Value-Based Risk Management (VBRM)

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ABSTRACT: As practiced in today's varied applications, traditional risk management is typically defined as a process to identify, analyze, mitigate, and control the risks and opportunities in decision-making. Although such actions move the ball, they do little to carry the decision-maker over the goal line. There are two additional requirements of risk management: benchmarking and grading. Incorporation of these two attributes into traditional risk management practice produces a much-improved decision technology, Value-Based Risk Management (VBRM). Value-Based Risk Management & VBRM are service marks of Decision Sciences Corporation, Saint Louis, Missouri. The management action chart, uncertainty benchmark horn, and uncertainty grading material included in this article are copyrighted by the Decision Sciences Corporation. They are used with permission for this article.

KEY WORDS: Value-Based Risk Management, uncertainty, mitigation and decision-making

The terms *risk* and *uncertainty* suffer from multiple definitions. For example, uncertainty may be defined as a state wherein there is an absence of knowledge while, in the same definitional set, risk is described in both unfavorable and favorable terms (e.g., *upside risk* denotes a favorable situation).

Such definitions are antithetical in many areas of business practice, most notably in applications that measure cost, profit, and schedule type variables. Many managers and engineers look upon risk as a wholly unfavorable entity, something from which no good can result. This interpretation is dramatically evident in risky business decision-making, a vigorous exercise to avoid, remove, or reduce the attendant risks in that decision and—this is equally important—take full advantage of its inherent opportunities (the managerial term for upside risks).

Since risk is considered nothing but unfavorable in many business decisions, risk may be defined as an unwanted and undesirable outcome consistent with the relationship uncertainty = risks + opportunities. (This is one of the three acceptable definitions specified in AACE International's **Risk Management Dictionary** and the applicable definition throughout the remainder of this article.)

In accordance with this definition, *risk management* is understood to mean risk and opportunity management and *risk analysis* as risk and opportunity analysis. (Some practitioners argue that risk management is a misnomer and that the process should be referred to as uncertainty management).

As practiced in today's varied applications, traditional risk management is typically defined as a process to identify, analyze, mitigate, and control the risks and opportunities in decision-making. Although such actions move the ball, they do little to carry the decision-maker over the goal line.

There often is an imbalance in the application of resources among the four phases of risk management. Inappropriately large amounts of resources tend to be allocated to the first two phases (identify and analyze) at the expense of the final two phases (mitigate and control).

By correcting this imbalance—and by incorporating benchmarking and grading into the traditional risk management process—Value-Based Risk Management (VBRM) produces higher quality results with a reduced expenditure of time and other precious resources.

More to the Point

The number of organizations devoting serious attention to risk management is rapidly increasing. With few exceptions, however, these organizations are plagued by a series of vexing problems, including the following.

- too many high-value people taking too much time plodding through the first two phases of risk management (identification and analysis);
- poor results (i.e., significant disparities between predictions and actual outcomes);
- lack of senior management understanding and support.

In many instances, identification and analysis alone consume weeks or even months of effort. Then, in a true case of irony, when the decision-maker finally receives the results, the project has mutated—it's not the same project! This paradox is most notable in—although certainly not limited to—projects in the public sector.

In project cost estimates, the identification and analysis phases develop the required amount of contingency and generate a prioritized list of risks and (possibly) opportunities. Other information such as a risk register and risk categorizations (e.g., high, medium, low) also may be prepared. Although this effort surfaces risks, many of those risks do not seriously jeopardize the project's bottom line cost performance. (Although much of VBRM also applies to schedule, its description in this article is restricted to cost.)

Overemphasis on the first two phases of risk management (identification and analysis) can greatly diminish the ability to effectively address the last two phases (mitigation and control). Consequently, the negative and positive components of potential mitigating actions are not explored in detail—certainly not down to the level of detail in the base cost estimate. Mitigating actions often have the potential to add risk in one or more areas other than the one in which they are designed to lower risk. Furthermore, with the large commitment of personnel, monies, and other resources to identification and analysis, many organizations quickly become reluctant to periodically re-assess and re-analyze the project during its implementation.

This lack of periodic attention over the life cycle of the project severely restricts development and testing of potential mitigations. This in turn adversely affects control, the fourth and final phase of risk management. Indeed, in many cases the first pass at identification and analysis turns out to be the only attempt to probabilistically analyze uncertainty during the life of the project.

