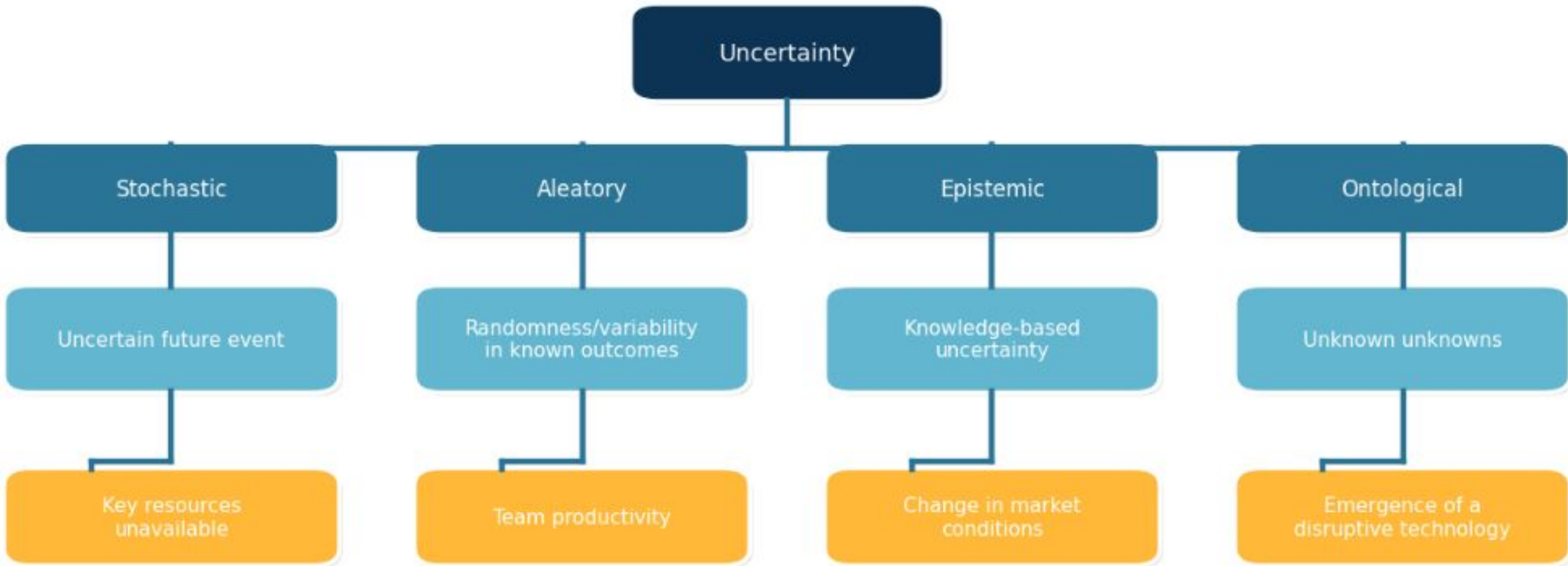
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Risk Versus Uncertainty

- Risk refers to a future event or condition with a **probability** that can be estimated or assessed.
- Uncertainty refers to situations where outcomes are unknown and probabilities cannot be reliably measured.
- Risk allows for analysis using qualitative scales or quantitative models such as probability distributions and simulations.
- Uncertainty often involves ambiguity, limited data, or emerging conditions where historical patterns do not apply.
- Risk can be priced, transferred, mitigated, or accepted through structured decision processes.
- Uncertainty requires judgment, adaptability, scenario planning, and strategic flexibility.
- In practice, organizations operate under uncertainty, but they manage risk when elements of that uncertainty become measurable and linked to objectives.



Types of Uncertainty



Source: *Risk management and analytics: A case-based approach* (1st ed.). Cognella Academic Publishing.

