NAC **Executive Insights**

Decision-Making Under Uncertainty

Key Points

- Uncertainty consists of ambiguity, volatility, and variability.
- Large, complex projects face high degrees of uncertainty.
- When uncertainty and complexity are both high, maintaining flexibility and optionality until unknown unknowns have emerged provides for the best ability to make the right decision.
- Uncertainty fundamentally differs from risk, which can be probabilistically assessed.
- Uncertainty is a compounding factor in complex projects and is integral with complexity.
- Effective project management, especially under uncertainty, requires agility—an ability to react quickly to emergent risks and threats.
- Effective decision-making under uncertainty must begin with strong project foundations.
- Decisions under uncertainty benefit from the project manager and team's mindfulness.
- Large scale, extremely complex projects have been delivered under high levels of uncertainty, but many of the elements of success in doing so seem to have been forgotten.
- High-reliability practices for managing uncertainty in projects are described.

Introduction

This Executive Insight examines the special case of decision-making under uncertainty. The relationship between uncertainty and complexity is explored as is their joint relationship with large complex projects. The importance of getting these projects well-founded from an ability to manage uncertainty is discussed and the aspects of these strong foundations are described.

Effective decision-making under uncertainty is discussed and high reliability practices for decision-making under uncertainty are tabulated. Additionally, the author suggests that the wrong lessons may have been learned from some of the most complex and most important projects delivered under high uncertainty and in the process hard coded a project management dogma that does not serve well under complexity or uncertainty.

What is Uncertainty?

Uncertainty consists of ambiguity, volatility, and variability.

Ambiguity, an unquantifiable measure of uncertainty, may result from several sources:

- Inadequate view of external factors
- Uncertainty of cause-and-effect relationships
- Uncertainty inherent in means, methods and their effectiveness

The importance of stakeholder engagement and an increased focus on monitoring, measuring, tracking and understanding external project impacting factors cannot be overstated. Our project control resources are inward looking while uncertainty arises external to the project.

Tight coupling of tasks without effective buffers or adequate preparation for contingent execution ignores the uncertainties and variability inherent in all activities.

Volatility is a constant source of uncertainty and is associated with unpredictable impacts or rates of change. It arises from unknown and often unknowable future events (Black Swans), but often is perceived to arise from knowable but undealt with factors (Black Elephants).

> Black Swan risk – high consequence, low probability risk. Often considered unknown-unknown risks.

> Black Elephant risk – high impact event that lies beyond the realm of regular expectations but is ignored despite evidence of its existence. In other words, everyone sees it, but nobody wants to deal with it.

Variability is associated with a known range of potential outcomes, but with the result itself being uncertain. This is *aleatoric uncertainty* as contrasted with the *epistemic uncertainty* or ambiguity.

> **Aleatoric uncertainty** - statistical uncertainty representative of unknowns that differ each time the same experiment is run (variability). Aleatoric uncertainty is taken from the Latin word "alea," which means dice, where the dice represent games of chance. Aleatoric uncertainty relates to probability-weighted outcomes, and the type of data one can plug into a spreadsheet.
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> **Epistemic uncertainty** - systematic uncertainty due to things one could in principle know but does not in practice. This may be because a measurement is not accurate, the model neglects certain effects, or particular data have been deliberately hidden (ambiguity). It relates to knowledge and whether the things one knows is or one may not be sure the data are correct. If the knowledge inputs are wrong, then all the conclusions from the models are likely to be wrong or useless (or both). A simplified version of this is the idea of "garbage in, garbage out."

Relationship of Uncertainty to Complexity

Large complex projects face high degrees of uncertainty.

