How the History and Science of Uncertainty and Risk Can Lead to Better Risk Management

By Shayne Kavanagh

Against the Gods: The Remarkable Story of Risk

Peter L. Bernstein

John Wiley & Sons

2008, 383 pages, $70

The Failure of Risk Management: Why It's Broken and How to Fix It

Douglas W. Hubbard.

Wiley

2009, 304 pages, $49.95

The Drunkard's Walk: How Randomness Rules Our Lives

Leonard Mlodinow

Pantheon

2008, 252 pages, $15.95

In *Against the Gods: The Remarkable Story of Risk*, Peter Bernstein explains that the concepts of uncertainty and risk are a modern phenomenon. Only in recent centuries has the Western world concluded that the future is not just a matter of fate or the plans of a higher power, but that human beings have the ability to shape their own future. In fact, Bernstein posits, our "ability to define what may happen in the future and to choose among alternatives lies at the heart of contemporary societies."

This ability also lies at the heart of the modern finance officer's job. Finance officers are asked to predict future revenues and expenditures and to help the organization craft financial plans and budgets that will allow the organization to reach its goals. These decisions entail risks like the possibilities of revenue shortfalls and cost overruns. Finance officers are often called upon to help the organization manage other uncertainties and risks as well, such as:

- Navigating a changing regulatory/legal environment, like how federal health care reform might affect the cost of the health-care benefits offered to employees.
- Holding the right amount of fund balance — enough to allow the organization to respond decisively to shocks like an economic downturn or natural disaster, but not so much that the organization forgoes the opportunity to provide public services or lower taxes.
- Entering into financial relationships with third parties like private firms to build infrastructure and encourage economic development.

The increasing speed at which business occurs and the increasing number of options that organizations have, thanks to forces like the Internet and globalization, means that governments face even more uncertainty and risk going forward.

NOT UP TO THE TASK

On top of that ever-increasing risk, finance officers face a third challenge : The human brain may be fundamentally ill-suited to the task. *In The Drunkard's Walk: How Randomness Rules Our Lives*, Leonard Mlodinow points out that many psychological studies suggest a close connection between the portions of our brains that assess uncertain situations and those parts that handle emotion. Emotion is not usually closely associated with rational decision making, which does not bode well for our ability to easily make clear-eyed assessments of uncertainty and risk.

Mlodinow cites compelling experimental evidence of our natural ineptitude in dealing with uncertain situations. The experiment is called probability guessing. Subjects are presented with a series of lights or cards, one at a time, in one of two colors (e.g., green or red). The experiment is designed so that the colors will show up in a predetermined proportion (e.g., green 75 percent of the time and red 25 percent of the time). The order in which the colors appear is random. After observing a number of cards or lights, the subject is then

asked to predict the color of each new light or card before it happens.

The subject can adopt two basic strategies. The first is one that animals usually use when playing a game for food pellets; they almost always predict whichever color is appearing more frequently (e.g., if green appears 75 percent of the time, a rat will always pick green and will, therefore, succeed 75 percent of the time). The other strategy is to attempt to guess the next color based on some other perceived pattern in the prior observations. If there is an actual pattern in the appearance of the colors (other than just the overall proportion of the time one shows up versus the other), this strategy could work well. However, if colors appear randomly, this strategy could backfire. The human brain is good at recognizing patterns, including in situations where patterns don't actually exist, so humans usually pick the second strategy. It yields a success rate of about 60 percent, which means humans are routinely outperformed by rats in this experiment.

Unfortunately, our proclivity for finding non-existent patterns in our experiences and in data is not the only flaw in our thinking that prevents us from accurately assessing uncertainty and risk. Cognitive scientists have catalogued a number of other inborn biases. Among some of the most important are:

- **Availability Bias.** Details that are more easily recalled (because they are occurred recently or were attached to a particularly vivid experience) are overweighed when assessing risk. For example, when preparing for future potential extreme events, a city government might over-prepare for an event that has happened in the recent past or that happened somewhere else and received a lot of media coverage. As a result, the city might then underprepare for a different kind of extreme event that is actually more likely to occur in the future. This is similar to the phenomenon where more people buy flood insurance immediately after a flood occurs and; then, as the years go by and the memory of the flood faces, they let the insurance lapse, even though the likelihood of a flood occurring again has not changed.
- **Confirmation Bias.** Random patterns will be taken as solid evidence if they match a preconceived expectation. For example, if school administrators implement a new program and student test scores go up by even a small amount, it might be interpreted as evidence of the program's success rather than just the product of random variation in student test scores that naturally occurs from year to year.
- **Overconfidence Bias.** We are overconfident in our ability to predict the future and naturally tend to underestimate the degree of uncertainty we face. Experimental evidence has shown we usually underestimate uncertainty by approximately 50 percent.

STRATEGIES FOR IMPROVEMENT

These limitations do not mean that we are fated to ineffective risk management. In *The Failure of Risk Management: Why It's Broken and How to Fix It*, Doug Hubbard describes strategies to improve how managers practice risk management. His prescriptions are consistent with the lines of reasoning set forth by Bernstein and Mlodinow. In this review, we will cover those that are most relevant to public managers: uncertainty, measurement of uncertainty, risk, and measurement of risk.

