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

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CHAPTER 5

An Ivory Tower of Babel: Fixing the Confusion about Risk

If you wish to converse with me, define your terms.

—VOLTAIRE

Concepts about risk and even the word risk are a source of considerable confusion even among those who specialize in the topic. There are a lot of well-entrenched and mutually exclusive ideas about risk and risk management and if we are going to make any progress, we have to work out these differences.

You might think that agreement on what the word risk means should be relatively simple and, for that matter, should have been resolved long ago. If only that were the
case. Multiple definitions have evolved in multiple professions. Even worse, some will not even know they are using it differently from others and may incorrectly believe they are clearly communicating with other risk professionals.

We need our vocabulary and concepts on firm footing before we can begin any heavy lifting with risk management. First, let’s clear up some confusion about how the word risk is used in different fields. I offered a clear definition of risk in Chapter 2, but it is worth restating here. While we’re here, let’s also clarify the related concept of uncertainty and distinguish between the qualitative and quantitative use of these terms. (Note that this is the same distinction I make in my earlier book, *How to Measure Anything: Finding the Value of Intangibles in Business*.)

**UNCERTAINTY VERSUS RISK AND THE MEASUREMENTS OF EACH**

- *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% chance it will rain tomorrow, and a 40% chance 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% chance the proposed oil well will be dry with a loss of $12 million in exploratory drilling costs.”

This specific distinction of the terms not only represents the de facto use of the terms in the insurance industry and certain other types of professions and areas of research, but is also closest to how the general public uses the term. And although risk professionals need to be a bit more precise in the use of these terms than the general public, these definitions are otherwise entirely consistent with the definitions offered in all of the major English dictionaries.
But a risk manager needs to know that this specific language is not universally adopted—not even by all risk professionals and academics. Some circles will use a language all their own and many of them will insist that their definition is the “formal” or the “accepted” definition among experts—unaware that other experts believe the same of other definitions. A risk manager needs to know these other definitions of risk, where they came from, and why we can’t use them.
THE FRANK KNIGHT DEFINITION

Frank Knight was an influential economist of the early 20th century who wrote a text titled Risk, Uncertainty and Profit (1921). The book, which expanded on his 1917 doctoral dissertation, has become what many economists consider a classic. In it, Knight makes a distinction between uncertainty and risk that still influences a large circle of academics and professionals today:

[To differentiate] the measurable uncertainty and an unmeasurable one we may use the term “risk” to designate the former and the term “uncertainty” for the latter.

According to Knight, we have uncertainty when we are unable to quantify the probabilities of various outcomes whereas risk applies to situations where the odds of various possible outcomes can be known. But Knight’s definition was and is a significant deviation from both popular use and the practical use of these terms in insurance, statistics, engineering, public health, and
virtually every other field that deals with risk.

First, Knight makes no mention of the possibility of loss as being part of the meaning of risk. It states that all we need for a state of risk is that we can quantify probabilities for outcomes—contrary to almost every other use of the term in any field. Whether any of those outcomes are undesirable in some way is irrelevant to Knight’s definition. Second, Knight’s definition of uncertainty seems to be routinely contradicted by researchers and professionals who speak of “quantifying uncertainty” by applying probabilities to various outcomes. In effect, Knight’s definition of risk is what most others would call uncertainty.

Knight starts the preface of his book by stating, “There is little that is fundamentally new in this book.” But his definitions of uncertainty and risk were quite new—in fact, previously unheard of. Even Knight must have felt that he was breaking new ground, since he apparently believed there were no adequate definitions to date that distinguished risk from uncertainty. He wrote in the same text, “Uncertainty must be taken in a sense radically distinct from the familiar notion of risk, from which it has never been properly separated.”

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1 Referenced note
In reality, there was already an extremely consistent, and sometimes mathematically unambiguous, use of these terms in many fields. Even within economics, it was generally understood that uncertainty can be represented quantitatively by probabilities and that risk must include loss. Consider the following quotes from economics journals, one published just after Knight’s text and one well before it:

- “Probability, then, is concerned with professedly uncertain [emphasis added] judgments.”
- “The word risk has acquired no technical meaning in economics, but signifies here as elsewhere [emphasis added] chance of damage or loss.”