"Stage-gate" mentalities (often hampering creativity or accepting sub-par performance) make it difficult for managers to take on risk, the very attribute which is often necessary when dealing with both complexity and uncertainty. The flexibility of response that uncertainty demands is constrained by traditional project inflexibility. Flexibility is about acting while continuing to think and adjusting as necessary.
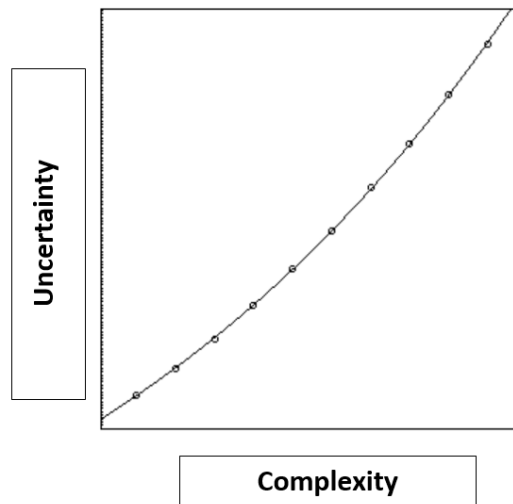
When uncertainty and complexity are both high, maintaining flexibility and optionality until unknown unknowns have emerged provides for the best ability to make the right decision. This requires valuing conceptual slack, which is a heterogeneity of perspectives focused on maintaining a variety of viewpoints to protect against "groupthink."

High uncertainty and complexity are characteristic behavior of large complex projects. High uncertainty, even in less complex projects, still demands a level of flexibility beyond what traditional project management organizations provide. This contrasts with low uncertainty and complexity, where standard project management and risk practices suffice.

Uncertainty fundamentally differs from risk, which can be probabilistically assessed. Uncertainty represents an unknown future with equally unknown impacts. There is no information to support a calculation, but there is enough insight to suggest maintaining capabilities and capacities to address and deal with uncertainty is valuable.

Relationship of Complexity, Uncertainty, and Large Complex Projects

The increasing complexity of projects necessitates a better understanding of increasing risk and uncertainty. Underestimating complexity results in a mismatch of risk and uncertainty.

Sources of complexity include:

- Technical complexity
- Financial/funding complexity
- Time

Complex projects have an inherently contingent nature of outcomes resulting from the multiplicity of interactions characteristic of such projects. A degree of unpredictability and unknowability exists, despite efforts to provide structure, control, and risk assessment.
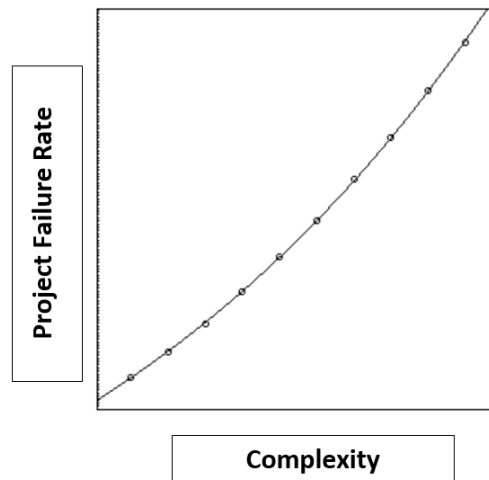
Uncertainty is a compounding factor in complex projects and is integral with complexity. Uncertainty exists not just in the interactions within a complex project, but often in the form of ambiguity in the strategic business objectives (SBOs) that the project is meant to accomplish. Additionally, given the longer durations of many projects, it is not unusual to see these SBOs change in response to perceived changes in future uncertainty. The result is changed project requirements, scope, frameworks, and potentially stakeholder relationships. Even means and methods experience adds complexity as the goal posts are moved or even the game itself is changed.

If uncertainty is to be understood, one must begin by measuring and tracking complexity, recognizing that complex projects have "unstable input-output relationships, changing system boundaries over time, and system behavior that is not (fully) depending on the past."

## Effective Decision-Making under Uncertainty

Effective project management, especially under uncertainty, requires agility and an ability to react quickly to emergent risks and threats. Uncertainty may be foreseeable (risk) or unforeseen. Unforeseen uncertainty can arise from:

- Consequential, unthinkable events (Black Swans)
- Flows/influences that act/interact through complexity.