Hubbard starts with the definition of uncertainty and risk. He points out that although these definitions appear to be straightforward, in practice, they often mean different things to different people. Without a common understanding of what uncertainty and risk actually are, it is impossible to come up with a coherent strategy to manage them. Hubbard's work offers the following definitions as the basis for a strong risk-management strategy:

- **Uncertainty.** The lack of complete certainty — that is, the existence of more than one possibility. The "true" outcome/state/result/value is not known.
- **Measurement of Uncertainty.** A set of probabilities assigned to a set of possibilities. For example, "There is a 60 percent chance it will rain tomorrow, and a 40 percent chance that it won't."
- **Risk.** A state of uncertainty where some of the possibilities involve a loss, injury, catastrophe, or other undesirable outcome (i.e., something bad could happen).
- **Measurement of Risk.** A set of possibilities, each with quantified probabilities and quantified losses. For example, "We believe there is a 40 percent chance the proposed project will fail, resulting in a loss of $1 million."

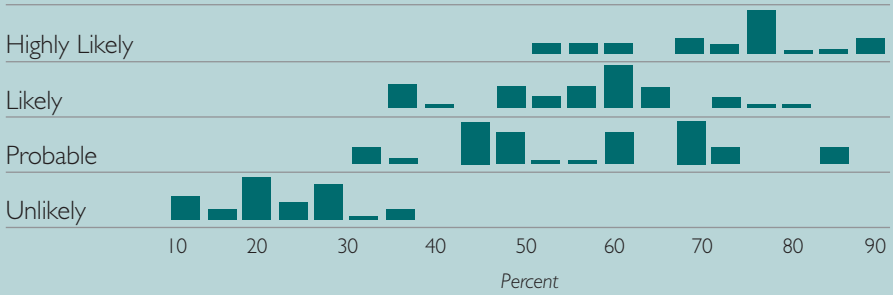
The key to Hubbard's definitions is expressing uncertainty and risk in probabilistic terms. As Bernstein puts it, "Without numbers, there are no odds and no probabilities; without odds and probabilities, the only way to deal with risk is to appeal to the gods and the fates. Without numbers, risk is wholly a matter of gut." As the other authors demonstrate, gut decision-making is a flawed and dangerous way to deal with risk.

This is not to say that human judgement has no place in managing risk. Hubbard tells us that we need to recognize the sources of error-judging risks and then take steps to correct for them. If we do not, the result is systematic underestimation of risk. Bernstein suggests that we design risk-assessment systems to encourage par-

ticipants to question their assumptions and to spend as much time looking for disconfirming evidence as we do confirming evidence. Hubbard suggests that we express our judgements in precise probabilistic terms (e.g., I am 60 percent confident that a given event will occur) and that we seek out clear and timely feedback on whether our estimates are correct. In fact, Hubbard advocates for practicing this skill in an artificial environment and presents evidence that such training can greatly increase our skills in making probabilistic estimates.

Exhibit 1: Translating a Subjective Assessment into a Probabilistic Estimate

NATO officers were asked to translate subjective assessments — "highly likely," "likely," "probable," and "unlikely" — into percentage-based probabilistic estimates.



Source: Richards Heuer, "The Psychology of Intelligence Analysis," Center for the Study of Intelligence, Central Intelligence Agency, 1999; provided by Doug Hubbard.

SUBJECTIVE SCORING

These prescriptions have profound implications for the subjective risk-scoring systems that are popular with many organizations (where risks are rated high/medium/low or something similar, and where there might be red/yellow/green color-coding associated with the labels). Hubbard cites research showing that when these systems are translated into precise probabilistic estimates, participants often have widely different interpretations of what the labels actually mean. For example, a study of North Atlantic Treaty Organization officers asked them to estimate the probability of various military-related risks occurring, using the subjective terms "highly likely," "likely," "probable," and "unlikely." These terms were customarily used in the military to assess risk levels, where each term represented a decreasing level of likelihood (e.g., "highly likely" is the most likely and "unlikely" is the least). They then asked those officers to translate the subjective terms into precise probabilistic estimates. The chart in Exhibit 1 shows the number of officers who translated a given subjective assessment into a given probabilistic estimate. For example, in the upper-right corner, we see that a higher number of officers translated "highly likely" to about 80 percent likely, a much smaller number translated it to 50 percent likely, and no one translated it to mean 30 percent likely.

This chart starkly illustrates the subjective nature of the assessment of risk. First is how "probable" and "likely" are very similar, when expressed in probabilistic terms, though "probable" was supposed be indicate a lower level of likelihood than "likely." Also, for some people, "likely" and "unlikely" mean the same thing (about 35 percent likely), when translated into a probabilistic assessment. Finally, there is much overlap between "highly likely" and "probable," even though there is supposed to be a completely separate category of likelihood between them.

CONCLUSIONS

You can imagine how risk-management systems that rely on subjective categories of risk might actually lead to lower-quality decisions: The imprecise characterization of the risk impedes a proper understanding of the likelihood and magnitude of the risk. At the same time, the fact that the participants have taken the time to think about risks and evaluate them might actually increase the participants' confidence that they have managed the risk appropriately, even though they have not actually done the work necessary to overcome the worst flaws of human judgement when it comes to assessing uncertainty.

For these reasons, Hubbard advocates for a more quantitative approach to risk management, where historical data is the preferred way of measuring risk but where human judgement, properly applied, can provide valuable input. In fact, GFOA researchers are working with a small number of cities to apply quantitative risk-management techniques to financial planning and budgeting. If you would like learn more about these techniques, visit www.gfoa.org/forecastbook.

SHAYNE KAVANAGH is the senior manager of research for the GFOA's Research and Consulting Center in Chicago, Illinois.