In the world of space exploration, this is equivalent to burning all of the fuel during the launch, leaving nothing for midcourse corrections on the way to the moon. Simply put, uncertainty must be regularly measured and monitored if it is to be managed!

Correcting these deficiencies in current risk management practice requires a better approach.

A Better Approach

Value-Based Risk Management greatly reduces the expenditure of human and financial resources in the first two phases (identification and analysis), applies a significant portion of that savings in resources to the last two phases (mitigation and control)—while simultaneously improving the reliability of the results derived from the first two phases.

In other words, VBRM optimizes human and financial resources to dramatically improve the risk management process, particularly the highly critical mitigation and control phases. Since its inception, VBRM has delivered substantial benefit on projects ranging in size from a few million to multiple billions of US dollars.

Improving risk management practice presents the following five challenges.

- Needlessly high expenditures of time devoted to identification and analysis must be eliminated and a significant portion of the resultant savings must be applied to mitigation and control where it is sorely needed.
- The quality of analysis results (contingency, risk/opportunity ranking, etc.) must be assured.
- All significant potential mitigations must be fully examined; in other words, the mitigation phase must be optimized.
- The approach must improve the project team's (and thus the organization's) risk management skills.
- Frequent and regular analyses (snapshots) must be performed throughout the project's life cycle (including implementation) to ensure true control of persistent risks and opportunities.

Meeting the Challenges

VBRM employs a combination of well-known, as well as more recently developed decision technologies to overcome the challenges facing today's risk management community.

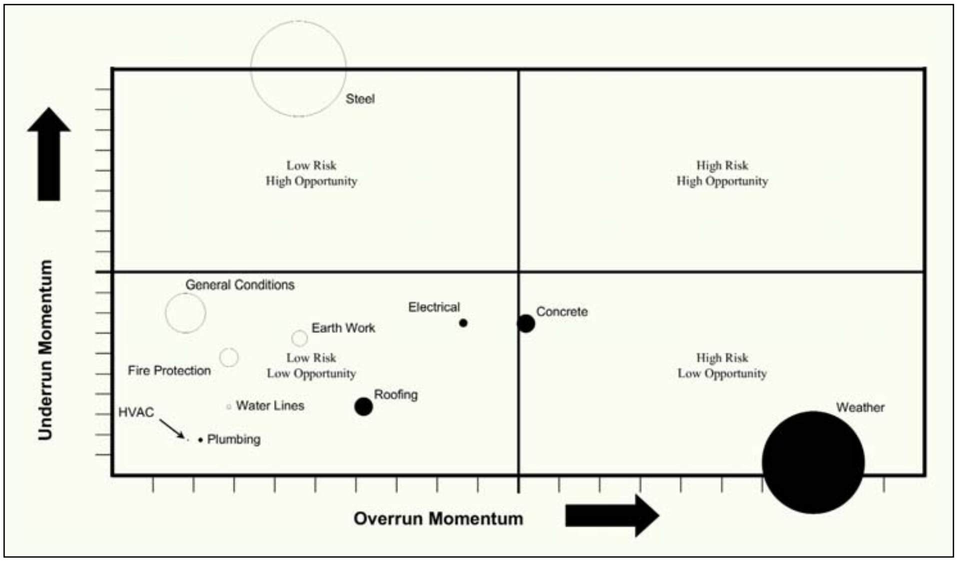

Figure 1— Management Action Chart, © by Decision Sciences Corporation

Challenge One—Reduce Identification and Analysis Time

VBRM, the third generation in probabilistic business risk management, builds upon the original Range Estimating [1] process to reduce identification and analysis time while ensuring its quality.

Developed in the late 1960s as a second generation probabilistic business risk management technology, Range Estimating is a synergistic combination of the application of Pareto's Law (in the form of the critical variance matrix), Monte Carlo simulation, and input/output heuristics.

Prior to Range Estimating, the first generation of probabilistic business risk management was exemplified by application of bare bones Monte Carlo simulation. (Range Estimating and the critical variance matrix have been the topics of numerous articles previously published in **Cost Engineering, AACE International Transactions** and other publications, and are not covered in the present context).

The first two phases of risk management (identification and analysis) are addressed in the VBRM data gathering session that occurs over a one-to-two-day period, regardless of project size or type.

All information required for the subsequent VBRM study is gathered during this session. Basic results (probability of cost overrun, required contingency, etc.) derived in the subsequent VBRM study are comparable to those derived with traditional, first or second generation business risk management methods—methods that may take weeks or months and incur hundreds of thousands of dollars of expense.

