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Uncertainty in Large Complex Projects

Key Points

- Uncertainty is an inability to foretell consequences or outcomes.
- There is often a failure to give uncertainty sufficient attention, assuming that more is known about the future than can be rightfully assumed.
- There is a reluctance to qualify or quantify uncertainty for fear it will impact confidence in risk assessments.
- When one acts as if everything is a risk, there is an increase in the chance of failure.
- When one acts as if everything is unknowable, uncertainty gets blamed for inaction.
- Strategies for managing uncertainty are laid out.

Introduction

Uncertainty in projects is often conflated with *risk*, and the two terms are used interchangeably. All too often uncertainty is then treated in the same way as risk, or worse ignored. In large complex projects, large pools may exist that are associated with project complexity.

This Executive Insight looks at uncertainty in projects and contrasts it with risk; identifies sources of uncertainty in projects; and outlines strategies for managing project uncertainty.

What is Uncertainty?

Uncertainty is an inability to foretell consequences or outcomes because of a lack knowledge or basis on which to make any predictions.

While the quantification of risks (event uncertainty) and risk values (estimate uncertainty) may have varying levels of uncertainty associated with them, *risk* is not the same as uncertainty. This Executive Insight is focused on project level uncertainty, where the content and results of future actions and activities are uncertain as are the conditions and circumstances under which they will take place.

Uncertainty falls along a spectrum ranging from known knowns to unknown unknowns. Unknown knowns are characterized by an inability to assign objective probabilities but for which there is an historical context. Known unknowns are possibilities but when, where or how they will occur cannot be

determined. Finally, unknown unknowns lead to the unexpected—the uncertainty that is the focus of this Executive Insight.

Contrasting Uncertainty and Risk

The best way to understand the differences between uncertainty and risk is a side-by-side comparison as shown in Table 1. Uncertainty often receives insufficient attention, assuming more is known about the future than anyone has a right to assume. Once the differences between uncertainty and risk are understood, a door opens to multiple potential outcomes that are limited only by the way the world is perceived.

Similarly, everyone thinks about uncertainty and risk differently,[1] which is why group efforts around identifying each and every associated management strategies is so important.

Table 1
Contrasting Risk and Uncertainty

Risk	**Uncertainty**
Risk is measurable uncertainty.	Uncertainty is immeasurable risk.
Risk describes a situation in which there is a chance of a loss or danger.	Uncertainty refers to a condition where you are not sure about the future outcomes.
Risk: We don't know what is going to happen next, but we do know what the distribution looks like.	Uncertainty: We don't know what is going to happen next, and we do not know what the possible distribution looks like.
Risk is unknown outcome with well-defined possibilities.	Uncertainty occurs when we have no idea of what the possible outcome might be.
Risk can be measured and quantified; risk taker can take steps to protect himself from.	Uncertainty does not allow someone to protect themselves since no one can foretell the future.
Risk may be taken or not.	Uncertainty is a circumstance that must be faced.
Taking a risk may result in either a gain or a loss because the probable outcomes are known.	Uncertainty comes with unknown probabilities.
A risk is a discrete event with a probability of occurrence. The risk effect (impact) is only felt if / when the event occurs.	There is no probability of occurrence with an uncertainty – you know that you don't know the actual value of the input variable.
Can be measured.	Cannot be measured.
Controllable	Uncontrollable
Probability of winning or losing something of worth is known as risk.	Uncertainty implies a situation where future events aren't known.
Chances of outcomes are known.	The outcome is unknown.

[1] Note the biological differences described in Table 1.

Table 1 Contrasting Risk and Uncertainty	
Risk	**Uncertainty**
Risk is an outcome which can be calculated through measuring probabilities.	Uncertainty concerns the unknown future.
Probabilities can be assigned.	Probabilities cannot be assigned.
Multiple alternatives resulting in a specific outcome where the probability of the outcome is known.	Multiple alternatives resulting in a specific outcome where the probability of the outcome is not certain and may be unknowable.
Measured in quantitative terms.	Cannot be measured in quantitative terms as the probabilities are unknown.
Risk can be minimized by taking necessary precautions.	Uncertainty cannot be minimized.
Risk, in principle, is calculable, and predictions can be expressed statistically or as mathematically determined probabilities.	Uncertainty is characterized by events in the future that are unknown and/or their consequences cannot be estimated/quantified.
Risk recruits the orbitofrontal cortex, striatum, insula, and posterior parietal cortex.[2]	Uncertainty recruits the amygdala and parts of the frontal cortex such as the inferior frontal gyrus, and the dorsal lateral prefrontal cortex.
Risk is the product of events regarded as having known outcomes.	Uncertainty exists in events with unknown probabilities and outcomes.