The first speaks of probabilities—a term that is widely understood in economics, math, and statistics to be a quantity—as something that applies to uncertainty in judgments. The second quote acknowledges that risk as a chance of loss is generally understood.

The definitions I previously presented for risk and uncertainty were also used consistently in mathematics, especially in regard to games of chance, long before Knight wrote his book. Prior to 1900, many famous mathematicians such as Bayes, Poisson, and Bernoulli
discussed uncertainty as being expressed by quantified probabilities. This directly contradicts Knight’s use of the word uncertainty as something immeasurable. And there was so much of this work that I could have written an entire book just about the measurement of uncertainty before 1900. Fortunately, I didn’t need to, because one was already written (Stephen Stigler, The History of Statistics: The Measurement of Uncertainty before 1900, Harvard University Press, 1986).

One intriguingly short definition of uncertainty that I came across was in the field of the psychology of gambling (where, again, uncertainties are quantified) in the early 1900s. Clemens J. France defined uncertainty as “a state of suspense” in his article, “The Gambling Impulse,” in the American Journal of Psychology in 1902. In 1903, this use of the concept of uncertainty within gambling was common enough that it shows up in the International Journal of Ethics: “Some degree of uncertainty, therefore, and willingness to take the risk are essential for a bet.”

Even shortly after Knight proposed his definitions, other fields carried on quantifying uncertainty and treating risk as the chance of a loss or injury. In 1925, the physicist Werner Heisenberg developed his famous
uncertainty principle, which quantified minimum uncertainty of the position and velocity of a particle. The mathematicians who dealt with decisions under uncertainty continued to define uncertainty and risk as we have. And the entire insurance industry carried on doing business as usual apparently without any regard for Knight’s proposed alternative definition.

A simple test will demonstrate that Knight’s use of the term uncertainty is not the way common sense would tell us to use it. Ask people around you the following three questions:

1. “If I were to flip a coin, would you be uncertain of the outcome before I flipped it?”
2. “What is the chance that the outcome will be tails?”
3. “Assume you are not betting anything on the flip or depending on the flip in any other way. Do you have risk in the coin flip?”

Almost anyone you asked would answer “yes, 50%, and no.” Knight’s definitions would have to answer “no, 50%, and yes” if he were serious about his definitions. Since our answer to question #2 indicates the odds are quantifiable, Knight would have to say a coin flip is not uncertain (he says uncertainty is immeasurable) even
though almost anyone would say it is. Also, since the coin flip meets his only criterion for risk (that the odds are quantifiable) then he has to answer “yes” to #3, even though the lack of having any stake in the outcome would cause most of the rest of us to say there is no risk.

While Knight’s definitions are quite different from many risk management professionals’, his definitions influence the topic even today. I was corresponding with a newly minted PhD who had conducted what she called a “prequantitative” risk analysis of a major government program. While discussing risk, it became clear that we had a different vocabulary. She was using the term uncertainty as unquantifiable randomness, just as Knight did. She didn’t mention Knight specifically but pointed out that, even though it was not the common use, this is how the term is “defined in the literature.” For evidence of this, she cited a definition proposed by the editors of a fairly important anthology of decision science, Judgment and Decision Making: An Interdisciplinary Reader, which defined the terms as Knight did. I happened to have a copy of this book and in less than five minutes found another article in the same text that discusses how uncertainty is “expressed in terms of probabilities” (Fischhoff, p. 362)—which is consistent with nearly every other source I find.
Knight himself recognized that this was not the common use of these terms. But, for some reason, despite the volume of prior work that quantified both risk and uncertainty, he felt that he needed to define risk proper. Unfortunately, Knight’s views held a lot of sway with many economists and non-economists alike and it still contributes to confusion in the advancement of risk management. Let’s just call it what it is—a blunder. This will brand me a heretic with fans of legendary economists (and there is more of that to come), but it was ill-conceived and didn’t clarify anything.
RISK AS VOLATILITY

In the world of finance, volatility, variance, and risk are used virtually synonymously. If a stock price tends to change drastically and frequently, it is considered to be volatile and, therefore, it is risky. This is sometimes associated with Harry Markowitz, the economist who won the Nobel Prize in Economics for Modern Portfolio Theory (MPT). As briefly mentioned in Chapter 4, MPT attempts to define how a rational investor would select investments in a portfolio in a way that makes the best overall risk and return for the portfolio.