Distinguishing Risk Attitude, Risk Appetite, and Risk Tolerance

Dimension	Risk Attitude	Risk Appetite	Risk Tolerance
 Core Meaning	General disposition toward taking or avoiding risk.	Level and type of risk the organization is willing to accept in pursuit of objectives.	Specific and measurable level of risk the organization can withstand within defined boundaries.
 Nature	Psychological and cultural	Strategic and directional	Operational and quantifiable
 Scope	Broad mindset influencing perception and behavior.	Organization-wide or strategic initiative level.	Specific objectives, categories, or metrics.
 Level of Precision	Qualitative	Broadly defined, may be semi-quantitative.	Clearly defined using thresholds or limits.
 Influence on Decisions	Shapes how leaders perceive and discuss uncertainty.	Guides strategic choices and investment decisions.	Establishes limits for acceptable variation in performance.
 Organizational Impact	Influences culture, governance style, and leadership behavior.	Determines which opportunities are pursued or avoided.	Defines escalation triggers and control mechanisms.
Example			
	Leadership prefers conservative expansion and avoids volatile markets.	The firm is willing to invest in emerging technologies with moderate revenue volatility.	The firm will not accept more than a 5% decline in quarterly earnings or a cost overrun above 3% on major projects.

Source: *Risk management and analytics: A case-based approach* (1st ed.). Cornella Academic Publishing.

The Continuum of Risk Attitude

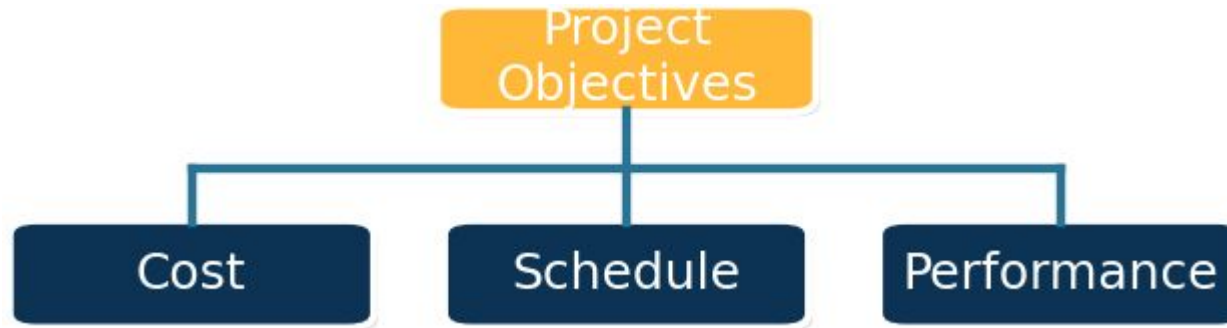


- **Risk Aversion:** Preference for predictable outcomes and avoidance of alternatives with high uncertainty, even when potential returns may be attractive.
- **Risk Neutrality:** Willingness to make decisions based on expected outcomes without strong preference for or against variability in results.
- **Risk Seeking Behavior:** Inclination to pursue high-uncertainty options in exchange for the possibility of significant gains or competitive advantage.

Source: *Risk management and analytics: A case-based approach* (1st ed.). Cognella Academic Publishing.

Summary

- A risk is the “Effect of uncertainty on objectives” (ISO 31000:2018, p. 1).



- Performance means scope performance
 - Quality requirements
 - Will your project meet acceptance criteria?

Source: *Risk management and analytics: A case-based approach* (1st ed.). Cognella Academic Publishing.

The Risk Management Life Cycle

- **Planning:** Establish the risk management approach, governance structure, roles, tools, and criteria that will guide all subsequent activities.
- **Identification:** Systematically determine potential events or conditions that may affect objectives and document them clearly.
- **Analysis:** Evaluate identified risks through qualitative analysis such as probability impact matrices and prioritization scales, and quantitative analysis such as simulations, statistical modeling, or expected value calculations to estimate overall exposure.
- **Response Planning:** Develop appropriate strategies to address threats and opportunities, such as mitigation, transfer, acceptance, or exploitation.
- **Response Implementation:** Execute approved risk responses, allocate resources, and integrate actions into project or operational plans.
- **Monitoring and Reporting:** Track risk indicators, review effectiveness of responses, identify emerging risks, and communicate status to stakeholders.