The first result of the VBRM session is the probabilistic analysis which delivers the following.

- The probability of overrunning the project's base cost (target) estimate.
- The realistic worst case cost scenario (i.e., the exposure).
- The realistic best case scenario (i.e., the maximum potential underrun).
- The required amount of contingency for the desired level of confidence of not overrunning the project's target cost.
- A ranking of project risks and opportunities.
- Allocation of the required contingency to each key element having net risk.

In addition to these traditional results, VBRM provides a management action chart that depicts each risk/opportunity source as a circle (see Figure 1).

The diameter of each circle represents the amount of net risk or net opportunity associated with the source. Net risk is the difference between the amount of risk (unfavorable potential) a source contributes to the bottom line and the amount of opportunity (favorable potential) it contributes.

Net opportunity is the difference between the amount of opportunity (favorable potential) a source contributes to the bottom line and the amount of risk (unfavorable potential) it contributes.

Net opportunity and net risk are somewhat analogous to the terms profit and loss seen on business statements of income and expense (so called P&Ls). If there is more risk than opportunity, then there is a net risk (loss). If there is more opportunity than risk, then there is a net opportunity (profit).

A source having a net risk contributes more unfavorable than favorable potential. Thus, it requires contingency in order to accommodate that net risk. Such a source is depicted as a solid circle on the management action chart.

On the other hand, a source having a net opportunity contributes more favorable than unfavorable potential. Therefore, it requires no contingency. This type of source appears as an unfilled circle on the management action chart.

Determination of net risk and net opportunity is not a simple calculation. It takes into account a myriad of variables: the source's input range, the sensitivity of the bottom line to changes in the source, the probability the source will experience an overrun or underrun, etc.

Most projects require contingency in order to bring the total estimate to the level of confidence required by management. Since contingency is typically a positive value (an addition to the base estimate), the allocation of contingency should go proportionately to the problematic sources —those with net risk (i.e., those with solid circles). The potential collective unfavorable impact of these sources determines the amount of total contingency.

Since sources with net opportunity (i.e., those with unfilled circles) are likely to induce underruns, they do not receive contingency. Their potential collective favorable impact on the bottom line has already been accounted for in the analysis and, in fact, exercises a downward restraint on total contingency, thus keeping it from becoming larger.

In extremely rare cases, negative contingency situations are encountered. This occurs when the base estimate overstates risk and/or understates opportunity. In one such case, management directed that a project cost estimate with contingency have an 80 percent chance of not overrunning. However, the base estimate, without contingency, had more than a 90 percent chance of underrunning.

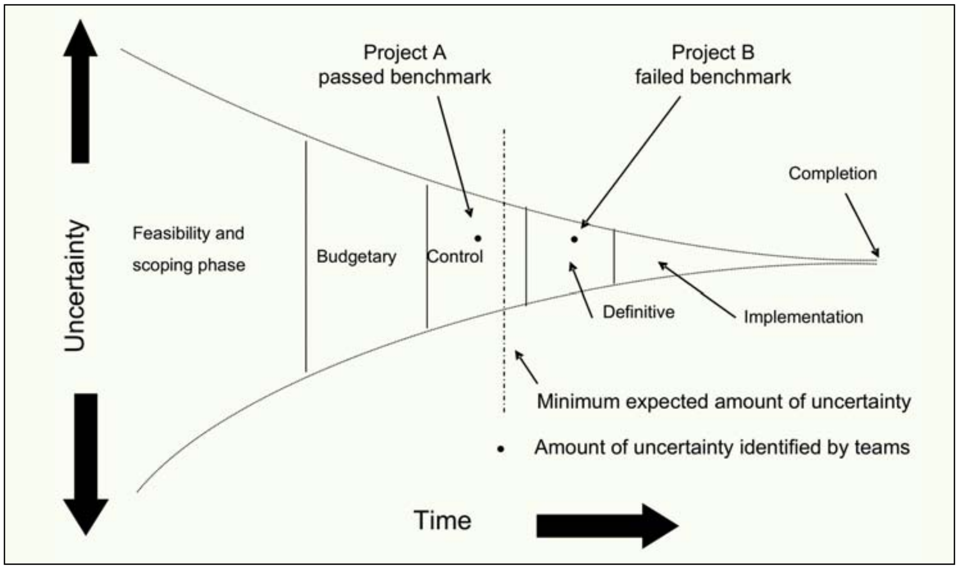

Figure 2— Uncertainty Benchmark Horn, © by Decision Sciences Corporation

In other words, the project team was extremely pessimistic when it prepared the base estimate; thus the estimate needed to be reduced in order to arrive at management's desired level of confidence. The amount by which it was reduced is negative contingency.

