Text accompanying slides in the PowerPoint presentation:

Estimating Project Value: The Expected Value of Success (EVS) and the Expected Value for the Portfolio (EVP)

by Glenn R. Koller

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Slide 2

Too many authors who write about risk focus on the mathematical aspects of the arts of risk assessment and risk management. It is undeniably true that good risk analysis is predicated on dependable and technically sound mathematical deterministic and stochastic algorithms. However, the real challenge in the risk game is to get people to honestly and earnestly implement such arithmetic techniques. To accomplish this, individuals need to <u>want</u> to apply risk-based processes to their projects. Often, as delineated in detail in my latest book: *Modern Corporate Risk Management: A Blueprint for Positive Change and Effectiveness*, implementing risk-identification and quantification techniques early in a project can bring to light shortcomings that might be deemed “better left alone” by the project team.

To have a project team view the early identification of project risks as a boon, appropriate behavior on the part of project team members must be encouraged. Such favorable behavior typically is achieved as a response to a reward system that encourages early identification of threats and opportunities. Such a reward structure encourages project team members to consider mitigation actions that will cause identified threats, for example, never to materialize. This is in stark contrast to the typical reward system that would reward a team for allowing the threat to materialize at some future time and for taking steps to “fix” the problem after it had occurred. Changing behaviors – not inventing new arithmetic – is the real challenge.

Slide 3

Bad behavior is not limited to individuals – corporations too exhibit behavioral traits that can certainly be improved upon. For example, some corporations, when considering the value of a portfolio of projects, consider that each project in the portfolio will be successful. Corporate executives know, however, that reality does not match the expectations generated by a fully-successful portfolio of projects, so after “summing up” the total value (however measured) of the portfolio, a “fudge factor” is applied to account for the fact that reality and the “sum” of all-successful projects do not jibe. This practice might cause real outcomes to come close to estimated (fudged) projections, but it does not allow the company to learn nor does it facilitate the spending of money on successful projects and culling of less-successful elements of the portfolio.

Slide 4

One way to eliminate the propensity for use of "fudge factors" is to introduce the concepts of the "Expected Value of Success" (EVS) and the "Expected Value for the Portfolio" (EVP). In this slide, consider that each dime represents a project and that our portfolio is composed of 10 identical projects. Executing any project – in this rather unrealistic yet illustrative example – consists of the flipping of the dime. If the dime comes up "heads," then we consider the project a success and we "win" 10 pennies. Conversely, if the dime comes up "tails," we consider the project to have failed and we receive nothing.

Now, suppose you are the project engineer on one of those projects and you are responsible for building the vessel that will hold the pennies if you should win (a "heads" is realized). How big do you build the vessel? Certainly, you don't count on losing, so you don't forego building any vessel. Also, you would not build a vessel that would hold, say, 5 pennies, because you know that if you win, you will have 10 pennies to deal with. Building for 5 pennies – if those pennies are the benefits from the project – will ruin the economics of the project because you will only be able to realize half the benefit (only be able to transport half the winnings to market in your 5-penny-big vessel) if you win. The project team has to build for success. So, you build a vessel that will hold 10 pennies – 10 being the Expected Value of Success or EVS.

Now, the corporate bean counters show up and ask you just how much they should "add" to the corporate projections for the portfolio of projects for your project. If each project leader (for each of the 10 dime-flip projects) related to the bean counter that he should count on 10 pennies for their individual project, then the bean counter would add-up ten 10s and proclaim to "the Street" that the portfolio will yield 100 pennies. Well, you know and I know that each project has a 50% chance of coming up "tails" and yielding nothing. So, if we use our 50% (0.5) chance of failure as a multiplier for each potential project yield, our individual-project risk-weighted value is 5 pennies. This is our Expected Value for the Portfolio or EVP. So, the bean counter adds up ten 5s and, in the end, should have (on the average, of course) a projected portfolio yield that is more in line with reality.

So, the project team builds and works around the EVS. The project reports to the corporation, however, the EVP. This is as it should be.

Slide 5

We can see from the previous slide that the difference between the EVS and the EVP is the application of the chance of failure (COF). In the previous dime-flip example, estimation of the COF is simple – it is the chance that we will get a "heads" or "tails" – it is 50%. However, in reality projects can fail for a host of reasons. In this slide, we make example of an energy company project. Such a project is composed of myriad disciplines each of which has its own method of evaluating the COF associated with that discipline. For example, the finance department might estimate that based on exchange rates and expected interest trends, there exists a 10% chance that financial factors alone might cause the project to fail. The people in the Commercial department estimate that prices for the commodity might collapse sometime in the 5-year critical window for the project and, therefore, estimate that there is a 5% chance that the project might experience commercial failure. Likewise, the Security personnel estimate that the probability of a civil war in the host country is at least 20% in the 5-year window. And so it goes with each discipline listed on the slide.