Unforeseen uncertainty requires more flexible and emergent approaches than those associated with foreseeable uncertainty or that which is allowed with traditional project management and stage-gate processes.

Effective decision-making under uncertainty must begin with strong project foundations. These include:

- Clear, outcome-appropriate, governance structures focused on organizational culture, capabilities, capacities, and trust building.
- Team alignment around strategic outcomes.
- Shared, no-blame learning culture.
- Consistent, open, transparent communication with always-on feedback loops.
- Recognizing that low probability/high consequence events cannot be ignored (Black Elephants). Do not be risk blind.
- Acceptance that unknown unknowns exist and a commitment to discover them.
- Assumption tracking.
- Willingness to adapt to change. Build organizational and plan resilience incorporating adaption.
- Distributed authority to act with short decision paths when more aggregated views are necessary.
- Concept of failing forward. Learning from one's mistakes.
- Understanding the value of time.
- Recognizing planning as preparation but not necessarily "the path."
- Recognizing that plans may make one blind to the unexpected in non-planned areas.

	Expected	Unexpected
Unplanned	Statistical	**Blind**
Planned	✓	See
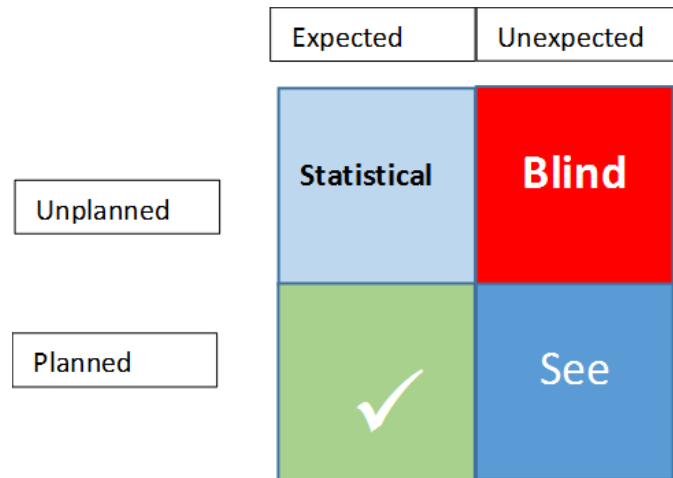
- Valuing capabilities and capacities.

> ### Act and Adjust
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> At the sound of the batter hitting the ball, an outfielder's first step is towards the back of the outfield to ensure he can keep the ball in front of him. As he sees and begins to track the ball, he adjusts his direction of travel. By then, he is already moving and ready to respond.

These foundations must be allowed to prevent "satisficing," that is, selecting the first viable solution when faced with a dilemma arising from uncertainty. Divergent views and challenges must be promoted while recognizing the need to move forward. The goal is to reach an *acceptable* decision, not an *optimal* one. Expertise and relevant experience must be given weight over role and rank. Maintaining organizational resilience is important so that all may adjust as required and recognize uncertainty often leads to a cascading set of unexpected events.

Decisions under uncertainty will have been more fully informed if the correct foundations are already in place and if the scans of changes in the environment have been rigorously carried out. Decision-making under uncertainty is an area that will benefit from the capabilities of Big Analytics.

Decisions under uncertainty also benefit from the project manager and team's mindfulness. Mindfulness is the ability to be fully present, aware of where one is and what one is doing, and not being overly reactive or overwhelmed by what is happening. It is the result of the organizational resilience that has been put in place, beginning with strengthened foundations.

Sensemaking further reinforces the collective understandings and actions required under uncertainty.

What are the Required Features of Large Complex Project Management to Address Uncertainty?

Large scale, extremely complex projects have been delivered under high levels of uncertainty. Historical examples include the Manhattan Project, Polaris, and Apollo. Many of the elements of success in delivering these complex projects under uncertainty, however, seem to have been forgotten or at the very least under-emphasized. Flexible approaches to dealing with uncertainty often appear to have been abandoned.