In such rare cases, those sources having net opportunity (those with unfilled circles) are used to determine where and by how much the base estimate needs to be reduced to arrive at management's desired confidence level.

However, caution must be exercised to avoid the temptation to subsequently add contingency to the reduced base estimate. Simply put, if it was correct to reduce the total estimate to conform to management's desired level of risk, why would it now be acceptable to go back and add anything?

The horizontal axis (overrun momentum) in Figure 1, measures each source's potential for creating an overrun of the target cost of the project. The vertical axis (underrun momentum) measures each source's potential for creating an underrun of the target cost of the project. The overrun and underrun momenta are calculated based on a variety of measures, including the source's probability of inducing a cost underrun/overrun, amount of the source's potential variation, its impact at the project's bottom line, etc.

A source whose circle appears close to the origin, (i.e., the bottom left corner of the chart) has a small potential impact on total project cost. One whose circle appears far from the origin has a large potential impact on total project cost.

In Figure 1, steel appears at the maximum level on the underrun momentum scale. Weather, although having the largest overrun momentum, does not reach the maximum level along that axis. This means that steel contributes slightly more opportunity (to underrun) than weather contributes risk (to overrun).

Management should focus first and foremost on capturing the opportunity in steel and only then address the risk in weather—perhaps by changing the overall construction schedule, altering the build sequence, moving toward prefabrication, etc. Those sources toward the middle of the chart contain various mixtures of underrun and overrun potential.

General conditions is treated as a single source of uncertainty in order to simplify the chart in this example. VBRM typically drills down into these types of sources in order to uncover specifics requiring management action.

The management action chart, derived from data collected during the one-to-two day VBRM session, is a primary tool used by project teams to identify mitigation actions.

This example is based on an actual VBRM analysis. Management decided to capture the potential opportunity in steel by purchasing all of the steel for this three-year project on the first day of implementation. This mitigation action avoided the rapid increase in steel prices that occurred shortly thereafter. (Unfortunately, in many other projects during that period, too many traditional analyses and too many managers focused primarily on risks and missed similar high-value opportunities prior to the onset of galloping steel prices.)

In simple terms, management's attention should be focused first on those sources having the largest circles—regardless of whether they are net risks or net opportunities.

Once the opportunities and risks have been addressed in those sources, attention should shift to the remaining circles appearing farthest from the origin—those not in the lower left quadrant of the chart.

The goal, although not always attainable, is to implement changes in the plan (alternatives, options, execution methods, etc.) such that there are only small circles on the management action chart and all of them appear in the lower left quadrant.

The overrun momentum and underrun momentum scales of the management action chart are adjusted so that at least one uncertainty source (circle) appears on the top margin or on the rightmost margin. The sizes of the circles are also adjusted so that the largest net risk or net opportunity has a large circle associated with it—even if the amount of net risk or net opportunity is relatively small.

These adjustments help management focus first on the most critically uncertain elements and, through successive analyses, fine tune the decision-making until no more alternatives or options are available.

Challenge Two—Ensure Reliability of Analysis Results

To ensure reliability of analysis results, VBRM calculates an uncertainty benchmark derived from a database of more than four thousand applications, compiled over a period of nearly four decades—applications whose risk/opportunity analyses and actual outcomes are known.

In 2004 alone, tens of billions of US dollars of projects in the energy, manufacturing, transportation, defense R&D, and other sectors of the world economy were analyzed for cost uncertainty. Each of these analyses and its actual project cost will be incorporated into the benchmarking database upon the project's completion.

Virtually all project types, sectors (private and public), sizes, and life cycle stages are represented in the benchmarking database. VBRM's uncertainty benchmark establishes a minimum level of uncertainty (cost variation) expected in a given risk analysis. The benchmark varies based on type of project, size of project, life cycle stage, etc.