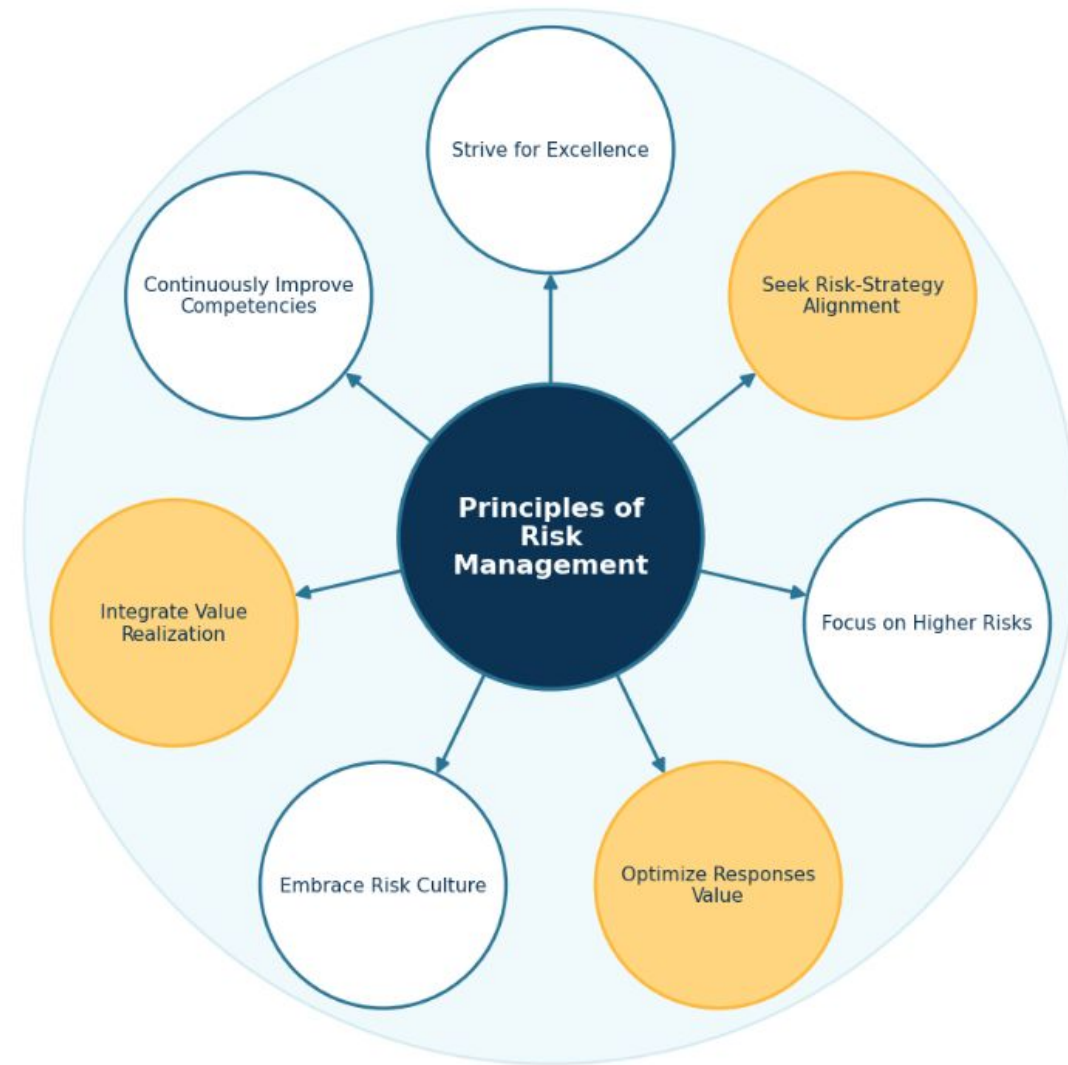


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Principles of Risk Management