The Chance of Success (COS) for the project is the multiplication of each of the individual COFs subtracted from 1. The EVP is calculated from the combined COFs as will be demonstrated in the examples to follow.

Slide 6

In this slide, we link the initial discussion of behavior change with the concepts of EVS and EVP. On the left side, we see where most corporations are today. Boxes in the right column illustrate the aspirational state. First, most corporations and project teams have inconsistent methods for reviewing and dealing with risk and uncertainty. Such entities should strive for consistent and practical methods for recognizing, capturing, and quantifying risk and uncertainty. When such techniques are developed, they need to be practically and consistently applied to impacting project value.

Even if practicality and consistency in risk-practice is achieved, that practice typically is deterministic in nature – that is, it is a process that generates a single-valued outcome. In order to take advantage of estimations of uncertainty, stochastic and probabilistic methods need to be developed and employed. In addition, estimates of individual-parameter COFs need to be combined so that EVS and EVP values can be generated and appropriately employed. Recognition and exposure of the COFs typically requires encouragement of new behaviors on both the part of the project team and their management. Incentive for such better behavior is the result of revamping the reward system.

Slide 7

Boxes along the top row of this slide demonstrate the risk-related steps (if they have a risk process at all) typical of a corporation. Boxes along the bottom of the slide illustrate that the typical corporate process should be modified such that multiple estimates of project value (EVS and EVP) are considered, that perceived project value should be impacted by uncertainty and estimates of failure, and that mitigation steps (aimed at preventing, for example, threats from ever materializing) need to be undertaken so that EVS and EVP values start to converge. In addition, risk tracking and risk management processes should be incorporated in the project's and corporation's overall risk-related plan.

Slide 8

To clearly illustrate the behavioral aspects and EVS/EVP concepts laid out in the previous slides, two project-based examples will be used. A first example focuses on the decision regarding whether or not to construct a chemical plant. The decision hinges on the estimated Net Present Value of the project. A second example illustrates how uncertainty and chances of failure impact production estimates from a chemical plant.

Slide 9

To illustrate the risk connection to value and to decision making, the first example focuses on a decision to build – or not – a chemical plant. An initial step in the decision-making process is to establish the decision criteria. That is, upon what metrics or measures will we base our decision. In this case, mainly to keep the scenario simple for this example, the green light for building the plant will be a positive NPV (Net Present Value). So, if after considering impacts from all sources of risk and uncertainty our risk/uncertainty-impacted economic model yields an NPV value greater than zero, then the decision to build the plant will be taken. Of course, in real life, such decisions are rarely based on just a single metric (like NPV), but for this simple example, such a basic and solitary metric will suffice.

Project parameters about which the team is uncertain must be identified and the appropriate metric range established. For example, the project team knows that the plant's first-year capacity might be less than expected but could also exceed expectations. Therefore, a plant-capacity range (uncertainty) will be established for this parameter and for all other parameters about which the team is uncertain. Using a Monte Carlo process, the ranges for each uncertain parameter will be applied to the deterministic (usually, spreadsheet-based) economic model to establish an NPV range, the mean of which is our Expected Value of Success (EVS) in that it has not yet been impacted by chances of abject failure.

Next, the project team needs to identify parameters that could cause the project to fail outright. That is, team personnel must list the events and attending probabilities that constitute chances of abject failure for the project. For example, as will be illustrated later, if the host-government-permit-granting process drags on for more than 1 year, then accumulated costs and violation of 3rd-party contracts will cause the project to no longer be tenable. Likewise, the project will fail outright if civil war breaks out in the host country during the construction phase of the project. The mean of the resulting chance-of-failure-impacted NPV range is the Expected Value for the Portfolio (EVP).

Slide 10

The project team determines that the parameters about which they are uncertain are First-Year Plant Capacity, First- and Second-Year CAPEX, and Fixed Costs. Through facilitated conversations, the range – minimum, most likely, and maximum values – of each of these parameters is established. When considering costs, it is always more efficient to initially focus the conversation on the minimum value. People love to tell you how cheap it could be and why. A skilled facilitator will keep a list of reasons given as to why the cost could be minimal. Then, the facilitator will explore the maximum end of the cost curve, using the antithesis of the reasons-it-could-be-cheap as the focus of the conversation.

For example, if an interviewee had indicated that a cost could be minimal because they were likely to utilize non-union labor and because the weather was likely to be favorable, the facilitator would explore the maximum-cost end or the curve by suggesting that they consider the situation in which union labor was used and in which the weather was worse than expected. Only after the minimum and maximum values have been established does a savvy facilitator consider exploration of the most likely value. If the most likely value is first established, then mental "anchoring" can occur and it can be difficult glean from the interviewee minimum and maximum values that represent realistic projections.