> Unknown unknowns are not knowable in terms of their profitability, consequence, or timing so preparation comes from the capacity, capability, and agility that are put in place.

To address uncertainty, management of these complex projects must:

- Ensure commonality and alignment of outcomes, objectives, and strategic direction.
- Recognize and acknowledge uncertainty.
- Establish dedicated organizations to overcome bureaucracy with clear, high-level, decision-making rules that will be effective under uncertainty.
- Put in place a strong open culture built on communication and sense of team.

- Accept that all is not knowable at the outset of a project and recognize that parallel efforts, especially related to non-standard technologies or means and methods, may be necessary (experimenting, prototyping, testing).
- Instill a strong sense of team and trust, sharing knowledge, and collectively learning from mistakes. Support with a no-blame culture and team-focused, monetized KPIs (key performance indicators).
- Recognize stakeholder and goal complexity and address up front. Manage in an "open" context.
- Avoid subservience to established project management dogmas.
- Recognize and support the duality of the project manager's role—executing the plan while managing the unexpected.
- Implement flexible, collaborative contract management.
- Gather data broadly and continuously. Err towards knowing too much. Develop a strong, team-based situational awareness.
- Avoid the tendency to simplify complex situations. Encourage debate and "devil's advocate" roles.
- Maintain conceptual slack in interpreting evolving events.
- Restore flexibility and agility of project managers and project teams (the antithesis of the stage-gate process).
- Recognize that complex projects, heavy on uncertainty, are journeys to an outcome rather than strictly bound by fixed plans.
- Plan for contingent execution.
- Adopt the open nature of systems thinking (relationship to environment; complex problems; outcomes maximization; impact minimization) as contrasted with closed solutions and approaches of systems engineering (stage-gate; stakeholder minimization, or management vs engagement; control).
- Employ contracting structures designed for flexibility with a strong complementary emphasis on relationships. They may even need to provide for emergent outcomes.
- Maintain a predisposition to action over complacency.
- Conduct meaningful after-action reviews to inform future decision-making under uncertainty.

In addition to these features, also include the following:

- Measure and track project complexity.
- Create an index for uncertainty.

Table 1 describes some high-reliability practices for managing uncertainty in projects.

Table 1 High Reliability Practices For Managing Uncertainty In Projects
Work with assumptions.
Draw on all available expertise (multidisciplinary), internal and external to project team, to reduce uncertainties.
Visibly recognize and reward openness and knowledge sharing.
Project manager delegates all decision-making powers from executive management within well-established but flexible decision-making rules.
Be flexible.
Staged conformance to established processes and procedures (action and improvement trump process).
Team encouraged to negotiate towards a workable action plan.
Active questioning to discover what they did not know.
Regular meetings and statusing to ensure current understanding of individual issues and aspects.
Risk mind set to deal with ambiguity.
Balance completeness of information with the need to act. Recognize that often a fast response is worth more than the correct response taken too late.
Intense but focused communication—simple, specific, selective.
Address threats to effective decision-making under uncertainty (organizational complexities; short-term incentives).
Decisions based on strategic incrementalism (keep the mission in mind as the team addresses uncertainty in adaptive, flexible, and inventive ways).
Empower the team without abdicating leadership. Recognize and utilize informal networks.
Visible, high-touch leadership and management.
Provide emotional stability.

Summary

Effective decision-making under uncertainty, including reliability practices for such decision-making, have now been discussed. Perhaps the biggest unanswered question, however, is whether one may have learned the wrong lessons from the most complex and important projects delivered under high uncertainty and, in the process, hard-coded a project management dogma that does not serve well under the complexity and uncertainty of the most challenging projects faced.

For Further Reading – Executive Insights

"Flows" in Large Complex Projects
Proper Reliance on AI in Project Management

References

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About the Author

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