- Principles of risk management provide the foundation for a structured and effective approach to navigating uncertainty.
- They serve as guiding values and practices that organizations can rely on regardless of industry, geography, or organizational scale.
- They help anchor risk management strategies in consistent and reliable practices enabling teams to approach uncertainty with clarity and purpose.
- Risk management principles also ensure alignment between theoretical frameworks and practical execution.
 - For example, the principle of governance emphasizes accountability ensuring that risks are identified and managed in alignment with the organization's objectives



Source: Adapted from Risk management in portfolios, programs, and projects: A practice guide. ©PMI

Principles of Risk Management: ISO31000

- **Integrated:** Risk management is embedded in organizational activities and decision-making at every level.
- **Structured and comprehensive:** A consistent and organized approach supports reliable and comparable risk management results.
- **Customized:** The risk management approach is tailored to the organization's objectives, environment, and risk profile.
- **Inclusive:** Appropriate stakeholder participation brings diverse knowledge and perspectives into risk decisions.
- **Dynamic:** Risk management responds to changes in internal and external conditions as new risks emerge and existing risks evolve.
- **Best available information:** Risk decisions use relevant, timely, and credible information while recognizing limitations and uncertainty.
- **Human and cultural factors:** Human behavior, organizational culture, and individual perceptions influence how risks are identified, assessed, and managed.
- **Continual improvement:** Risk management practices evolve through experience, learning, feedback, and changes in the organization and its environment.



Source: Adapted from International Organization for Standardization. (2018). ISO 31000:2018 Risk management – Guidelines.

Back to Monday, 8:12 AM: From Chaos to Evidence

- The CFO still wants an updated forecast tomorrow morning.
- But before changing the forecast, we need to separate four very different things:

What are we dealing with?	Scenario example	What should we do with it?
Known Information	Supplier announced a 17% price increase	Update the financial model
Risk	Additional cost or schedule effects for which likelihood can be estimated	Quantify probability and impact
Uncertainty	Final tariff rate and future energy or transportation costs are not reliably known	Model ranges and scenarios
Opportunity	Customer demand could increase 25%, but no commitment exists	Estimate upside scenarios without treating them as guaranteed revenue

- The first step toward clarity is not calculation. It is determining what we know, what we can estimate, and what remains uncertain.

Turn the Chaos Into Risk Statements

- The situation feels chaotic because management is facing several different signals at the same time.
- **The first analytical task** is to convert those signals into structured statements that can be evaluated.

Scenario signal	Structured risk statement	Objective affected
Supplier announces 17% price increase	If remaining supplier purchases are exposed to the higher price, then project cost may increase above the approved budget.	Cost
Proposed tariff remains unclear	If the tariff is imposed on imported components, then project cost and cash requirements may increase.	Cost / Cash flow
Energy and transportation costs are rising	If logistics and energy prices continue to increase, then the estimate to complete may rise.	Cost
AI redesign request of \$2.4M	If management approves the redesign, then project cost will increase, but expected benefits may also change.	Cost / Benefits / Value
Customer signals possible 25% demand increase	If additional demand materializes, then project benefits and expected return may exceed the original business case.	Revenue / Return

- Chaos becomes manageable when vague concerns are translated into specific uncertainties linked to objectives.
- What evidence do we need to assess each one?

Separate Evidence From Assumptions

- Not every input deserves the same level of confidence.
- Clarity starts when facts, estimates, assumptions, and unknowns are labeled correctly.

Scenario Signals	Evidence Available	What Is Still an Assumption?	Confidence
Supplier price increase	Supplier notice confirms 17% increase	Amount of remaining project spend exposed to the increase	High / Medium
Tariff	Proposed tariff information and affected product categories	Final rate, effective date, exemptions	Low
Energy & transportation	Recent invoices, vendor quotes, market indices	How long increases will persist and how much suppliers will pass through	Medium
AI redesign	\$2.4M project team request, technical proposal, vendor estimates	Approval, implementation cost, timing, and incremental benefits	Medium / Low
Customer demand	Customer communication and existing demand history	Whether the 25% increase will materialize, when, and for how long	Low

Match the Question to the Risk Analytics Tool

- The method should follow the decision question, not the software.
- No single technique turns uncertainty into clarity. Different questions require different evidence and different analytics.