Actually, Markowitz never explicitly promotes such a definition. He merely states that, in most financial articles in general, “if . . . ‘risk’ [were replaced] by ‘variance of return,’ then little change of apparent meaning would result.” He treats volatility, like risk, as something that is acceptable if the return is high enough. In practice, though, analysts who use MPT often equate historical volatility of return to risk.

While it is true that a stock with historically high
volatility of returns is probably also a risky stock, we have to be careful about how this is different from the definitions I proposed earlier. First—and this may seem so obvious that it’s hardly worth mentioning—volatility of a stock is risky for you only if you own a position on that stock. I usually have a lot of uncertainty about the outcome of the Super Bowl (especially because I don’t follow it closely), but unless I were to bet money on it, I have no risk.

Second, even if I have something at stake, volatility doesn’t necessarily equate to risk. For example, suppose we played a game where I roll a six-sided die and whatever comes up on the roll I multiply by $100 and pay you that amount. You can, therefore, win anywhere from $100 to $600 on a roll. You only have to pay me $100 to play. Is there uncertainty (i.e., variance or volatility) in the outcome of the roll? Yes; you could net nothing from the game or you could net as much as $500. Do you have risk? No; there is no possible result that ends up as a loss for you.

Of course, games like that don’t usually exist in the market, and that’s why it is understandable how volatility might be used as a sort of synonym for risk. In an actively traded market, the price of such a game would be “bid up”
until there was at least some chance of a loss. Imagine if I took the same game and, instead of offering it only to you, I offered it to whoever in your office would give me the highest bid for it. It is very likely that someone out of a group of several people would be willing to pay more than $100 for one roll of the die, in which case that person would be accepting a chance of a loss. The market would make any investment with a highly uncertain outcome cost enough that there is a chance of a loss—and therefore a risk for anyone who invests in it.

But what works in the financial markets is not always relevant to managers dealing with investments in the operation of a firm. If you have the opportunity to invest in, say, better insulated windows for your office building, you may easily save substantially more than the investment. Even though energy costs are uncertain, you might determine that, in order for the new windows not to be cost effective, energy costs would have to be a small fraction of what they are now. The difference between this and a stock is that there is no wider market that has the opportunity to compete with you for this investment. You have an exclusive opportunity to make this investment and other investors cannot just bid up the price (although, eventually, the price of the windows may go up with demand).
It is also possible for operational investments with very little variance to be risky where the expected return is so small that even a slight variance would make it undesirable. You would probably reject such an investment, but in the market the investment would be priced down until it was attractive to someone.

In summary, volatility implies risk only if some of the outcomes involve losses. Our definition of risk applies equally well regardless of whether the investment is traded on the market or is an operational investment exclusive to the management of a business.
A CONSTRUCTION ENGINEERING DEFINITION

I came across another use of the term risk when I was consulting on risk analysis in the engineering construction industry. It was common for engineers to put ranges on the costs of an engineering project and they would refer to this as the variance model. The price of steel might vary during the course of construction, so they would have to put a range on this value. This was likewise done for the hourly rates of various labor categories or the amount of effort required for each category. The uncertainty about these items would be captured as ranges such as “The hourly cost of this labor next year will be $40 to $60 per hour” or “This structure will take 75 to 95 days to finish.”

Fair enough; but they didn’t consider this a risk of the project. The separate “risk model” was a list of specific events that may or may not happen, such as “There is a 10% chance of an onsite accident that would cause a work stoppage” or “There is a 20% chance of a strike among the electricians.” This use of the word risk makes an arbitrary distinction about risk based on whether the source of the uncertainty is a range value or a discrete
event.