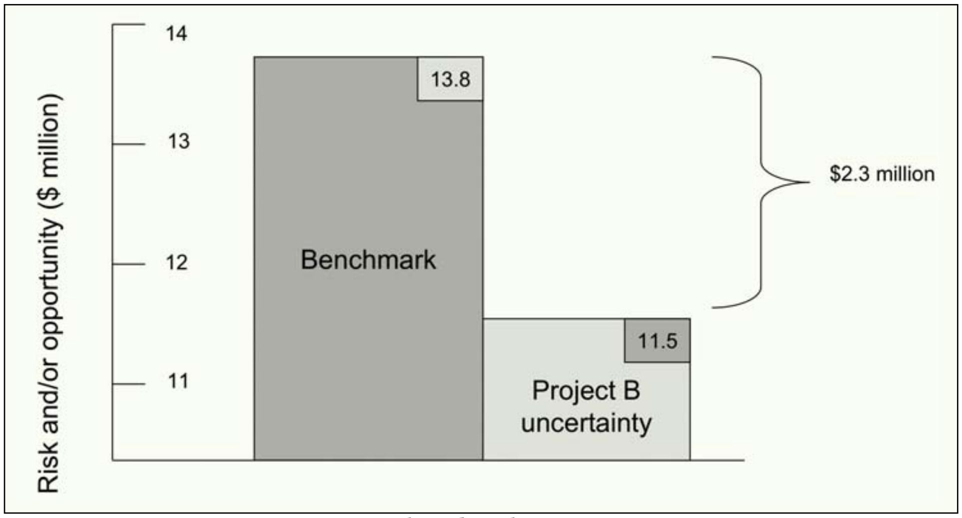

Figure 3— Project B, Uncertainty Benchmark Failure

An analysis result, passing the uncertainty benchmark, indicates that the project team likely has identified and adequately quantified the project's key risks and opportunities.

An analysis failing the uncertainty benchmark, likely indicates there are substantial risks and/or opportunities that have escaped the project team's attention. History has shown that if an analysis fails benchmark, there is a significant probability that the total cost of the project will exceed the faulty worst case scenario predicted in the analysis!

If an analysis fails benchmark, the project team then revisits its assumptions and logic to uncover overlooked or understated risks and opportunities. This early warning system keeps the project on track. With few exceptions, projects that pass benchmark meet their budgetary goals—without de-scoping. (The uncertainty benchmark is also being successfully applied to non-VBRM analyses such as those prepared by third parties or with the use of off-the-shelf risk analysis software packages.)

Uncertainty benchmark results are conveyed to the project team in the form of two graphics. The first is the uncertainty benchmark horn (Figure 2). The horn represents project life cycle stages beginning from the left. The height of the horn at any given point represents the amount of uncertainty at that stage in the project life cycle. The far right represents project completion—where there is no cost uncertainty (i.e., the horn comes to the point of actual cost, a place where there is no potential cost variation).

Figure 2 depicts uncertainty benchmarks for two projects (A and B). Both benchmarks were predicated on control estimates of the projects. The dashed, vertical line is the uncertainty baseline. It represents the minimum amount of uncertainty that the project team should have mined during the identification and analysis phases.

The horizontal position of the uncertainty baseline depends upon a project's size, type, life cycle stage, percentage of total estimated cost in lump-sum contracts, and other factors. For this reason, the uncertainty baseline generally does not appear on a boundary of a project stage, but rather, somewhere between such boundaries.

The time scale on the horn does not relate specifically to days, weeks, months, etc. Rather, it indicates the progress of each project as it flows from the feasibility stage to completion. The two hypothetical projects in this example are assumed to be at identical levels of progress in their control estimating phases, therefore they share the same uncertainty baseline.

Benchmarking results that are considered passing, lie to the left of the uncertainty baseline; whereas, failing results lie to its right. A benchmark failure indicates that the project team fell short in the identification and/or analysis phases by not extracting the minimum amount of uncertainty expected. A failing benchmark is a robust indicator of an impending cost overrun (rarely, an underrun) should the faulty risk management exercise be relied upon for decision-making.

Project A passed the uncertainty benchmark. This means the project team likely has identified all of the significant cost risks and opportunities and has adequately quantified their impacts on the total cost of the project.

Project B, however, failed the uncertainty benchmark. The project team either has missed significant risks and/or opportunities or understated their impact on total project cost—or both.

This ironic type of decision error is an example of iatrogenic risk, a term to describe the case where the use of faulty risk management information in decision-making is a risk in itself! (The word "*iatrogenic*" is borrowed from the field of medicine where it means "*physician caused*" injury or disease. In business risk management, it means an analyst caused error in decision-making.)