For each uncertain parameter, a distribution is created from the minimum, most likely, and maximum values. This is always an asymptotically-tailed distribution (NOT a triangular distribution) for use in the Monte Carlo process. For this example, only the distribution established for the Fixed Cost parameter is shown.

Slide 11

To facilitate impacting the economic forecast with uncertainties, a probabilistic model is constructed using a software package separate from the spreadsheet-based project economic model. The Monte Carlo-based probabilistic model is not just a spreadsheet add-on – computer code and logic can be written in the Monte Carlo-based software package so that data can be manipulated in the probabilistic model independent of the spreadsheet. The probabilistic model can be used as a stand-alone software package with no connection to a spreadsheet.

Distributions are constructed for each uncertain parameter (see previous slide on which a Fixed Cost distribution is shown as an example). On each of, say, 1000 Monte Carlo iterations, a value is drawn from each distribution and the randomly-selected value from each distribution is "pasted" into the appropriate cell (or series of cells in the case – not shown here – in which we are dealing with a time-series of values) in the spreadsheet. In special cases, the probabilistic software package can, within a single iteration, be instructed to re-sample a single distribution once for each cell in a time-series of cells.

Two plots are shown in this slide. The first is a depiction of the yearly cash-flow values resulting from the Monte Carlo (stochastic) process. Vertical bars are representations of distributions. The bottom, "middle," and top horizontal bars on the vertical bars represent the minimum, mean, and maximum values for the distribution. On each Monte Carlo iteration, cash flow values are combined in the usual way in the economic model to produce an NPV value. The NPV plot shown is the result of the generation of 1000 NPV values – one from each of 1000 Monte Carlo iterations.

It can be seen from the NPV plot that there exists about a 10% chance that the project could generate a negative (less than 0) NPV. Therefore, there is, considering uncertainties only, a 10% chance that the project will be a failure, according to our definition of a failed project (a negative NPV). The mean NPV is about +$12.8 million – a “go” case. If this were all there was to it, this project might be a pretty good bet – a 90% chance of success. However, we have yet to integrate into the analysis the chances of abject failure.

Slide 12

Project team members had previously determined that there were, for this particular project, two chances of abject failure. That is, there were two events that, if they happened, would spell disaster for the project. One event was a prolonged host-government permit-granting process. If the host government “drags its feet” longer than one year regarding the critical-permit granting process, the project will be in an unrecoverable position with respect to 3rd-party contracts and will have spent more capital during the waiting period than can be recovered by a successful project. So, if the permit-granting process takes more than one year, the project will fail.

In this slide is depicted the range of “wait time” for permits that the project team deems possible. The minimum time to wait for permits is 1 month. The maximum time is 24 months. According to the plot, the probability that wait time will exceed 12 months is about 12%.

Civil war in the host country is the second chance of abject failure identified by the project team. Because major elements of the chemical-production process will be offshore and because corporate security experts believe that they can adequately defend a completed plant against the types of attacks to be expected from the poorly-armed and disorganized combatants, they believe that if the plant is complete in its construction, the probability of the plant to continue to operate during a civil war is very good. However, if the civil war breaks out during the construction phase during which critical materials-supply lifelines would be severed, the project would certainly fail. Team members have determined that the probability of a civil war breaking out during the critical construction phase is 20%.

Slide 13

In this slide, the impact of only the permit delay is shown in the first plot and the combined impact of the permit delay and civil war is depicted in the second plot. Note that in the first plot, the cumulative frequency curve reaches only to 88%. This reflects the 12% chance of abject failure (100 – 12 = 88) due to the failure of the permit process. The mean NPV resulting from the impact of uncertainties and the permit-related chance of abject failure is about +$11.3 million – still a “go” case.

To reflect both chances of abject failure (permits and civil war) in the second plot, the probabilities had to be combined thus:

Chance of Success (COS) = (1 – 0.12) * (1 – 0.2) =

$0.88 * 0.8 = 0.704 * 100 = 70.4\%$ COS

Note that in the second plot, the cumulative frequency plot intercepts the Y axis at 70.4%. Note also that the combined chances of abject failure and the uncertainties result in a mean NPV value of about +$8.7 million. If all chances of abject failure have been accounted for, then this value (+$8.7) represents the EVP – that is, the number that should contribute to any corporate comparison of project values. This represents the fully risk-weighted estimate of value for this project to be used in any portfolio process. Note also that the plot shows that there is about a 35% chance that the NPV from the project, after accounting for all uncertainties and chances of abject failure, will be negative. This represents, of course, a 35% chance of project failure. The EVS value of +$12.8 million is, to the project team or to the corporation, not a very useful value even though it reflects the projected value of the project if it does not experience any failures. So, when would the EVS and EVP both be of use? We will see an example of this in our 2nd project example. But first, some closing remarks concerning the first project.