In the definition I propose for risk, the price of steel and labor, which could be much higher than they expected, would be a legitimate source of risk. The construction project had some expected benefit and it is quite possible for increasing costs and delayed schedules to wipe out that benefit and even cause a net loss for the project. Some uncertain outcomes result in a loss and that is all we need to call it a risk. Risk should have nothing to do with whether the uncertainty is a discrete event or a range of values.
RISK AS EXPECTED LOSS

I sometimes come across risk defined as “the chance of an unfortunate event times the cost if such an event occurred.” I’ve encountered this use of the term in nuclear power, many government agencies, and sometimes IT projects. The product of the probability of some event and the loss of the event is called the expected loss of the event.

Any reader new to the decision sciences should note that when risk analysts or decision scientists use the word expected they mean “probability weighted average.” An expected loss is the chance of each possible loss times the size of the loss totaled for all losses (this value can be very different from the loss that is the most likely).

This definition was going down the right path before it took an unnecessary turn. It acknowledges the need for measurable uncertainty and loss. But this definition requires an unnecessary assumption about the decision maker. This definition assumes the decision maker is “risk neutral” instead of being “risk averse,” as most
people are. A risk-neutral person always puts a value on anything that is equal to its expected value, that is, the probability weighted average of all the outcomes. For example, consider which of the following you would prefer:

- A coin flip that pays you $20,000 on heads and costs you $10,000 on tails.
- A certain payment to you of $5,000.

To a risk-neutral person, these are identical, since they both have the same expected value: $(20,000 \times .5) + (-10,000 \times .5) = 5,000$. However, since most people are not risk neutral, it’s too presumptuous to just compute the expected loss and equate that to their risk preference.

But why do we have to reduce risk to a single value just yet? How much the manager values a given risk (that is, how much she is willing to pay to avoid it) depends on her risk aversion and this cannot be determined from simply knowing the odds and the losses involved. Some people might consider the two options above equivalent if the certain payment were $2,000. Some might even be willing to pay not to have to flip the coin to avoid the chance of a $10,000 loss. But we will get to quantifying risk aversion later.
We can, instead, just leave the risk in its separate components until we apply it to a given risk-averse decision maker. This treats risk as a sort of vector quantity. Vector quantities are quantities that can be described only in two or more dimensions and they are common in physics. Quantities that are a single dimension, like mass or charge, are expressed with one number, such as “mass of 11.3 kilograms” or “charge of .005 coulombs.” But vector quantities, such as velocity or angular momentum, require both a magnitude and a direction to fully describe them.

As with vector quantities in physics, we don’t have to collapse the magnitude of the losses and the chance of loss into one number. We can even have a large number of possible outcomes, each with its own probability and loss. If there are many negative outcomes and they each have a probability and a magnitude of loss, then that entire table of data is the risk. (See Exhibit 5.1.) Of course, losses and their probabilities often have a continuum of values. If a fire occurs at a major facility, there is a range of possible loss and each point on that range has an associated probability.

Any of the definitions you might find for risk that state that risk is “the probability/chance and
magnitude/amount/severity of a danger/harm/ loss/injury” implicitly treat risk as a vector (an Internet search will reveal quite a few such definitions, including those from scientific literature). The definition simply states that risk is both the probability and the consequence and doesn’t say that they should necessarily be multiplied together.

**EXHIBIT 5.1 EXAMPLE OF THE RISK OF A PROJECT FAILURE EXPRESSED AS A VECTOR QUANTITY**

<table>
<thead>
<tr>
<th>Event</th>
<th>Probability</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total project failure—loss of capital investment</td>
<td>4%</td>
<td>$5–12 million</td>
</tr>
<tr>
<td>Partial failure— incomplete adoption</td>
<td>7%</td>
<td>$1–4 million</td>
</tr>
</tbody>
</table>
RISK AS A GOOD THING

It’s clear that most people use the word risk to refer to the possibility of some negative outcome. But can risk mean the chance of a good thing happening? Oddly enough, it does mean that to some in the emerging profession of project management.