A second measure generated in the uncertainty benchmark is captured in a bar chart (see Figure 3) that compares the minimum amount of cost uncertainty expected versus the amount uncovered by the project team. This information is critical as it alerts the project team and decision-makers to the potential error embedded in the risk management results.

Here, the minimum amount of cost uncertainty (i.e., potential variation in total cost) expected for project B is $13.8 million. However, the identification and analysis results identified only $11.5 million in potential cost variation. Therefore, there is a minimum of $2.3 million that has not been identified and analyzed.

This information provides an early warning to decision-makers that the analysis is likely understating cost uncertainty by at least $2.3 million. This missing uncertainty could be in the cost overrun side, the cost underrun side, or a mixture of both.

At this point, the project team must re-evaluate the information elicited in the session in order to uncover the missing uncertainty or provide specific information as to why the project is more certain than were other similar projects.

In most such cases, the project team uncovers errors in its cost impact calculations and/or it surfaces additional critical items that escaped earlier detection.

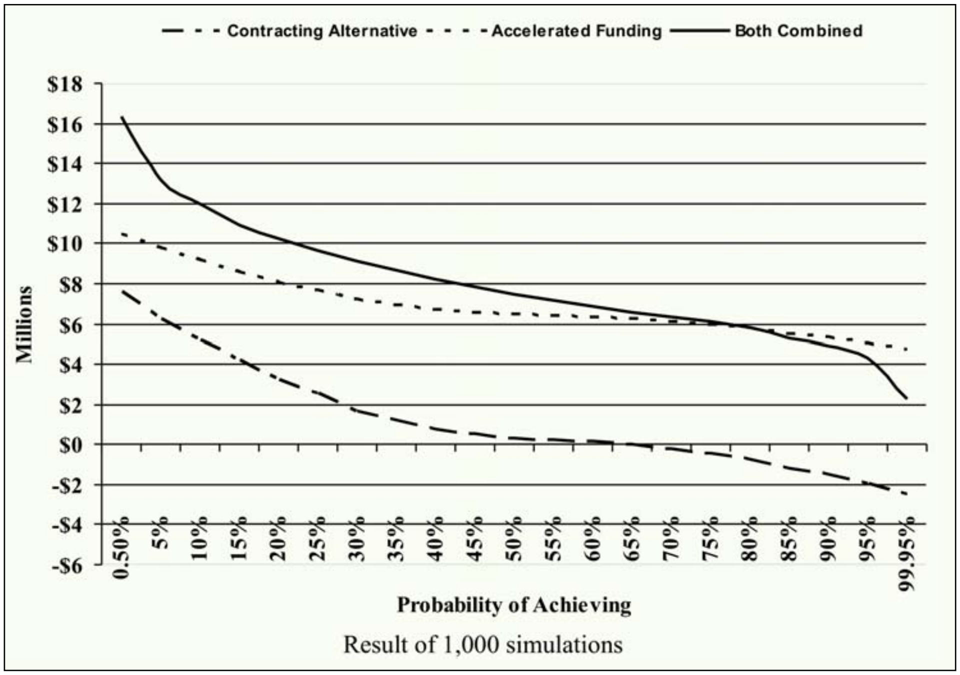

Figure 4— Mitigation Savings Profiles

Challenge Three—Optimize the Mitigation Phase

VBRM helps project teams formulate mitigation actions regarding project risks and opportunities and probabilistically analyzes their impacts.

During the one-to-two day VBRM data gathering session, quantitative information is gathered concerning mitigation. These data are subsequently analyzed to provide a detailed, probabilistic mitigation analysis. Such analyses often identify mitigations that actually introduce more, rather than less, risk or demonstrate that the potential action is not likely to have a favorable cost/benefit ratio. Since mitigation data are gathered during the VBRM session, the demand on personnel and other resources is minimal.

There are two common errors in mitigation: taking credit for mitigating actions before they are realized, and not analyzing them probabilistically.

The first of these flaws is often seen in analyses that fail the uncertainty benchmark. In these cases, the project team takes credit for mitigating actions during the analysis phase. The outcome is predictable: the analysis understates the true amount of cost variability.

The second flaw is much more common—the analysis phase is completed, the project team assumes that the identified mitigating actions will perform to the extent assumed, and no further action is taken.