Management Question	Risk Analytics Tool	What Clarity Does It Provide?
Which risks deserve our attention first?	Qualitative risk analysis	Prioritizes risks based on probability, impact, and other relevant characteristics
Which assumptions have the greatest effect on the outcome?	Sensitivity analysis	Identifies the variables that drive cost, schedule, return, or value
What happens if several assumptions change together?	Scenario analysis	Shows outcomes under coherent combinations of assumptions
What is the expected financial exposure of a discrete risk?	Expected Monetary Value	Converts probability and financial impact into expected exposure
What is the probability of achieving our objective when several uncertainties operate together?	Monte Carlo simulation	Produces a distribution of possible outcomes rather than one forecast

Which Uncertainties Drive the Cost Outcome?



Illustrative assumptions for the \$45M project

Uncertain Variable	Exposure Base	Working Assumption	Plausible Range
Supplier price increase	\$8.0M remaining purchases	17%	10% to 25%
Tariff rate	\$6.0M imported components	5%	0% to 15%
Energy and transportation increase	\$4.0M remaining spend	8%	0% to 20%

Effect on Forecast at Completion

Variable	Low-Case Effect on EAC	High-Case Effect on EAC
Supplier price increase	-\$0.56M	+\$0.64M
Tariff rate	-\$0.30M	+\$0.60M
Energy and transportation	-\$0.32M	+\$0.48M

- Sensitivity analysis tells management where uncertainty matters most. It does not tell us which combination of events will occur.

Build Scenarios, Not Predictions

- Sensitivity analysis changes one input at a time. Scenario analysis changes several assumptions together to create plausible views of the future.
- For the \$45 million project, we can combine the major external uncertainties into four scenarios.
- Scenarios do not tell us which future will occur. They show management what different futures would mean.
- When probabilities are weak, plausible scenarios are often more defensible than precise-looking forecasts.

Scenario Assumptions and Illustrative Cost Outcomes

Assumption	Favorable	Planning	Adverse	Stress
Supplier price increase	10%	17%	25%	30%
Tariff on exposed imports	0%	5%	15%	20%
Energy and transportation increase	0%	8%	20%	25%
Customer demand change	+25%	+10%	0%	-10%
Incremental cost exposure	+\$0.80M	+\$1.98M	+\$3.70M	+\$4.60M
Illustrative project cost	\$45.80M	\$46.98M	\$48.70M	\$49.60M

Watch the Signals Before the Outcome Changes

- Scenario analysis tells us what different futures could look like.
- Risk monitoring helps management detect which future may be starting to emerge.

- **Leading indicator:** Something may be changing.
- **Trigger condition:** It is time to act.
- **Lagging indicator:** The effect has already reached performance.
- Clarity improves when every major uncertainty has a signal to watch, a threshold for action, and a response prepared in advance.

From Uncertainty to Early Warning

Risk / Opportunity	Leading Indicator	Trigger Point	Management Response
Supplier cost escalation	Supplier quotations; % of remaining purchases without fixed pricing	Remaining exposed spend exceeds \$5M or quotes exceed baseline by 20%	Renegotiate, evaluate alternate suppliers, update cost exposure
Tariff exposure	Regulatory announcements; value of imported components exposed	Final tariff announced above 5% or effective date confirmed	Activate tariff scenario, evaluate sourcing alternatives, update forecast
Energy & transportation escalation	Freight indices, carrier quotations, fuel and energy trends	Two consecutive reporting periods above established cost threshold	Reforecast logistics costs, negotiate rates, activate planned response
Customer demand opportunity	Order pipeline, signed commitments, customer forecast updates	Confirmed orders exceed baseline demand by 15%	Evaluate capacity, benefits, cash flow, and opportunity response

Quantify What Can Be Quantified

- Not every element of uncertainty can be objectively measured.
 - Where credible probability and impact estimates exist, we can translate risk into financial exposure.
-
- Expected Monetary Value (EMV) = $\sum (\text{Probability of Risk} \times \text{Financial Impact})$
 - Calculate incremental exposure above our current planning assumptions.
 - Probability converts potential impact into expected exposure.
 - It does not convert uncertainty into certainty.