The Guide to the “Project Management Body of Knowledge” (PMBok), 2000 edition, published by the Project Management Institute (PMI), defines project risk as “an uncertain event or condition that, if it occurs, has a positive or negative [emphasis added] effect on a project objective.”

This definition is acknowledged by a large number of people in project management. The PMI began in 1969 and by 2008 had over 265,000 members worldwide. In addition to publishing the PMBoK, it certifies individuals as Project Management Professionals (PMPs). Although PMI attempts to cover projects of all sorts in all fields, there is a large presence of information technology (IT) project managers in its membership.
There are also UK-based organizations that define risk in this way. The Project Risk Analysis & Management Guide (PRAM Guide, 1997) of the UK Association for Project Management (APM) defines risk as “an uncertain event or set of circumstances which, should it occur, will have an effect on achievement of objectives,” and further notes that “consequences can range from positive to negative.” And the British Standards BS6079-1: 2002 Guide to Project Management and BS6079-2: Project Management Vocabulary define risk as a “combination of the probability or frequency of occurrence of a defined threat or opportunity [emphasis added] and the magnitude of the consequences of the occurrence.”

I was discussing this definition of risk with a PMI-certified PMP and I pointed out that including positive outcomes as part of risk is a significant departure from how the term is used in the decision sciences, insurance, probabilistic risk analysis in engineering, and most other professions that had been dealing with risks for decades. He asked why we wouldn’t want to include all possible outcomes as part of risk and not just negative outcomes. I said, “Because there is already a word for that—uncertainty.”
I had another project manager tell me that risk can be a good thing because “sometimes you have to take risk to gain something.” It is true that you often have to accept a risk in order to gain some reward. But, if you could gain the same reward for less risk, you would. This is like saying that expenses—by themselves—are a good thing because you need them for business operations. But, again, if you could maintain or improve operations while reducing spending, you would certainly try. The fact that rewards often require other sacrifices is not the same thing as saying that those sacrifices are themselves desirable. That’s why they are called sacrifices—you are willing to endure them to get something else that you want. If it were a good thing, you would want more of it even if all other things were held constant. You accept more costs or more risks, however, only if you think you are getting more of something else.

Perhaps this definition is somehow connected to Knight’s use of the term, since Knight also made no distinction about loss (he merely required measurable probabilities of outcomes). This may also be influenced by the use of risk as meaning simply volatility even if the uncertainties contain no negative outcomes. But even some of the editors of the *PMBOK* don’t seem to be aware of Knight’s use of the word. They apparently made this up on their own.
The fact is that every English dictionary definition you can find—including Merriam-Webster, American Heritage, Oxford English, or even Dictionary.com—defines risk in terms of peril, danger, chance of loss, injury, or harm. Not one mentions risk as including the possibility of a positive outcome alone. Risk as “opportunity,” in and of itself (as opposed to something one is willing to accept in exchange for opportunity), also contradicts the most established use of the word in the practical world of insurance as well as the theoretical world of decision theory.

Such an odd deviation from the general use of a common word can happen only in an insular group that feels it has to reinvent such concepts. And being confused about the meaning of the word risk isn’t the only problem with PMI’s approach to risk management. I will be discussing PMI again when I talk about problems with their risk assessment approach. But the vocabulary would not be such a problem if we familiarized ourselves with the other work on the topic before creating a “new” risk management approach.

The problem with PMI, as with many other home-
brewed versions of risk and risk management, is that risk was added almost as an afterthought. I can tell by looking at the content that they had nobody on their committee with a background in decision science, actuarial science, or probabilistic risk analysis. To their credit, somebody realized that part of project management must be risk management. But, apparently, they sat down and made up risk management (and the new definitions) with no input from existing literature on the topic.
RISK ANALYSIS AND RISK MANAGEMENT VERSUS DECISION ANALYSIS

Part of the desire to include opportunities and benefits in risk analysis and risk management can be traced to lack of familiarity with the field that already includes those things. Decision analysis (DA), introduced in Chapter 4, is a large body of theoretical and applied work that deals with making decisions under a state of uncertainty. It addresses decisions where tradeoffs have to be made between uncertain costs, uncertain benefits, and other risks.