Sources of Uncertainty in Projects

Uncertainty is a lack of precise knowledge about what the truth is, either qualitatively or quantitatively. This lack of knowledge can reflect a current gap with respect to the present or near future or more likely a later period in time. There is often a reluctance to qualify or quantify uncertainty for fear it will impact confidence in risk assessments. This undermines the central goal of good risk management to produce the best possible assessment of project outcomes and strategies to assure their achievement.

Table 2 outlines some sources of uncertainty on projects. They have been segregated into sources within the project context and external to it.

[2] "Disentangling Risk and Uncertainty: When Risk-Taking Measures Are Not About Risk," Kristel De Groot and Roy Thurik; *Frontiers, Psychology*; Section Decision Neuroscience, https://doi.org/10.3389/fpsyg.2018.02194, November 15, 2018.

Table 2 Sources of Uncertainty in Projects	
Project Team	**Project Environment**
Complexity of selected project design, technology or execution approach	Incomplete information; inadequate time to gain better information and knowledge
Complex organizational relationships and diversity of personalities and behaviors	Stakeholders, changing, competing, and conflicting demands
Lack of clear organizational culture	Governmental and institutional decisions and decision-making process
Information overload; ambiguous information	Political influences
Turbulence of project objectives, facts, and decisions	Geopolitical forces
Randomness of project changes	Regulatory landscape in turmoil or transition
Lack of understanding of key project issues	Industry, market, and supply chain capabilities and capacities
Relationship between cause and effect in various aspects of the project not understood	Number of stakeholders
Inadequate or untimely decision-making in project	Industry capability to deliver project
Uncertain or ever changing project scope	Project team capabilities
Scale of project	Maturity of project processes
Actual or perceived complexity of the project	Availability and capability of required resources
Extended project timeframes	Inappropriate or inadequate contractual frameworks

Mitigating Project Uncertainty

When everything is perceived as a *risk*, the chance of failure increases. The author describes his own experiences below:

"Business decisions, for example, deal with situations which are far too unique, generally speaking, for any sort of statistical tabulation to have any value for guidance. The conception of an objectively measurable probability or chance is simply inapplicable. The confusion arises from the fact that we do estimate the value or validity or dependability of our opinions and estimates, and such an estimate has the same form as a probability judgment; it is a ratio, expressed by a proper fraction. But in fact it appears to be meaningless and fatally misleading to speak of the probability, in an objective sense, that a judgment is correct."

When all act as if everything is unknowable, *uncertainty* gets blamed for inaction.

"It finally dawned on me what the uncertainty trope is all about. It took a conversation with a nervous chief executive to reveal it, but I teased out the answer. Most of the time, people exist in a happy little

bubble of self-created delusion. We engage in selective perception, seeing only the things that agree with us. Our selective retention retains the good stuff and disregards most of the rest. In our minds, we are all younger, better-looking, slimmer, with more hair than the camera reveals. In short, we construct a reality that bears only passing resemblance to the objective universe.

During those brief instances when the facade fades, the curtain gets pulled back and the ugly reality becomes clear. We get a glimmer of understanding about our own lack of understanding. That's when the grim reality of the human condition is revealed — and it terrifies us.

The next time you hear someone mention uncertainty, ask yourself this: How much less do they actually know about the future today vs. what they knew last week or year?

How much less do they think they know?"

Not knowing cannot be used as an excuse not to act. Everyone either suppresses uncertainty and acts overconfidently or they overemphasize uncertainty and do not act at all. Both are bad outcomes.

Table 3 summarizes some strategies for managing project uncertainty.

Table 3
Managing Project Uncertainty

Strategic business outcomes clearly articulated, agreed to, and communicated.	Strong stakeholder engagement, including client, around project uncertainties.
Robust and complete scope of facilities.	Transparency and communication.
Robust and complete scope of services.	Looking ahead and over the horizon more than the rearview mirror.
Expanded basis of design.	Structured approach to continuous re-orientation - Brainstorming, scenario and sensitivity analysis, horizon scanning.
Well-developed project baselines (scope, schedule, estimate/budget, risk).	Seeking external advice and identifying project or situational analogs.
Gated review processes.	Piloting and small scale trials to understand uncertainties and test solutions.
Steering reviews to ensure strategic business outcomes being achieved.	Contingent execution planning and authorities.
Risk processes that keep areas of uncertainty front and center.	Project contingencies that reflect levels and extent of uncertainties the project may face.

Table 3 Managing Project Uncertainty	
Uncertainty-appropriate team based behaviors: Flexibility, optimism, valuing time/decisiveness, and a focus on changing areas of uncertainty.	

Summary

The only thing certain about uncertainty is that it can happen anytime and no one is exempt from its effects. The most effective thing to do is to prepare for it.

Uncertainty is not an unknown *risk*. In uncertainty, the background information of an event is lacking, even though it has been identified. In the case of an unknown risk, although the background is known information, it was simply missed during the identify risks process.

About the Author

Bob Prieto was elected to the National Academy of Construction in 2011. He is a senior executive who is effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering, and construction industries.

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