VBRM incorporates mitigation during the identification and analysis phases while protecting against the two errors mentioned in the previous paragraph. During identification and analysis, VBRM tends to surface potential mitigations (e.g., alternatives in design, labor, materials, and equipment) which are then adjudged probabilistically. Figure 4 portrays the results of such a study derived from the VBRM session.

Note that the mitigation labeled "*Contracting Alternative*" can produce either positive or negative savings—in other words, it can add to the overall risk burden. There is roughly a 65 percent chance that the contracting alternative will reduce cost risk by as much as nearly $8 million, but there is a 35 percent chance that it will increase it, possibly by as much as $2.5 million. Obviously, decision-makers must carefully evaluate this mitigation to be sure it is worth the potential growth in risk.

The mitigation labeled "*Accelerate Funding*" (e.g., front-load capital infusion to purchase highly discounted equipment) appears to save at least $4.5 million with the potential to save as much as $10.5 million.

Finally, the "*Both Combined*" curve depicts the savings if both of these mitigations are implemented. That curve crosses the accelerated funding curve because, in some of those 1,000 simulations, the contracting alternative produced cost overruns and thus reduced savings.

Letter grade	Numerical Grade	Interpretation
A	90 – 100%	SUPERIOR – Even hidden, uncontrollable , and global issues do not escape the team's scrutiny. Team has good grasp of probabilities of achieving forecasts in key variables.
B	80 - 89%	ABOVE AVERAGE – Team possesses ability to correctly assess uncertainty when facilitated. Assessment of probabilities of achieving forecasts is above average.
C	70 - 79%	AVERAGE – Team has some difficulty identifying and quantifying the most extreme risks and opportunities. Team has some difficulty identifying the true probability of achieving forecasts.
D	60 - 69%	BELOW AVERAGE – Team has difficulty identifying and/or considering issues not fully under its control. Over-optimism and/or over-pessimism frequently come into play.
F	0 – 59%	POOR – Team has difficulty imagining that actuals can vary from forecasts by other than minor degrees and/or the team has difficulty understanding the uncertain universe in which it operates.

Figure 5— Uncertainty Grading, © by Decision Sciences Corporation

The probability of a cost overrun in the contracting alternative is different than the point where "*Both Combined*" drops below "*Accelerated Funding*" because of the intrinsic mathematics of combining two independent probability curves. Delving into probability theory here would be unnecessarily tedious. However, the following analogy may prove helpful.

Imagine that mitigation "A" is represented by a six-sided die, each side representing a possible savings in cost. The probability that "1" will be rolled is one chance in six or 1/6 (about 17 percent).

Imagine also that mitigation "B" is represented by a separate six-sided die, each side also representing a possible savings in cost. The probability that "1" will be rolled is also about 17 percent. However, since the roll of the first die is independent of the roll of the second, the probability of rolling "1" on both dice is 1/36 (1/6 x 1/6, about three percent). Essentially the same principle applies to the summation of mitigation (and other independent probabilistic) curves.

The author has encountered several cases where ad hoc risk analysts (and some decision-makers) have simply eyeballed two curves, adding a point on one to a point on the other, claiming that the sum was the probability of occurrence of both combined. Some have even attempted to add entire curves! Such efforts are fatally flawed and are alarming examples of iatrogenic risk.

Challenge Four—Improve Risk Management Skills

Adoption of VBRM reduces the time devoted to the identification and analysis phases, primarily by improving the project team's risk management skills. The most visible vehicle for accomplishing this is VBRM's grading system—a mechanism that provides periodic and timely feedback to the project team as the project moves through its life cycle.

Grading, as its name implies, compares the team's current analysis of the project to one or more analyses conducted in the past on the same project. In other words, the current risk management snapshot is compared to one or more of the project's previous snapshots.

Using various VBRM algorithms, the project team's risk/opportunity identification and analysis performance is reported in familiar terms—the five letter grades (A, B, C, D, F) and their numerical counterparts (e.g., 90-100 percent for "A").

Not only is a grade established for the team's assessment of the project's bottom line uncertainty, each element of input data having an uncertainty assessment is given a grade as well.

Grading provides a lessons learned feedback to the project team, while the project is still in progress. Such feedback and reinforcement hones the collective skills of the team, and thus continues to provide benefit throughout the project's march to completion. Interpretation of the five uncertainty grading scores is given in Figure 5.

Obviously, grading cannot be delayed until completion of the project. Valuable team improvement opportunities would be lost by that time. In addition, the simple comparison of early predictions with actual results will not suffice.