Part of the problem with risk management, at least in some organizations, has been its rapid growth—mostly in isolation—from already well-developed quantitative methods such as those found in decision analysis. But now the additional implications of the term risk management need to be considered. Management itself denotes that decision making and risk management must include analysis of decisions. Clearly, nearly all management decisions have risks. Is risk management now the home of all decision analysis in the firm?
I propose a solution: Risk managers do deal with decisions as they are related to tracking and reducing risks inherent in the business. If a risk manager can find a cheaper way to mitigate a risk without interfering with other business operations and do so within his own budget, then he has the authority to do so. When it comes to assessing decisions with other business opportunities where risk is a factor, the risk professional simply provides the input for the risk assessment to be used in the decision analysis. I will write more later about how risk analysis, risk management, and decision analysis should come together.
ENRICHING THE LEXICON

Let’s summarize risk terminology and add a few more items to our lexicon. We just reviewed several definitions of risk. Many of these were mutually exclusive, contradicted commonsense uses of the language, and defied even the academic literature available at the time. A risk manager in a large organization with professionals in finance, IT, and perhaps engineering could have easily encountered more than one of these definitions just within his own firm. If a risk manager does run into these alternative uses of the word, we have to respond:

- Risk has to include some probability of a loss—this excludes Knight’s definition.
- Risk involves only losses (not gains)—this excludes PMI’s definition.
- Outside of finance, volatility may not necessarily entail risk—this excludes considering volatility alone as synonymous with risk.
- Risk is not just the product of probability and loss. Multiplying them together unnecessarily presumes that the decision maker is risk-neutral. Keep risk as a vector quantity where probability and magnitude of loss are separate until we compare it to the risk aversion of the decision maker.
• Risk can be made of discrete or continuous losses and associated probabilities. We do not need to make the distinctions sometimes made in construction engineering that risk is only discrete events.

One final note about this terminology is that it has to be considered part of a broader field of decision analysis. Just as risk management must be a subset of management in the organization, risk analysis must be a subset of decision analysis. Decisions cannot be based entirely on risk analysis alone but require an analysis of the potential benefits if managers decide to accept a risk. Later in the book we will get into the implications of this for various types of decisions in the firm, but, for now, let me introduce the idea along with some additional required terminology.

An enriched professional vocabulary doesn’t mean shoe-horning disparate concepts into a single word (like PMI did with risk). We have different terms for different concepts and they seem to me to be less about hair-splitting semantics than about clear-cut night-and-day differences. Here are some clarifications and a couple of new terms that might have been useful to the authors of some of the definitions we just reviewed:
• *Uncertainty*. This includes all sorts of uncertainties, whether they are about negative or positive outcomes. This also includes discrete values (such as whether there will be a labor strike during the project) or continuous values (such as what the cost of the project could be if the project is between one and six months behind schedule). Uncertainty can be measured (contrary to Knight’s use of the term) by the assignment of probabilities to various outcomes.

• *Strict uncertainty*. This is what many modern decision scientists would call Knight’s version of uncertainty. Strict uncertainty is where the possible outcomes are identified but we have no probabilities for each. For reasons we will argue later, this should never have to be the case.

• *Risk/reward analysis*. This considers the uncertain downside as well as the uncertain upside of the investment. By explicitly acknowledging that this includes positive outcomes, we don’t have to muddy the word risk by force-fitting it with positive outcomes. Part of risk/return analysis is also the consideration of the risk aversion of the decision maker, and we don’t have to assume the decision maker is risk neutral (as we would when we assume that risk is loss times probability).

• *Ignorance*. This is worse than strict uncertainty since in the state of ignorance, we don’t
even know the possible outcomes, much less their probabilities. This is what former U.S. Secretary of Defense Donald Rumsfeld and others would have meant by the term “unknown unknowns.” In effect, most real-world risk models must have some level of ignorance, but this is no showstopper toward better risk management.
NOTES