Slide 14

So, how does all of this help us? First, having identified our uncertainties and chances of abject failure, we now have a better grip on just what the critical uncertainties and problems are, and, on our chance of success. Second, a real sense of urgency and a focus on identifying and capturing opportunities can be engendered in the project team because this type of analysis demonstrates clearly the probability of falling short of the mark. Third, because the project team now recognizes and understands the potential pitfalls, mitigation actions can be defined that will lessen the probability or impact (or both) associated with any given problem. Mitigation actions are no longer seen as “What do I do to fix it after it happens?” but rather are defined as “What can I do proactively to prevent this problem from ever materializing or to reduce its impact if it does happen?” This is a VERY different mindset.

Slide 15

The second example focuses on the promise made by a Business Unit Leader (BUL) regarding production from the new chemical plant described in the previous example. After taking account of all uncertainties (not listed here) related directly to the first-year production, the projected mean for first year production is about 135,000 tons (tones). In this first slide, two plots are shown. The first plot shows a time series of production ranges. Each vertical bar on the first plot is the representation of a distribution. The second plot on this slide is the cumulative frequency plot that represents year 2003 production.

So, we know that when the people responsible for logistics, for example, walk into the BUL’s office and ask: “Around what production value do we base our first-year logistics contracts?” the answer has to be something like the 135,000-ton value – the EVS. You have to plan for success. If, for example, the logistics people were to sign contracts for the transport of a fraction of the 135,000-ton success value, then profits are diminished because profit-making product could not get to market and would have to be stored on site. However, when the corporate planners come to visit and ask how much the project would contribute to a corporate roll-up of production for a given year, does the BUL respond with the 135,000 value? Not likely. Here's why.

Slide 16

In addition to the two already-identified overall-project chances of abject failure (permit delay and civil war), the project team has identified another chance of abject failure that relates only to the first year production. That is, this failure parameter will not cause the entire project to fail, but could cause the BUL to fail in meeting his first-year promise regarding production. The new chance of abject failure related only to fist-year production is the chance that the time it will take to get the bugs out of new technology will prevent the plant from meeting its first-year production expectation. The project team estimates that the minimum time that debugging will take is a few weeks, the most likely time is 6 months, but it could take as long as the full year. They believe that if the debug-time is greater than 6 months, the BUL will not be able to deliver on his first-year production promise. They estimate that there is a 10% chance of the debugging process taking 6 months or more.

The EVS production value – accounting for all uncertainties – is 135,000 tons. Impacting this success estimate with the new debugging-of-new-technology abject failure reduces the production value to about 120,000 tons. See the fist plot in **Slide 17** to see the cumulative frequency plot from which the 120,000 ton value was derived. Introducing the two original chances of abject failure (permit delays and civil war) further reduces the projected first-year production value to 86,300 tons. This is the EVP – the value that the BUL would offer to the corporate roll-up of portfolio production. So, the project team signs contracts and "builds" around the EVS value of 135,000 tons. However, the amount to be incorporated in any roll-up of corporate production is the EVP (86,300 tons).

Slide 17

Cumulative frequency plots discussed in the previous section.

Slide 18

Like the first example, how does any of this help the project team? First, now that we recognize the potential problem with the permitting process, we can begin to take political and other steps to ensure that the permit-granting process goes as smoothly as it can. Again, the mitigation actions defined are NOT about what the team should do when the permit process is deemed to be taking too long. Rather, the mitigation actions are proactive and are aimed at preventing an extended permit-granting process in the first place.

Also, we can begin to take steps to lessen the impact of war on our facilities. These steps might include offering construction jobs to local factions which might lessen the probability that the plant would be attacked in the event of a civil war. Options for alternate supply routes can be investigated as well as speeding up the schedule for offshore construction.

To help offset the impact of technical delays, the team might encourage colleagues at existing chemical facilities to build a small new-technology demo plant so that bugs will be identified and dealt with prior to implementation in the new plant.

Slide 19

There are some significant challenges in implementing a risk-based plan as described above. First, given the reward system in place in most modern corporations, it can be difficult to encourage project team members to identify uncertainties and chances of abject failure and to quantify their probabilities and impacts. If the team is being rewarded for speed and cost savings, then such risk-identification practices can be viewed as detrimental to the perception of the project.

A second challenge is to get the required training and tools to the project teams so that the corporation can expect consistent evaluations of projects. In addition, it can be a real challenge to encourage project teams to take a holistic view of the attendant risks – that is, to consider cultural, organizational, logistical, financial, commercial, political, technical, etc. aspects of a project. Even if these first two challenges are met, the real hurdle can be getting decision makers to request and to correctly utilize fully risk-weighted values such as the EVS and EVP.

Slide 20

Do you have similar challenges in your business? Can you think of uncertainties and chances of abject failure that relate to what you do?