Risk Event	Illustrative Probability	Incremental Impact if It Occurs	EMV
Supplier increase rises from 17% to 25%	30%	\$0.64M	\$0.192M
Tariff rises from planning assumption of 5% to 15%	35%	\$0.60M	\$0.210M
Energy/transport increase rises from 8% to 20%	40%	\$0.48M	\$0.192M
Total Expected Incremental Threat Exposure			\$0.594M

Expected Value Is Not a Possible Outcome

- We estimated expected Incremental Threat Exposure = \$594,000.
 - But that does not mean the project will cost an additional \$594,000.
 - EMV is a probability-weighted average across uncertain outcomes.
-
- **EMV = \$594,000** is not one of the possible outcomes in this simplified model.
 - The average tells us where the distribution balances.
 - Management also needs to know the range, likelihood, and downside exposure.

Risks That Occur	Incremental Cost	Probability
None	\$0	27.3%
Energy / transportation only	\$0.48M	18.2%
Tariff only	\$0.60M	14.7%
Supplier only	\$0.64M	11.7%
Tariff + energy / transportation	\$1.08M	9.8%
Supplier + energy / transportation	\$1.12M	7.8%
Supplier + tariff	\$1.24M	6.3%
All three	\$1.72M	4.2%

Let the Uncertainties Move Together

- What happens when we have ten, twenty, or fifty uncertain variables, each with a range of possible values, and some of them interact?
- Monte Carlo simulation repeatedly samples uncertain inputs to produce a distribution of possible project outcomes rather than a single estimate.
- Start With Our Current Planning Estimate = \$46.98M