VBRM's grading process provides feedback to project teams any time the project is re-analyzed. (Re-analysis of project risks and opportunities should occur on a regular basis in order to best control risks and capitalize on opportunities).

Most organizations fail to re-analyze projects on a frequent basis—often because of resource constraints. By minimizing the impact on high value people in the identification and analysis phases, VBRM makes it possible to deploy them later, so that highly important and frequent snapshots can be made of the project throughout its life cycle.

Although highly important, the grading process does not simply determine how well, or how poorly, the team assessed total project uncertainty. If the project's scope does not change significantly (or if scope changes can be separated from the estimate as originally analyzed), the grading can likewise be applied to specific types of uncertainty such as: site preparation, electrical work, piping, etc.

In one case, for example, an organization was consistently pessimistic concerning equipment risks. This pessimism generated additional, unneeded contingency for appropriation. Applying VBRM grading to several other of the organization's projects uncovered this flaw and its impact on the bottom line. Once the firm's project teams understood this undue degree of pessimism, they applied that knowledge in subsequent projects with the result that the firm was able to reduce overall capital commitment without jeopardizing the budgets of subsequent projects.

Challenge Five—Perform Frequent and Regular Analyses (Snapshots)

Skilled decision-makers know how to manage quantities, expenditures, and time in their projects. Their approach can be summarized in three words: measure, monitor, manage. (Imagine how difficult it would be to manage a project's quantities, expenditures, and time without first measuring the values of those variables and then monitoring their performance!) When it comes to risks and opportunities, the same approach applies: measure, monitor, manage!

Decisions are made, actual costs materialize, and new information is gained throughout the project's life cycle. Uncertainty profiles are directly affected by these events and decision-makers need to know what lies ahead.

VBRM, by reducing identification and analysis time, ensuring the reliability of analysis results, and analyzing mitigating actions, enables decision-makers to regularly re-assess project uncertainty. This ensures that risks and opportunities will be effectively addressed by giving decision-makers the most up to date information available—with a minimal expenditure of resources. In addition, VBRM provides for easy assessment of various mitigations and design/execution alternatives throughout the project's life cycle.

The Value of VBRM in Value Engineering

A major goal in value engineering (VE) is to identify and implement new ways to reduce cost and improve (i.e., add value to) the project. VBRM can, and is, playing a key role in accomplishing this goal. By virtue of its ability to reduce resource requirements, identify and rank key uncertainties, and profile alternatives (previously referred to as mitigations), VBRM focuses attention on areas most in need of VE consideration.

In one example, a structure requiring a vertical build was a key circle in the management action chart. VE was applied to address issues related to this part of the project.

The VE solution was a sectionalized build-and-lift approach which had never before been performed for that type of structure. After some relatively minor engineering changes, the VE solution was implemented resulting in a significant savings in both construction cost and time.

In another case, VBRM surfaced the fact that major uncertainty surrounded installation of a piece of manufacturing equipment in an existing plant. The uncertainty was related to the potential exposure to environmental problems once some existing slabs were removed in order to place the new equipment.

No one knew what might be below grade in the decades-old facility. Using the VBRM information as a guide, the project team developed a VE solution using different (though slightly more expensive) equipment. The alternative equipment had a different post installation profile, one that would not require slab removal.

The combined work of VBRM and VE resulted in a slightly higher total project cost (because of the higher price of the alternative equipment) but, as was discovered in a subsequent project, avoided several hundred thousand US dollars of environmental remediation costs.

The primary goal of combining VBRM and VE is not to reduce the cost estimate. Their combined power resides in the ability to help keep costs lower than they would have been, had the two techniques not been applied synergistically.

The purpose of risk management is not to identify, analyze, mitigate, and control every iota of uncertainty. Senior managers know and appreciate the fact that a sensible balance must be met—a balance between the amount of effort applied and the amount of benefit derived.

Traditional risk management tends to pump greater amounts of resources into the early phases (identification and analysis) compared to the equally important late phases (mitigation and control).

Value-Based Risk Management significantly reduces the amount of resources applied to the early phases, and with a significant part of that savings, bolsters the late phases—while simultaneously improving the quality and reliability of the early phases.

In so doing, Value-Based Risk Management significantly enhances the organization's ability to truly manage uncertainty so critical risks and opportunities are detected long before they come over the hill. That's how risk management is supposed to work! ◆

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