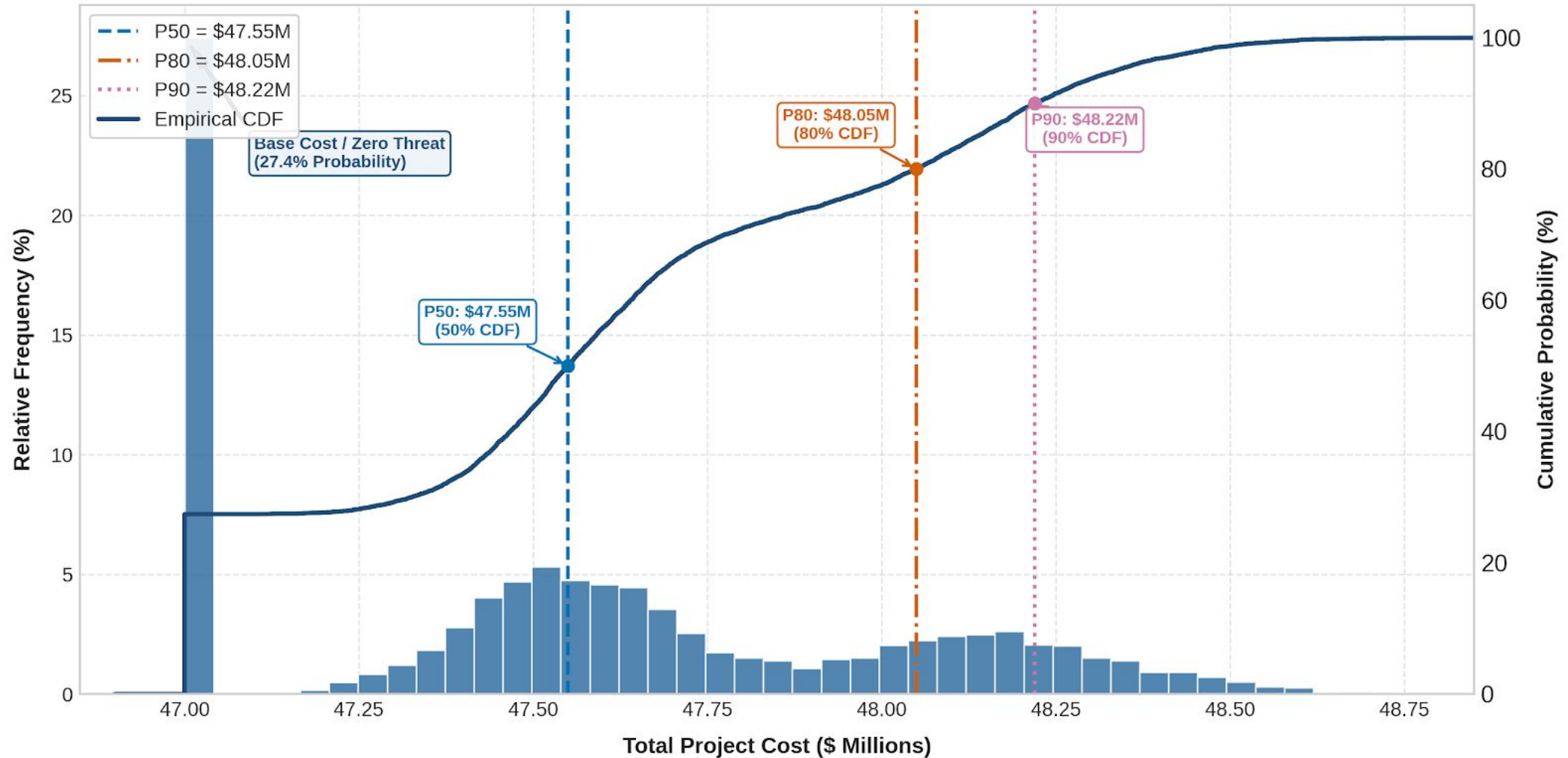
- Simulation Inputs



Incremental Threat	Probability of Occurrence	Impact if It Occurs
Supplier escalation above 17%	30%	Triangular: \$0.48M, \$0.64M, \$0.80M
Tariff increases above 5%	35%	Triangular: \$0.30M, \$0.60M, \$0.90M
Energy / transportation exceeds 8%	40%	Triangular: \$0.24M, \$0.48M, \$0.72M

Let the Uncertainties Move Together

Monte Carlo Simulation of Total Project Cost Outcomes
10,000 Iterations



How Much Contingency Buys the Confidence We Want?

Contingency Above \$46.98M			
Confidence Level	Simulated Cost	Planning Estimate	Residual Overrun Risk
P50	\$47.55M	\$0.57M	50%
P80	\$48.05M	\$1.07M	20%
P90	\$48.22M	\$1.24M	10%

- Contingency is not a guess. It is a risk tolerance decision expressed in financial terms.

Tomorrow Morning: What Do We Tell the CFO?

- Present a range of possible outcomes, with scenarios and key assumptions.
- Current planning estimate: \$46.98M.
- Simulated cost range:
 - P50: \$47.55M
 - P80: \$48.05M
 - P90: \$48.22M
- Recommended working contingency: \$1.07M for P80 confidence.
- AI redesign: treat as a separate management decision, not an automatic baseline change.
- Demand upside: show as an opportunity scenario, not committed revenue.
- Monitor supplier pricing, tariff decisions, transportation costs, and customer commitments.
- Clarity does not mean certainty. Clarity means management understands the range, drivers, confidence level, and decision options.

Key Takeaways: From Chaos to Clarity

- Uncertainty cannot be eliminated, but it can be structured.
- Risk management begins with objectives, not with a risk register.
- Separate facts, estimates, assumptions, risks, and unknowns before analyzing the forecast.
- Use the analytical method that fits the management question.
- Sensitivity analysis shows what matters most.
- Scenario analysis shows how different futures could affect the project.
- Expected value summarizes exposure, but it does not describe the full range of outcomes.
- Monte Carlo simulation converts multiple uncertainties into a distribution of possible outcomes and confidence levels.
- Contingency should reflect risk exposure and management's tolerance for uncertainty.
- The goal is not to predict one future. The goal is to support better decisions across several plausible futures.

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